University of Minnesota

A magazine for alumni of the College of Science and Engineering | Fall 2010

INVENTING TOMORROW

BRAINSTORMING FELLOWS

Mid-career professionals spend a year innovating medical device solutions

ALSO INSIDE:

Stimulus funds support faculty research >>

International alumni are leaders in their fields >>

WE'RE NOW THE **College of Science and Engineering**

see the dean's message inside

INVENTING TOMORROW

Fall 2010
Vol. 35, No. 1

Inventing Tomorrow is published by the College of Science and Engineering communications team twice a year for alumni and friends of the college. This publication is available in alternate formats for those with visual impairments by calling 612-626-7959.

TELL US WHAT YOU THINK

Inventing Tomorrow welcomes readers' comments and story ideas for future issues.

E-mail
csemagazine@umn.edu

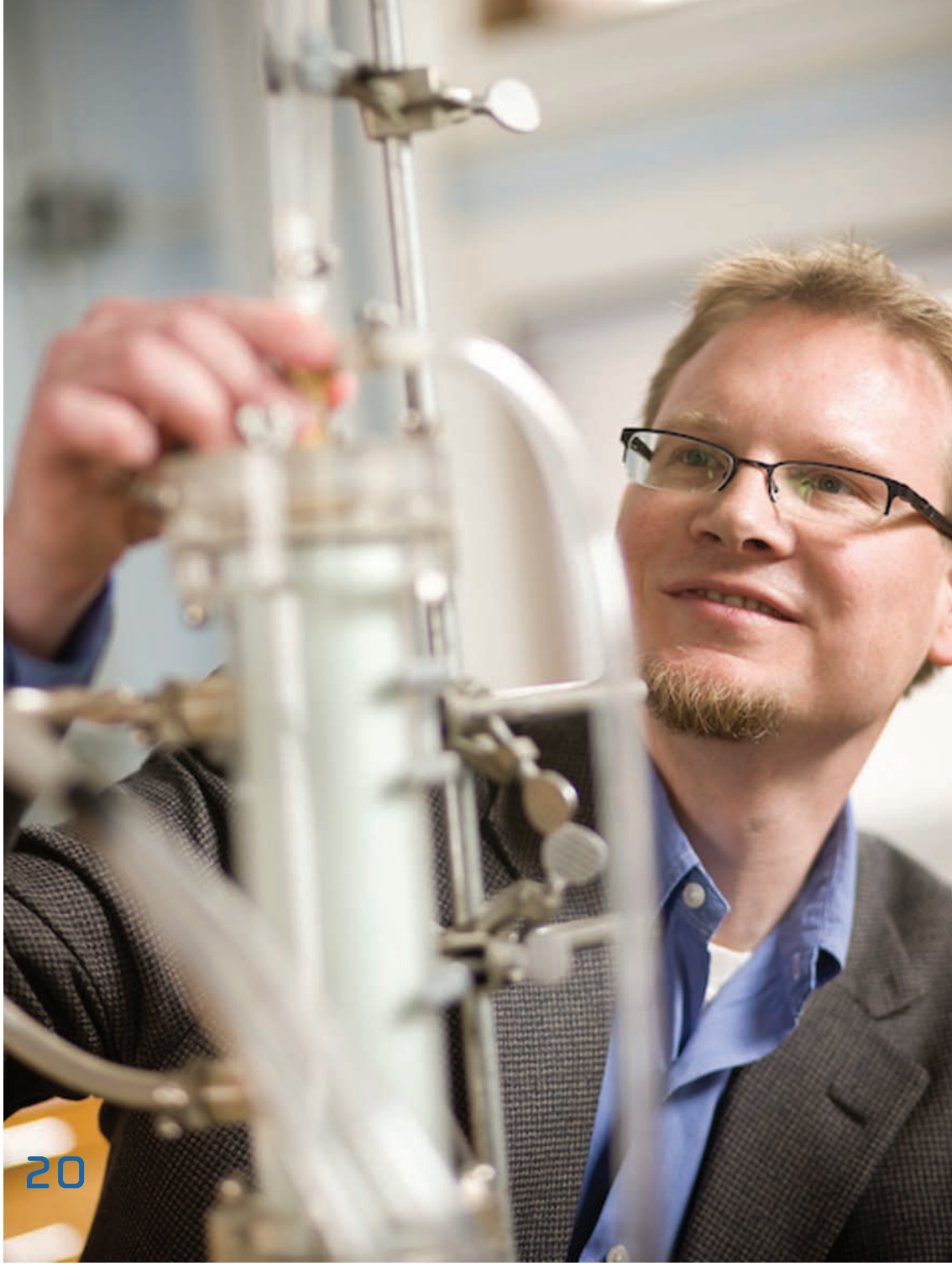
U.S. Mail
Inventing Tomorrow
College of Science and Engineering
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

Phone: 612-626-7959
Fax: 612-624-2841
Web: cse.umn.edu

MOVING?

Send us your new address to keep receiving *Inventing Tomorrow*.

Printed on recycled paper



fall **2010**

INVENTING TOMORROW

Designing Fellows • 8

Four mid-career professionals in the Medical Devices Fellows Program are designing products to improve health care

BY KERMIT PATTISON

Coming to America • 14

College of Science and Engineering alumni who left their native countries to study in the U.S. are leaders in their fields

BY KERMIT PATTISON

Stimulating Research • 20

Research funding for College of Science and Engineering faculty is helping to stimulate economic recovery

BY JUDY WOODWARD

Fluid Dynamics Research Helps World • 28

St. Anthony Falls Laboratory's rich legacy inspires solutions to world's greatest challenges

BY MAIA HOMSTAD

DEPARTMENTS

From the Dean

New college name, same strong college • 2

Web Extras

College of Science and Engineering faculty and students are featured in several Web videos; join us on Facebook and Twitter • 3

TechDigest

U of M team places second in American Solar Challenge, U of M offers new master's program with Peace Corps, EE/CSci building renamed, and more • 4

Alumni Report

Mission—Create an engaged community, Pichler receives alumni award, volunteer for CSE mentor program, and more • 24

Investing in Tomorrow

Support students for careers of tomorrow, celebrate 75 years with us, student thankful for scholarship, and more • 26

ON THE COVER

Marie Johnson, director of the Medical Devices Fellows Program meets with fellows Karl Vollmers and Christopher Scorzelli. They are part of a cross-functional team that works to develop and test new medical devices. • 8

PHOTO BY JOSH KOHANEK

New college name, same strong college

Today, our college's spirit of innovation and entrepreneurship is as strong as ever.

AFTER A QUICK GLANCE AT THE COVER of this issue of *Inventing Tomorrow*, it's easy to see that something is different about our college. On July 1, 2010, the Institute of Technology changed its name to the College of Science and Engineering. We are confident that the new college name will better position us for the future when recruiting new students, competing for grants, and securing private support.

Our new name showcases our unique combination of science and engineering within one college. In fact, we are the only major research university in the country that combines the physical sciences, engineering, mathematics, and computer science within one college. The name change was recommended by the Dean's Advisory Board and they donated private funds to cover many of the costs of the change.

This academic year, we embark on the 75th Anniversary of our college. It is clear that our new name doesn't change our long, proud history of innovation and success. We continue to celebrate the faculty and alumni who have made an impact on our daily lives with their inventions including synthetic rubber, the first wearable pacemaker, the retractable seatbelt, the Post-it®note, GORE-TEX®, Roundup® herbicide, and much more. Our alumni have also founded more than 4,000 companies worldwide that employ more than 500,000 people and generate more than $90 billion in annual revenue.

Today, our college's spirit of innovation and entrepreneurship is as strong as ever. The story in this magazine entitled "Designing Fellows" highlights four mid-career professionals who spent last year in our intensive Medical Devices Fellows Program developing new inventions to improve health care. The focus is on creating marketable products that meet consumer and industry needs. In only its second year, the program has already produced 15 provisional patents, one start-up company, one product license, and three ideas being considered for licensing by major companies.

Equally important, the program is creating innovative leaders who can explore solutions to complex problems by looking across disciplines to think in new ways. The fellows take hundreds of ideas and winnow them down to a list of about 20 that are feasible.

The fellows also drive home another important lesson: innovation is 99 percent perspiration. In the course of a year, each fellow will likely read more than 100 papers, talk to dozens of clinicians, visit medical device companies, and immerse themselves in the clinical atmosphere observing surgeries and accompanying doctors on rotation. This commitment is the basis of success now and into the future.

In another story entitled "Coming to America," we learn about three College of Science and Engineering international alumni who came to the University of Minnesota and are now leaders in their fields. The education they received at the University helped these alumni create successful ventures that have impacted the world.

Our faculty are also creating a better future through their research. The story "Stimulating Research" highlights research funded by the American Recovery and Reinvestment Act of 2009. One faculty member is researching geothermal energy and has devised an ingenious "two-for-one" strategy to simultaneously produce renewable energy and reduce the presence of harmful carbon dioxide. Another professor is using stimulus dollars to better understand an aggressive type of brain cancer. And a project in northern Minnesota building a high-tech neutrino detector is generating dozens of jobs.

"Jobs" and "innovation" are more than buzzwords for us in the University of Minnesota's College of Science and Engineering. It is our promise to prepare the next generation of scientists and engineers to improve our communities—far beyond the next 75 years. ■

New 75th anniversary book chronicles college's history

For 75 years the College of Science and Engineering (formerly the Institute of Technology) has been at the center of a remarkable story. A new book entitled "IT: 75—The College of Science and Engineering: The Institute of Technology Years (1935-2010)" chronicles the origin, development, and contributions of the college to the University of Minnesota, the State of Minnesota, and worldwide. The 170-page book includes the history of the college dating back to the early years of the University and includes more than 100 images. Books will be for sale online this fall. Visit our web site at cse.umn.edu in October for more information on how to order your copy of the book.

RECOMMENDED Extras | *on the Web*

To see these videos and more featuring College of Science and Engineering faculty, students, and alumni, just visit our page on You Tube at **www.youtube.com/umncse**.

Through the gold ring

Bin He, a University professor of biomedical engineering, has moved the technology of "mind control" into the realm of 3-D, which he hopes will help people who have only their minds with which to communicate.

2010 solar car unveiled

University of Minnesota students unveiled their new Solar vehicle, "Centaurus II." The light vehicle helped them take second place honors in the 2010 American Solar Challenge held in June.

Justin Revenaugh: Oil spill impact

Justin Revenaugh, a University of Minnesota professor of geology and geophysics, discusses some of the pressing issues that the United States currently faces in light of the BP oil spill.

Two recent CSE grads launch start-up

Two recent College of Science and Engineering graduates discuss NewWater, the start-up company they created that will offer a biocatalyst-based drinking water filtration technology.

Meet a U of M physics student

Benjamin Kofalt, a sophomore majoring in physics, talks about the research group that is studying neutrinos and building a 15,000-ton particle detector that is part of the federally-funded NOvA project.

NOvA project: Community voices

Residents of northern Minnesota and construction workers building the NOvA detector facility discuss the benefits the high-energy physics research project has brought their communities.

facebook twitter

JOIN US ON FACEBOOK AND FOLLOW US ON TWITTER

We have a new *Facebook* fan page for the College of Science and Engineering. More than 500 alumni and friends have already signed up. Join us today at www.facebook.com/umn.cse. Find out about the latest research and exciting events. Also follow us on *Twitter* at twitter.com/umncse for the latest news about the college. We welcome your feedback and suggestions.

TECHDIGEST>

University of Minnesota team places second in American Solar Challenge

THE UNIVERSITY OF MINNESOTA Solar Vehicle Project team finished second overall and took home two additional awards in the 2010 American Solar Challenge, held June 19-26.

The student group was among 18 teams that designed, built, and drove a solar-powered car more than 1,100 miles, from Tulsa, Okla., to Chicago, Ill.

The team took home the electrical excellence award for their car's reliable and well-designed electrical and electronic system. Additionally, the team won the sportsmanship award for the third consecutive time. They won the same award at the 2005 and 2008 solar car races.

"We are very proud of our car's custom electronics and our spirit of helping other teams throughout the race," said Alan Jacobs, a senior who is double majoring in materials science and physics. "It's amazing to us that we had such a great race since this is the first time we've raced this car. Most of the other top-finishing teams were able to work out problems with their new cars during races in 2009."

The Minnesota team prides itself on building extremely light and aerodynamic solar cars. This year's model, called Centaurus II, was the school's ninth solar car project. Weighing less than 400 pounds without a driver, it measures about 3 feet tall, 16 feet long, and 6 feet wide.

Aside from a blown tire and an overheated battery, Jacobs said the race went well.

The team very briefly took the lead during Day 5 of the race, however, ran out of juice and had to pull over to recharge while Michigan and Stanford passed them by. The Minnesota team passed Stanford the next day but were unable to catch Michigan, which held on to win first place.

The team finished with a total elapsed time of 30 hours, 26 minutes and 53 seconds. "It was a really close race," said Jacobs. "We were just trying to keep going the best we could."

During the past year, about 30 students collectively spent more than 50,000 hours planning and building the solar car. Materials for the vehicle were funded primarily through cash donations and in-kind donations of parts and materials.

MISSOURI S&T STUDENT DESIGN & EXPERIENTIAL LEARNING CENTER

University of Minnesota Solar Vehicle Project team members—comprised of about 30 College of Science and Engineering students—built Centaurus II over the past year. Finishing second overall in the 2010 American Solar Challenge race, the team received the award for electronics excellence for the car's well-designed electrical and electronic systems. They also received the sportsmanship award for the third time.

U of M offers new master's program with Peace Corps

THE UNIVERSITY OF MINNESOTA and the Peace Corps have teamed up to offer a new Master's International degree in civil engineering that combines service abroad with graduate studies.

The program, which is focused on environmental engineering and water resources engineering, will require students to spend two semesters studying at the University before spending 27 months serving abroad with the Peace Corps.

Enrollment in the new program will require a degree in math, engineering or science, but students with skills the Peace Corps will admit are tied to the specific needs of world locations where students will be dispatched. The program will begin accepting applications this fall.

"We are thrilled to offer this new program," said Julian Marshall, assistant professor in the College of Science and Engineering's Department of Civil Engineering. "More and more, students want not only to learn skills, but also to apply those skills to real-world problems."

The program is highly competitive. Gaining access is a two-fold process, said Marshall. To be considered, students first have to be accepted to the graduate program. In addition to the math, engineering, or science degree, students must have a minimum 3.0 grade point average. They must also indicate on their application that they would like to participate in the Peace Corps program.

According to a 2009 Peace Corps report, the University of Minnesota, which has traditionally had a strong partnership with the Peace Corps, has become one of the top large public universities for supplying Peace Corps volunteers, who serve in 77 countries worldwide. Altogether, 1,269 University of Minnesota alumni have served in the Peace Corps since the agency was founded in 1961 by President John F. Kennedy.

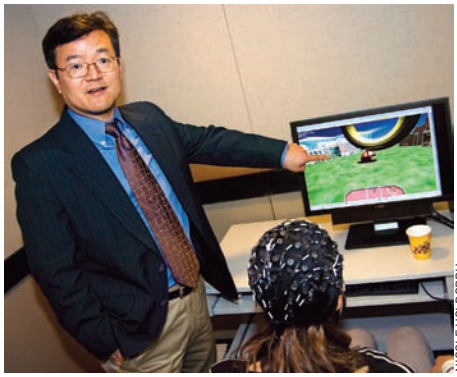
Research hopes to help those who can only communicate with mind

BIN HE, A PROFESSOR OF BIOMEDICAL ENGINEERING, is leading a team of researchers who have moved the technology of "mind control" into the realm of 3-D.

With the new technology, He hopes someday his work on brain-computer interfaces will give some control over their environment to people who have only their minds with which to communicate. Among the potential beneficiaries are stroke and paralysis survivors.

To He's knowledge, no other research group has designed a system that allows a person to move objects on a screen at will through 3-D space using this noninvasive technology. The system could have implications far beyond the hospital. It could possibly help people drive or navigate, or it may find a use in entertainment software.

The concept is simple. A cap embedded with 64 electrodes picks up EEG signals from a person's cerebral cortex. To move an object on the receiving screen, the person only needs to think about moving one side of their body. The neural activity that is generated is translated to a command that moves the object in the same direction.



NICOLE HOLDORPH

Bin He, professor of biomedical engineering, has developed technology that lets a person's thoughts steer virutal objects in 3-D.

"Our dream is to develop a way to integrate brain and machine to help patients and give everyone a better life," said He.

Center receives NSF grant renewal

THE ENGINEERING RESEARCH CENTER for Compact and Efficient Fluid Power (CCEFP) has received a four-year, $16 million grant from the National Science Foundation ensuring the center will continue its research improving the overall efficiency and effectiveness of fluid power. Industry partners will augment NSF funding with cash and in-kind contributions, and the center's seven university partners will contribute an additional $3.2 million.

"The CCEFP has already made landmark breakthroughs," said Kim Stelson, University professor of mechanical engineering and center director. "The Center has transformed hydraulic and pneumatic research in this country from isolated efforts by a few to a cohesive, strategically directed collaborative team linking seven universities and many leaders in the fluid power industry."

The NSF funding renewal is welcome news to the more than 30 faculty, 300 undergraduate and graduate engineering students, and the 57 industry sponsors who have been involved in the CCEFP since its founding in 2006 through an initial NSF grant. Their work on four test beds and 25-plus research projects focuses primarily on increasing the efficiency of existing fluid power applications, expanding use in transportation, creating portable, untethered human-scale fluid power applications and assuring that fluid power is clean, quiet, safe, and easy to use. Research results to date are impressive with 14 inventions disclosed and more than 100 technical papers published.

The center' s education and outreach program is equally ambitious with more than 20 projects designed to attract pre-college students to science, engineering, and to hydraulics and pneumatics in particular. The goal is to educate all mechanical engineering undergraduate students about fluid power, raise public awareness of fluid power, and establish forums where industry and academia can exchange ideas.

The CCEFP is a research center headquartered within the University of Minnesota's College of Science and Engineering. Other universities in its network include the University of Illinois at Urbana-Champaign, Georgia Institute of Technology, Purdue University, and Vanderbilt University.

EE/CSci renamed

IN HONOR OF FORMER University president and chemical engineering and materials science professor Kenneth H. Keller, the Electrical Engineering/Computer Science Building has been renamed Kenneth H. Keller Hall.

Keller joined the University's Department of Chemical Engineering faculty in 1964. He subsequently became chair of the Faculty Consultative Committee, acting dean of the Graduate School, and vice president for academic affairs. In 1984, he was chosen to be acting president of the University of Minnesota, and in 1985 officially became the president, serving in that role until 1988.

After two years at Princeton University and seven years as a senior fellow at the Council on Foreign Relations in New York, Keller returned to the University of Minnesota in 1996 as the Charles M. Denny, Jr. Professor of Science, Technology, and Public Policy in the Hubert H. Humphrey Institute of Public Affairs. He was designated President Emeritus by the Board of Regents in 2006 and is currently director of the Bologna Center of the Johns Hopkins School of Advanced International Studies, a multidisciplinary graduate program in international affairs, which enrolls students from 35 to 40 countries each year.

"We have a long and proud tradition at the University of Minnesota of honoring our past presidents by naming a building after them," said Board of Regents Chair Clyde Allen. "Making the Electrical Engineering/Computer Science building into 'Kenneth H. Keller Hall' in honor of our 12th president was a natural choice. It's close to his academic home and also reflects one of President Emeritus Keller's lasting legacies for our University."

PATRICK O'LEARY

The Electrical Engineering and Computer Science Building is now Kenneth H. Keller Hall.

FACULTY HONORS

Professor **Eray Aydil** (chemical engineering and materials science) was awarded the 2009 Plasma Prize for the Plasma Science and Technology Division of the American Vacuum Society.

Assistant professor **Arindam Banerjee** (computer science and engineering), associate professor **Marc Hillmyer** (chemistry), and associate professor **Paige Novak** (civil engineering) have been named resident fellows in the University's Institute on the Environment.

Assistant professor **Arindam Banerjee** (computer science and engineering), assistant professor **Gilad Lerman** (mathematics), assistant professor **Mohamed Mokbel** (computer science and engineering), assistant professor **Jonathan Schilling** (bioproducts and biosystems engineering) have been awarded grants from the National Science Foundation Faculty Early Career Development program.

Professor **Frank Bates** (chemical engineering and materials science) was named to the American Academy of Arts and Sciences.

Assistant professor **David Blank** (chemistry) and assistant professor **Kent Kirkby** (geology and geophysics) have received the Horace T. Morse Award for Outstanding Contributions to Undergraduate Education.

Assistant professor **Daniel Cronin-Hennessy** (physics) is recipient of the 2010 George W. Taylor Career Development Award.

Professor **Jane Davidson** (mechanical engineering) and professor **Eray Aydil** (chemical engineering and materials science) were awarded The Ronald L. and Janet A. Christenson Chair in Renewable Energy.

Assistant professor **Kevin Dorfman** (chemical engineering and materials science) was named a 2010 Camille Dreyfus Teacher-Scholar, which supports research and careers of talented young faculty in the chemical sciences.

Associate professor **Douglas Ernie** (electrical and computer engineering) was named a Distinguished Faculty Mentor of the University of Minnesota.

Professor **Lorraine Francis** (chemical engineering and materials science), professor **James Kakalios** (physics), professor **James Leger** (electrical and computer engineering), and professor **Kenneth Leopold** (chemistry) have been named Taylor Distiniguished Professors for 2010.

Professor **Roger Fosdick** (aerospace engineering and mechanics) has received the 2010 Engineering Science Medal from the Society of Engineering Science.

Professor **Maria Gini** (computer science and engineering) and professor **Christopher Paola** (geology and geophysics) were named 2010 College of Science and Engineering Distinguished Professors.

Assistant professor **Christy Haynes** (chemistry) and assistant professor **Tyler Lawson** (mathematics) have been awarded prestigious Alfred P. Sloan Research Fellowships for 2010.

Professor **Caroline Hayes** (mechanical engineering) has received the 2010 President's Award for Outstanding Service, recognizing exceptional service to the University. She also received the George W. Taylor Award for Distinguished Service and the Mullen-Spector-Truax Women's Leadership Award.

Associate professor **Alexander Heger** (physics) has received a Council of Graduate Students (COGS) Outstanding Faculty Award.

Associate professor **Marc Hillmyer** (chemistry) and adjunct professor **David Norris** (chemical engineering and materials science) have been named fellows of the Association for the Advancement of Science (AAAS). Hillmyer also recently received the George W. Taylor/IT Alumni Society Award for Distinguished Teaching.

Professor **Wei-Shou Hu** (chemical engineering and materials science) has received two prestigious awards from the American Institute of Chemical Engineers (AIChE). They are the Food, Pharmaceutical, and Bioengineering Division Award for his groundbreaking contributions in cell-culture engineering, genomics, liver-tissue engineering, and metabolic engineering; and the Society for Biological Engineering Award for Excellence and Service for founding the Consortium of CHO Cell Genomics.

Assistant professor **Ibrahim Volkan Isler** (computer science and engineering), assistant professor **Vuk Mandic** (physics), and assistant professor **Yoichiro Mori** (mathematics) are among 10 recipients of the 2010–12 McKnight Land-Grant Professorship, a program designed to advance the careers of the University's most promising junior faculty.

Assistant professor **Nihar Jindal** (electrical and computer engineering) has received the Guillermo E. Borja Award recognizing exceptional research and scholarly accomplishments.

Assistant professor **Mihailo Jovanovic** (electrical and computer engineering) and assistant professor **Sang-Hyun Oh** (electrical and computer engineering) have received Initiative for Renewable Energy and the Environment (IREE) Early Career Grant Awards.

Professor **James Kakalios** (physics) was nominated for "Best Video" in the Variety category of the 14th Annual Webby Awards for the video, "Science of Watchmen."

Professor **Yiannis Kaznessis** (chemical engineering and materials science) has received the 2010 Charles E. Bowers Faculty Teaching Award.

Professor **Joseph Konstan** (computer science and engineering) was nominated to run for president of the Association of Computing Machinery (ACM).

Professor **James Leger** (electrical and computer engineering) has received the John Tate Award for Excellence in Undergraduate Advising.

Professor **Timothy Lodge** (chemistry) has been awarded the 2009 SPSJ International Award from the Society of Polymer Science, Japan for his excellent contribution to polymer science.

Professor **Tom Luo** (electrical and computer engineering) received the Leiv Eiriksson mobility program grant from the Research Council of Norway for his "Dynamic Spectrum Management in Cognitive Radio Networks" project.

Professor **Robert Lysak** (physics) has been appointed as Senior Editor of the Journal of Geophysical Research in Space Physics for the American Geophysical Union (AGU).

Associate professor **Krishnan Mahesh** (aerospace engineering and mechanics) is recipient of the 2010 George W. Taylor Award for Distinguished Research.

Professor **Ned Mohan** received a Utility Wind Integration Group (UWIG) Achievement Award for his work on curriculum development.

Professor **Yousef Saad** (computer science and engineering) and professor **Fadil Santosa** (mathematics) have been named Fellows of the Society for Industrial and Applied Mathematics.

Professor **Guillermo Sapiro** (electrical and computer engineering) has been selected for the 2010 U.S. Department of Defense National Security Science and Engineering Faculty Fellowship program.

Professor **William Seyfried Jr.** (geology and geophysics) was recently named a Fellow by the Geochemical Society and the European Association for Geochemistry.

Professor **Ilja Siepmann** (chemistry) and professor **Joseph Konstan** (computer science and engineering) are recipients of the University's 2010 award for Contributions to Postbaccalaureate, Graduate, and Professional Education.

Associate professor **Loren Terveen** (computer science and engineering) has been selected as a Distinguished Member of the Association of Computing Machinery (ACM).

Professor **Donald Truhlar** (chemistry) was awarded an honorary degree from the Technical University of Lodz, Poland, and also was elected future chair of the Chemical Physics Division of the American Physical Society.

Associate professor **Renata Wentzcovitch** (chemical engineering and materials science) was elected as a fellow of the Mineralogical Society of America.

Professor **Donna Whitney** (geology and geophysics) and professor **Marc Hillmyer** (chemistry) are recipients of the 2010 Distinguished McKnight University Professorship.

Professor **Pen-Chung Yew** (computer science and engineering) received the 2009 Information Science Honorary Medal from the Institute of Information and Computing Machinery.

U study finds rising dioxin levels from common soap

A COLLABORATIVE STUDY led by University researchers shows increased levels of dioxins associated with an antibacterial agent used in hand soaps, deodorants, dishwashing liquids and other consumer products in Mississippi River sediments. The findings appeared online recently in *Environmental Science and Technology.*

Led by recent Ph.D. chemistry graduate, Jeff Buth, the research group examined sediment core samples from Lake Pepin, a widening of the Mississippi River south of the Twin Cities. They found over the past three decades, the levels of the four dioxins derived from triclosan rose by 200 percent to 300 percent. Triclosan has been linked to disruptions of hormonal function and may play a role in evolving bacterial resistance to antibiotics.

Earlier research conducted by civil engineering professor William Arnold and his colleague, former University of Minnesota chemistry professor Kristopher McNeill, showed that triclosan generated a specific suite of four dioxins when exposed to sunlight.

In this recent study, core samples of Lake Pepin sediments, which contain a 50-year record of pollutant accumulation, were analyzed for triclosan, the four dioxins derived from it, and the entire family of dioxin chemicals.

"In the deepest part of the sediment, there is no triclosan and these dioxins are not present," Arnold said. "Once triclosan was introduced, a record of triclosan and these four dioxins appears in the sediment."

HAROLD WIEGNER

Researchers collect water samples at Lake Pepin in southeastern Minnesota.

Triclosan was added to commercial liquid hand soap in 1987, and by 2001, about 76 percent of commercial liquid hand soaps contained it. About 96 percent of triclosan from consumer products goes down residential drains, and much of it eventually reaches wastewater treatment plants, where it is not completely removed. When treated wastewater is released into rivers, sunlight converts some of the triclosan into dioxins.

According to Arnold, neither the toxicity of the dioxins derived from triclosan nor the extent of the dioxins distribution in the environment is well understood.

Researchers make gains in solar cell power

UNIVERSITY OF MINNESOTA researchers may have cleared a major hurdle in increasing solar cell efficiency and reducing the cost of manufacturing the cells. The research was recently published in *Science*.

Led by chemical engineering and materials science professors Eray Aydil and David Norris, chemistry professor Xiaoyang Zhu (now at the University of Texas-Austin) and, chemical engineering and materials science graduate student William Tisdale, the group used a technique they described as hot electron extraction.

In most solar cells, light hits their uppermost layers, which are usually made of crystalline silicon. The light frees electrons from the silicon atoms, which makes the electricity. But some electrons in the silicon absorb excess energy and radiate that away as heat. Consequently, solar cells are almost never more than 30 percent efficient.

Using quantum dots to construct the semiconductor layer on the nano-scale, the researchers were able to change the solar cell's absorption properties. By switching from silicon to lead selenide, even more success was achieved. Nano-scale semiconductors caused energy to be lost more slowly. This delay allowed the scientists to relocate the energy into tiny wires made from titanium dioxide.

"This is a very promising result," said Tisdale. "We've shown that you can pull hot electrons out very quickly—before they lose their energy. This is exciting fundamental science."

"This work is a necessary but not sufficient step for building high-efficiency solar cells," said Aydil. "It provides motivation for researchers to work on quantum dots and solar cells based on quantum dots."

The research was co-funded by the U.S. Department of Energy and the National Science Foundation.

Designing Fellows

WRITTEN BY **KERMIT PATTISON**

PHOTOS BY **JOSH KOHANEK**

> "We are four very unique individuals. Put us all together in one very small room, apply a little bit of pressure, shake and see what kinds of ideas explode out."
>
> —KARL VOLLMERS

Karl Vollmers earned a master's and Ph.D. in mechanical engineering from the University of Minnesota. He completed his doctoral research in Zurich before becoming a Medical Devices Fellow.

Four mid-career professionals in the University's Medical Devices Fellows program focus on creating marketable products that meet consumer and industry needs.

Four people sit over their laptops around a table in a cramped office on the University of Minnesota campus. It's the weekly meeting of the Medical Devices Fellows and these aspiring innovators are reviewing their projects. Over the course of a year, the fellows will brainstorm hundreds of ideas, doggedly research them, and mercilessly cull the list to the best bets. They will read hundreds of papers, talk to scores of clinicians and develop multiple prototypes in a quest to build better medical "mousetraps."

"The primary objective of this program is to be smart about what you're inventing," said Christopher Scorzelli, M.D., as he sits at the conference table with his colleagues. "Not just do it willy-nilly, but to have a calculated path about where you're going."

In the darkened room at the University's Shepherd Labs, an overhead projector beams a spreadsheet listing dozens of tasks and projects. Some are identified only by code words because the fellows operate in stealth mode to protect their intellectual property and the University's. Others are bizarre, such as the line item about buying a roast from Rainbow supermarket to test a prototype hemorrhoids product. Rump roast anyone?

Most fellows are professionals in their 30s and 40s who work for a fraction of what they might make in private industry. In exchange, they have an opportunity to innovate with freedom rarely afforded in the working world. Although only in its second year, the fellows program has already produced results: 15 provisional patents, one startup, one product license and three ideas being considered for licensing by major companies.

The office has the feel of a dorm room-meets-bootstrap company: two small rooms crowded by desks—one raised on blocks—espresso machines, a conference table and mountain bike. On the cinderblock walls, whiteboards are scrawled with notes. Cables and wires snake along walls and ceilings.

"To me, this fellowship really means teamwork," said Karl Vollmers, a mechanical engineer Ph.D. and current fellow. "We are four very unique individuals. Put us all together in one very small room, apply a little bit of pressure, shake and see what kind of ideas explode out."

> "Our primary goal is to educate the next generation of leaders on state-of-the-art medical devices."
>
> —MARIE JOHNSON

The Discipline of Innovation

Founded in 2008, the Medical Devices Fellows Program allows four mid-career professionals from engineering, medicine, or biosciences to spend a year learning the discipline of innovation.

"Our primary goal is to educate the next generation of leaders on state-of-the-art medical devices," said Marie Johnson, director of the fellows program. "Our second goal is to create commercializable intellectual property."

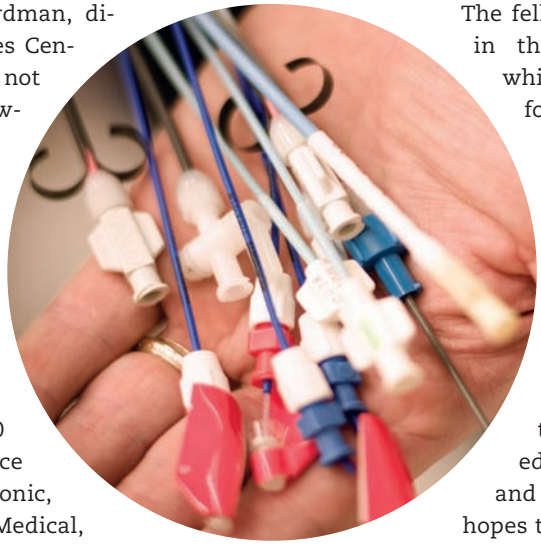
The program is one of only a handful in the nation. It is modeled on a similar initiative at Stanford University, where Johnson did a postdoctoral fellowship after earning her biomedical engineering Ph.D. at the University of Minnesota. While at Stanford,

As director of the Medical Devices Fellows Program, Marie Johnson oversees a cross-functional team of fellows who interface daily with faculty, medical professionals and industry collaborators to develop and test new medical devices with the goal of improving health care worldwide.

(Right) Parts of catheters are often used to make medical device prototypes. (Below) Before becoming a Medical Devices Fellow, Eric Little earned a bachelors degree in business and a Ph.D. in mechanical engineering from Michigan Technological University and a law degree from William Mitchell College of Law. He also served as an adjunct professor in the University's Department of Mechanical Engineering.

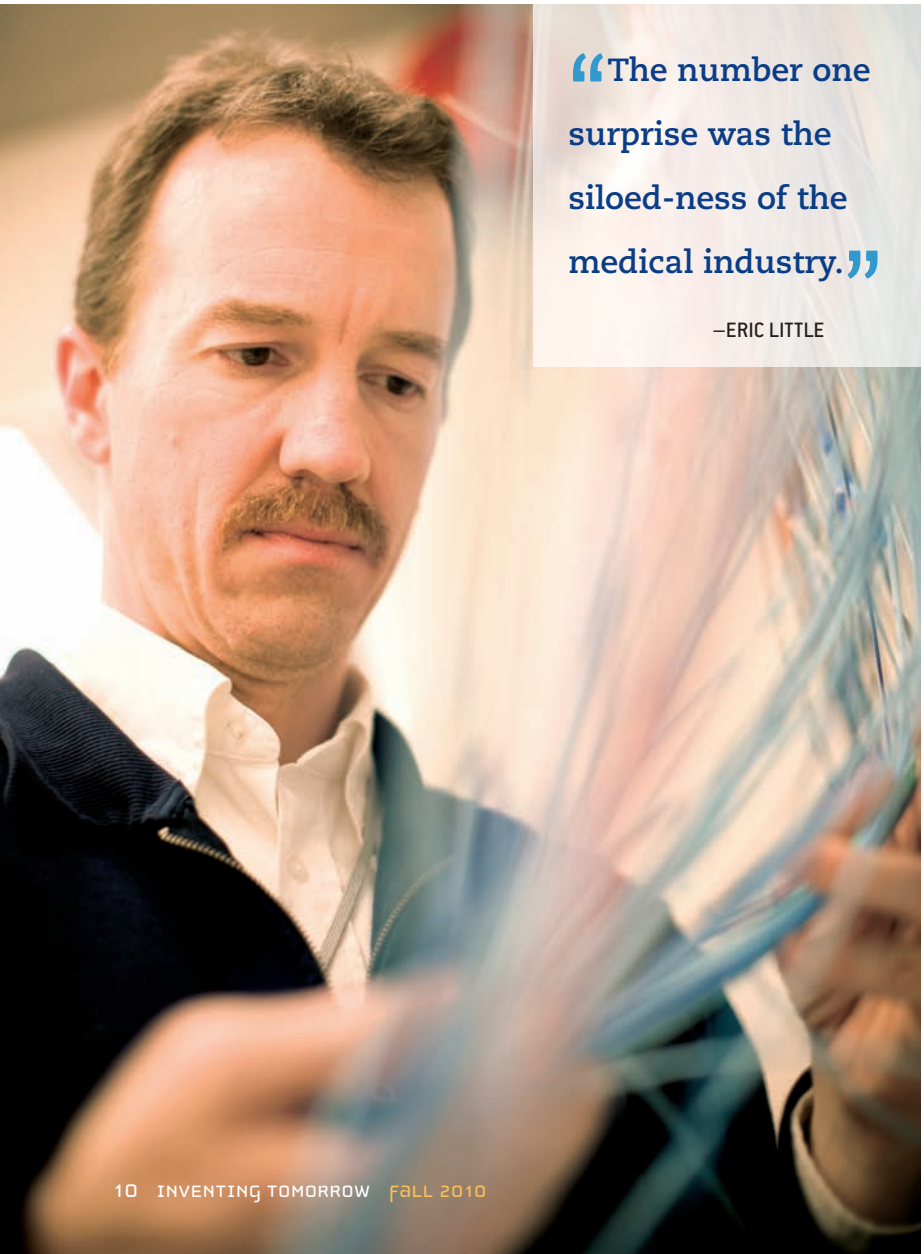
Johnson approached Art Erdman, director of the Medical Devices Center and pitched an idea: why not start a medical device fellowship in Minnesota?

It was a natural fit because Minnesota is a hotbed of medical innovation. Over the last half century, Minnesotans have pioneered open heart surgery, the pacemaker and countless medical devices. Minnesota has more than 500 FDA-registered medical device companies including Medtronic, Boston Scientific, St. Jude Medical, and countless small startups. The medical device industry represents three quarters of the biobusinesses in Minnesota.



The fellows program found a home in the Medical Devices Center, which is part of the Institute for Engineering and Medicine, jointly sponsored by the College of Science and Engineering and the Medical School. According to Johnson, the fellows program has a budget of $600,000 per year, mostly for salaries and prototyping (in addition to University funding, the program also is supported by Boston Scientific, St. Jude, and Symbios Clinical). Johnson hopes the program will become self-funding within five years through revenues from innovations produced by the fellows. The first class of fellows began in the 2008-2009 academic year.

The program has ambitious goals: to produce the next generation of medical device innovators and entrepreneurs. The fellows are tasked to identify fundamental technology needs and the technical barriers—and surmount them. They are encouraged to think broadly, work across disciplines, and cultivate interdisciplinary networks. Their goals: 20 viable devices by the end of the year, some of which hopefully lead to startups or licenses other companies.



> "The number one surprise was the siloed-ness of the medical industry."
>
> —ERIC LITTLE

Fine Fellows

There is stiff competition for the four fellowship spots. Last year, there were 80 applicants, 12 of who were invited for full-day interviews with a panel of industry executives, academics, venture capitalists, cardiologists, and current fellows. Afterward the judges retire to a room and evaluate applicants one-by-one in vetting that Johnson calls the "sorority download."

"We're looking for the perfect combination of team player, innovator, and tinkerer. We are also looking to balance the team with engineering and clinical expertise," said Johnson.

The program looks for a combination of degrees in engineering, medicine, biosciences (most have M.D.s or Ph.Ds) and product development experience. They also try to balance personalities. Each applicant takes a Myers-Briggs test and Johnson consults with an industrial psychologist and tries to balance the personality types so they complement each other—and hopefully don't drive each other nuts while working cheek-to-jowl 10 or 12 hours per day. As Johnson said, "We put them together, and we pray."

The fellows begin with a bootcamp—and that

term is not entirely an exaggeration. In eight weeks, the fellows meet with 110 guest lecturers, including many leading lights of the local medical device industry like Bill Hawkins, CEO of Medtronic, Manny Villafana, founder of St. Jude Medical, plus numerous vice presidents, researchers, physicians, entrepreneurs, patent attorneys, and venture capitalists. "Most days, it was four lectures per day, two hours apiece," said Vollmers. "You'd go home and your head would be exploding."

Next comes clinical immersion. The program takes advantage of the resources available at a major research institution. Fellows don scrubs and observe surgeries and accompany doctors on rotations. They visit medical device companies.

The rest of the year is spent on identifying medical needs—the goal is 200 ideas—filtering them to a list of 20 and then drilling down one-by-one to devise solutions.

"We dispel the myth that it doesn't take that much work, and it just takes a great idea," said Johnson. "We drill down the fact that it takes a ton of work."

Fellow Eric Little, a Ph.D. mechanical engineer and lawyer, was struck by the extent to which medical specialties were isolated from one another. "The number one surprise was the siloed-ness of the medical industry," said Little, who became interested in medical devices when his 9-month-old son was diagnosed with unilateral hearing loss.

"The cardiologists are very focused on the heart, pulmonologists are very focused on the lungs, and nephrologists are very focused on the kidneys. Many times, there's not a lot of interaction between the various specialties."

On the bright side, that means those who can work across disciplines—as the fellows are trained to do—can see new possibilities. "It opens up a wonderful opportunity," said Little, "because, if you can bridge some of those gaps, not only do you get better health care but you get some pretty neat products too."

Some fellows like to say the program gives them license to ask dumb questions, which may provoke smart answers. Christopher Scorzelli always asked too many questions in medical school—a habit that sometimes annoyed his instructors and classmates.

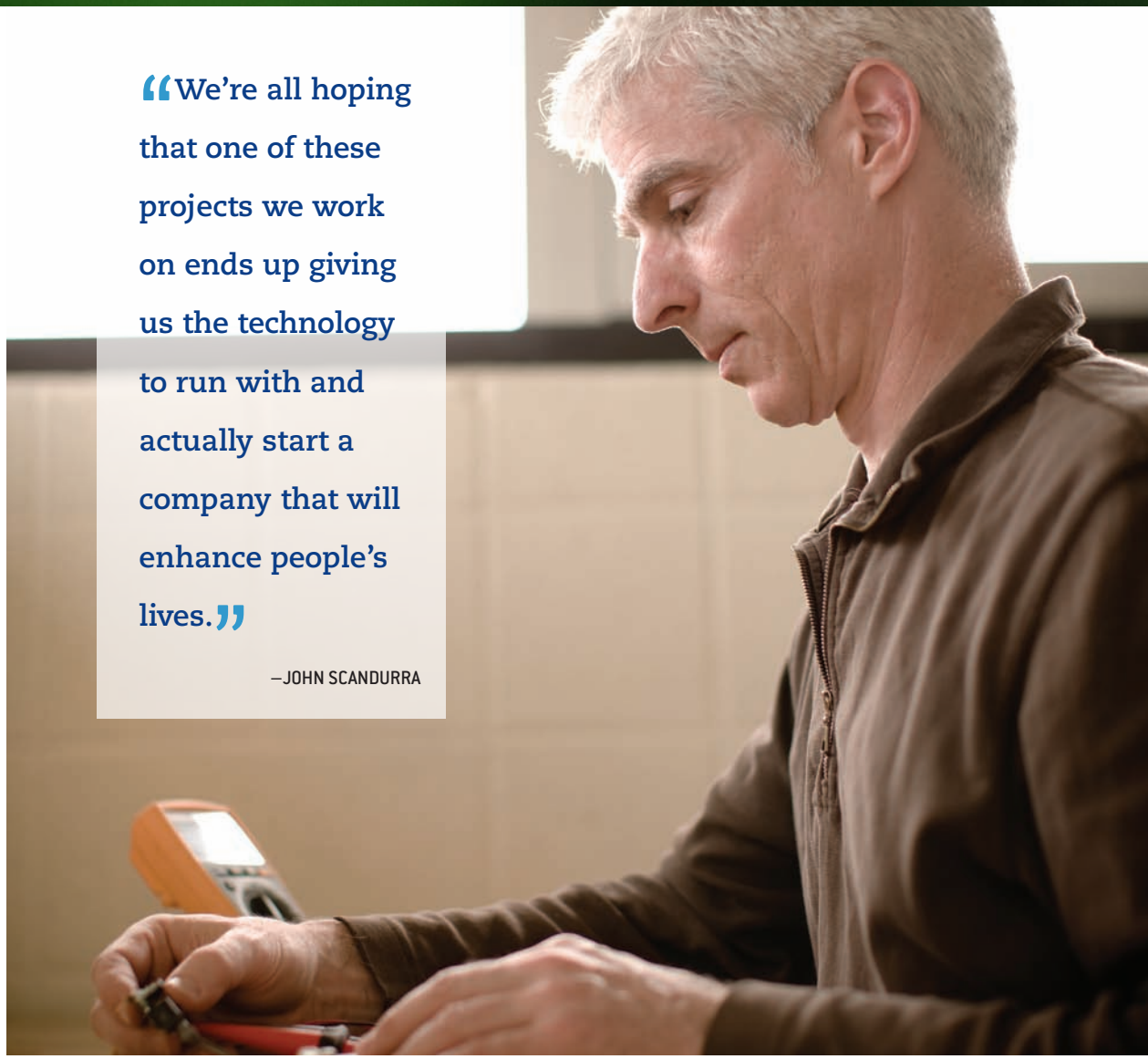
"I was always directed away from asking too many 'why' questions—why do we do it this way? Why don't we do it that way?—when I saw inefficiencies and problems treating patients," he recalls.

Scorzelli wasn't a cookie cutter med student; he had worked as an artist and house remodeler before enrolling in St. George's University School of Medicine in Grenada, West Indies. He also was a handyman with a knack for building homemade devices such as a contraption to hold a bottle for his infant daughter and a ski-borne baby stroller.

Medical Devices Fellow Christopher Scorzelli, who holds a doctorate of medicine degree, postponed his medical residency to focus on his long-time interest in medical device innovation.

> "The primary objective of this program is to be smart about what you're inventing."
>
> —CHRISTOPHER SCORZELLI

Medical Devices Fellow John Scandurra worked as a veterinarian in Wellington, New Zealand, where he specialized in treating companion animals with heart disease. In addition to a Doctor of Veterinary Medicine degree, Scandurra holds a bachelor's and master's degree in mechanical engineering.



> "We're all hoping that one of these projects we work on ends up giving us the technology to run with and actually start a company that will enhance people's lives."
>
> —JOHN SCANDURRA

"It's the first time in a long time I've been in a position where creativity and innovation are greatly encouraged," Scorzelli said of the fellowship. "It's been a long time since I felt that way."

Innovation at Work

Nobody likes pulling teeth—especially from dead people.

But that's the problem the funeral industry was facing because of concerns about mercury pollution from the burning of dental fillings in crematoriums. Ultimately, the first class of fellows in 2008-09 devised a solution, which resulted in the program's first license.

The Minnesota Funeral Directors Association approached the Medical Devices Center seeking a solution. At first, everybody assumed the task was building a dental device to extract teeth from the deceased. The fellows began brainstorming how to design a better tooth puller. One evening, they gathered around the table trying to hammer out a definition of the problem before heading home. They realized the task wasn't necessarily preventing mercury from entering the furnace; rather it was to prevent mercury from being incinerated.

2008-09 Fellow Ben Arcand, a mechanical engineering Ph.D. and former research and development engineer at Boston Scientific, had a notion. Years earlier, he'd taken a class on blacksmithing for artists and had learned about fireproof ceramics. Could they fireproof the teeth? If so, there would be no need to pull them.

Fast forward through a lot of brainstorming, research, cadavers, and prototyping to the solution: a caulk gun-like device that allowed funeral homes to encase teeth with fireproof cement. According to Arcand, the lump doesn't burn and can be removed from the ashes and disposed. The university donated the solution to the Minnesota Funeral Directors Association. As Johnson recalls, "The funeral directors gave the fellows a standing ovation at the Minnesota Funeral Directors Association (MFDA) annual conference.

Learning the Business

The fellowship repeatedly drives home one lesson: innovation is 99 percent perspiration.

In the course of researching a specific topic, each fellow may read 100 papers and talk to dozens of clinicians. They might watch surgeries, examine cadavers, and go through multiple prototype designs. As Johnson said, "If you define a problem well enough, the solution falls out automatically."

Johnson pushes fellows to focus their ideas, pinpoints weaknesses in their arguments, and teaches the technologists the realities of business. "I force them to dig in and find the very specific place we're going to sell this thing," she said. "If it can be applied everywhere, in general you've applied it nowhere."

Only a small percentage of ideas survive the scrutiny. They will kill ideas if they lack a clear entry point, if the market is too small, if the intellectual property is already claimed or if the fellows lack personal interest. Sometimes a good idea is not viable simply because it is unlikely to get insurance reimbursement.

Along the way, fellows can tap the resources of a major medical university. They have access to the Medical Devices Center and its state-of-the-art facilities for designing, prototyping, and testing new medical devices. They can consult colleagues at the Carlson School of Management for business advice and market research. They can rely on the university's Office of Technology Commercialization and Venture Center for advice about patents and funding.

One example of an innovation cycle at work occurred when the 2008-09 fellows developed a device to treat chronic sinus infections. The idea began with a casual conversation when Johnson mentioned that her husband had sinus problems. The fellows added it to their growing list …and then forgot about it.

The idea sat on back burner for months before the fellows began sniffing around for a solution. They talked about nasal irrigation and removing mucus with vibrations, but none of the early ideas seemed feasible.

One day, Arcand and a colleague donned medical garb and latex gloves and went to the cadaver lab at Jackson Hall. Arcand brought along some pieces of wire, rulers, and started probing the nasal passages. He bent the wire into a fishhook and—voila!— it slipped into the maxillary sinus ostium. They realized it was easier to access the sinuses through the backdoor: inside the mouth.

"That was the eureka moment," Arcand recalls. "The rest of the tool got designed around that idea."

Next came another long grind of developing the product. They met with ear, nose and throat doctors at the University. They tested prototypes. Eventually they arrived at a design that combined Arcand's fishhook shape with a balloon that inflates to clear the sinuses (similar to angioplasty). The device enables minimally invasive accesses to the maxillary sinus and can be used in an office setting—without surgery or drugs. In 2009, Arcand founded Labyrinth Medical, LLC, which he hopes will provide the vehicle to develop the technology.

Will it Fly?

This past year's fellows hope for similar successes. They began with a goal to generate 200 ideas. They came up with 800.

They sifted the list to 20, which span a wide range of areas including cardiology, orthopedics, radiology, ENT, hematology, vascular, urology, dentistry, neurology, and dermatology. They began work on three projects involving a catheter, pulmonary hypertension, and women's health.

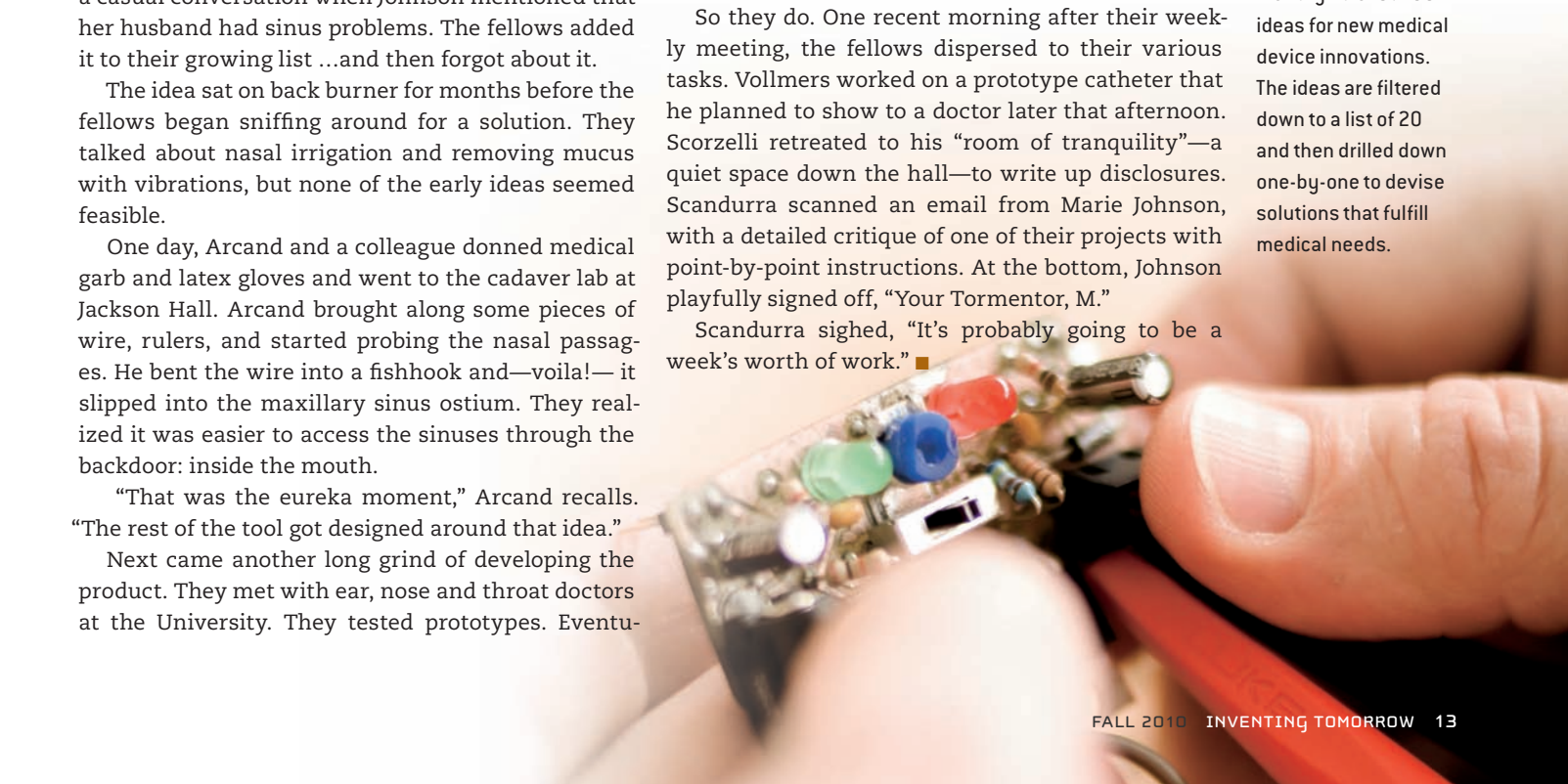
"We're all hoping that one of these projects we work on ends up giving us the technology to run with and actually start a company that will enhance people's lives," said fellow John Scandurra, a veterinary doctor and former mechanical engineer.

An entrepreneur must be a master of many trades, and fellows learn to approach problems from multiple perspectives: engineer, user, entrepreneur, healthcare provider, regulator, insurer, venture capitalist, and so on. They wear many caps; Vollmers even has a baseball hat that says "engineer" hanging by his desk.

"The center operates like a startup," said Vollmers, who learned about being a Jack-of-all-trades while growing up on a farm. "There's not a lot of money, so if you want something done you have to do it yourself."

So they do. One recent morning after their weekly meeting, the fellows dispersed to their various tasks. Vollmers worked on a prototype catheter that he planned to show to a doctor later that afternoon. Scorzelli retreated to his "room of tranquility"—a quiet space down the hall—to write up disclosures. Scandurra scanned an email from Marie Johnson, with a detailed critique of one of their projects with point-by-point instructions. At the bottom, Johnson playfully signed off, "Your Tormentor, M."

Scandurra sighed, "It's probably going to be a week's worth of work." ■



(Below) A power supply board fabricated in the Medical Devices Center is tested. Initially, the Medical Devices Fellows identify at least 200 ideas for new medical device innovations. The ideas are filtered down to a list of 20 and then drilled down one-by-one to devise solutions that fulfill medical needs.

Three College of Science and Engineering international alumni who came to the University of Minnesota for an education are now leaders in their fields

Coming to AMERICA

WRITTEN BY **KERMIT PATTISON**

Starting a company takes a lot of resolve and Branislav Vajdic showed it early. He left his native Yugoslavia, showed up on the doorstep of the University of Minnesota and talked his way into graduate school.

This drive, along with a Ph.D. in electrical engineering, propelled Vajdic to the forefront of the Silicon Valley technology industry. His education at the University of Minnesota spawned a career designing cutting-edge products for Intel and heading a medical startup.

"To this day, the professors I worked with have an impact on me," Vajdic said. "What I learned from the University of Minnesota has stayed with me and been applied in every day of my professional life."

The University of Minnesota has long been a magnet for students from around the world. Last year, the University enrolled 4,120 international students and scholars. More than one third of those come to the College of Science and Engineering. Various engineering majors and computer science are the top programs for foreign students.

"We think it's an indispensible mix in the big picture here at the University," said Paula Brugge, associate director of admissions who oversees international undergraduate student admissions.

"As we become a smaller and smaller global society, the more exposure our University community can have with other countries and cultures, the better. This enhances the learning environment and helps our students become more competitive in a global society," she added.

It's estimated there are 30,000 international University of Minnesota alumni and many of them from the College of Science and Engineering have become scientific and technical leaders across the globe.

The following three stories of foreign-born College of Science and Engineering alumni show how their educations have helped to create successful ventures that have impacted the world. Vajdic emigrated from Yugoslavia and became a prominent technologist in Silicon Valley. Susan Rani, born in Korea, used her degrees in civil engineering and business to start her own engineering firm in the Twin Cities and mentor young professionals. Ajay Pandey, a native of India, leveraged his Ph.D. in computer science to reform government in his homeland.

Branislav Vajdic: Engineering with Heart

Vajdic made the journey to Minnesota back when the world seemed not so small a place. He grew up in communist Yugoslavia. He was groomed to follow the career path of his father, a surgeon and medical school professor. To the disappointment of his father, Vajdic's interest turned to engineering. The young man also had an even more headstrong idea: for reasons that he still can't quite explain, he became determined to study engineering in the United States.

But that wasn't so easy because Vajdic lacked the necessary academic credentials. Although he had excellent grades, he had earned his undergraduate

Branislav Vajdic came to the University of Minnesota from his native Yugoslavia and earned a Ph.D. in electrical engineering. His research into the burgeoning field of chip design earned him a job at Intel, where he rose to senior director of technology development. He now is CEO of New Cardio.

degree at a new university that was unknown to the outside world. He wrote to several American universities, but they told him they could not accept his credentials.

So Vajdic decided to go knock on the door of universities and prove himself in person. He finished his degree on a Thursday and the following day he was on a plane headed to the United States At the time, Yugoslavia was not a hardline communist country and allowed citizens to travel.

He landed in Minnesota in January 1979 and showed up on the doorstep of the director of graduate studies, the late Allen Nussbaum. Vajdic, then 24, spent the next few weeks speaking with professors, taking admission tests and validating his credentials. Another grad student offered to let him crash on the living room couch. Minnesota was his first stop because the University had shown the most willingness to work with him; the visit went so well that he cancelled plans to visit other schools. By the end of the month, he had earned a spot in the graduate program.

"The bottom line is the University of Minnesota cared," he recalls. "I felt this was really the place where I could get an education and be surrounded by people who were extremely helpful and friendly, which made a big difference."

Vajdic earned a Ph.D. in electrical engineering and conducted research into the burgeoning field of chip design with professor Al Tuszynski. He toyed with the idea of pursuing a career in academia, but one of his professors, Ray Warner, a former executive at Motorola, suggested Vajdic would be a better fit for business.

"He saw some of the initiatives I had at the University might be more in line with an industrial person than an academician," Vajdic said. "He was absolutely, 100 percent wise. I have to thank him more than anybody else."

Apparently others in industry agreed. By the time he graduated with a Ph.D. in 1984, Vajdic had six job offers. He accepted a position with Intel.

At the time, the semiconductor industry was

Susan Rani, who came to Minnesota from Seoul, Korea at age 11, combined her civil engineering and business degrees from the University of Minnesota to establish a succesful woman- and minority-owned engineering firm.

PATRICK O'LEARY

growing rapidly as personal computers proliferated and the Internet became ubiquitous. Vajdic led Intel's flash memory and Pentium development teams. He rose to become senior director of technology development in product design and assumed he would happily remain at Intel until his retirement.

But then his career took a turn that might have made his doctor father proud after all. In 2004, Vajdic became an angel investor in a new medical technology company called New Cardio, which used new software to develop a more sophisticated model from electrocardiogram (ECG) data.

The more he learned, the more excited he became that the new technology could be commercialized into a game changer because it creates a more precise three-dimensional model with existing ECG data. In 2006, he resigned from Intel and became the CEO of New Cardio. His decision to join the company—as well as every major business decision he makes—is shaped by a habit instilled by his graduate school mentors. When confronting any issue, he asks, what is the impact of solving this problem? Is it a theoretical exercise with little impact, or could it have profound applications?

"That's one thing I'll never forget," Vajdic said. "That's probably the most profound advice I got. It stays with me practically every day."

Susan Rani: A Model Engineer

Susan Rani is a civil engineer who built her own engineering firm from the ground up. But first she had to build a life in a new country.

Rani combined her civil engineering and business degrees from the University of Minnesota to find success on two fronts: operating a successful firm and diversifying the profession. Entering the field at a time when there were few engineering firms owned by women and minorities and few role models, she founded her own firm and mentors young talent. And Rani Engineering has demonstrated its talent by winning contracts for major projects such as the 35W bridge, the Weisman Art Museum expansion and the Central Corridor light rail project.

Rani arrived in Minnesota at age 11, alone and knowing no English. Until then, she had lived with her grandfather in Seoul, Korea, which she recalls as a primitive city with dirt roads and ox-drawn carts. There was no indoor plumbing and most families used outhouses. It was not an auspicious environment for a future civil engineer.

Rani's father had left Korea to study at the University of Minnesota before she was born. In 1971, he sent for his 11 year-old daughter.

Rani had never been on a plane and the journey across the Pacific was bewildering. She spoke no English and carried an envelope printed with her name and destination. She met her father for the first time at the airport.

"I felt like I had been thrown into the Jetsons," she recalls. "I didn't know how to work a toilet. I had never slept in a bed."

In fact, on her first night in the United States, she fell out of the bed.

She credits the English as a Second Language program at Minneapolis public schools with helping her adjust to her new country. She received one-on-one tutoring and collected thousands of flash cards with words and phrases. "The hardest part was American humor," she said with a laugh. "It wasn't until I had been here over 20 years that I could understand Saturday Night Live."

Rani worked hard and by the time she finished high school she was qualified to enter the University of Minnesota. "The [engineering] program was tough back then," she recalls. "I went through the program with perseverance and hard work." To pay for her education, she worked stuffing envelopes for the University Foundation, spinning blood in a hematology lab,

Last year the University of Minnesota enrolled 4,120 international students, which ranked them 20th among research institutions. More than one third of those were students in the College of Science and Engineering.

(opposite page) Ajay Bhusan Pandey returned to his native India after earning his master's and doctoral degrees in computer science and engineering from the University of Minnesota to become managing director and CEO of Maharashtra State Electricity Distribution Company, the largest electricity distribution utility in India. Under his leadership, he managed a complete turnaround of the company in less than two years.

and selling popcorn in the old Memorial Stadium.

"For the most part, I did not consider myself an international student," Rani said. "But I went to international functions because I found them fascinating—and that's where I met my husband."

Rani's husband studied electrical engineering at the U. Today they have two children, one of whom now attends the University's College of Liberal Arts.

Rani graduated with a bachelor's degree in civil engineering in 1982. Although her father also was an engineer, he discouraged her from the profession because of the discrimination she may face. Undeterred, she pursued a career in civil engineering. Her first job took her to California, where she worked as an engineer on nuclear power plants and later for the U.S. Army Corps of Engineers.

"I didn't know what earthquake engineering was," she said. "But I could pick up the building codes, study them, and pass the California license, which included earthquake engineering. The University education helped me do that. It gave me confidence that I could understand the concepts and pass the most difficult exam in the United States."

Rani continued challenging herself. She returned to Minnesota, earned an MBA from the Carlson School of Management while continuing to work and have her first child. At age 33, she started her own company.

"There weren't any role models for me at the top of an organization," she recalls. "There were no female or minority upper managers who could guide me along. What I saw was a glass ceiling for women engineers. In order for me to grow, I thought I had to give it a try."

Rani Engineering has grown to 17 employees. Rani prides herself on establishing a woman and minority-owned engineering firm. She has hired a number of young graduates and aspires to be the kind of mentor she wished she had as a young engineer.

"The most satisfying part about running a business," said Rani, "is seeing people develop."

Ajay Pandey: Data-Driven Reform

Years before India emerged as an information tech powerhouse, Ajay Bhushan Pandey saw the potential for technology to transform his country. He has used his computer science Ph.D. from the University of Minnesota to bring new reforms and efficiencies to the government of India. By making smarter use of data and technology, he has helped improve the efficiency of government, electrical distribution, tax collection and access to public services.

Pandey spent 14 years working as a career civil servant with the Indian Administrative Service. By the mid 1990s, he had a sense that information technology could become a powerful tool for reform and efficiency in government. When he became eligible for a mid-career sabbatical, he took a different path than most of his civil service colleagues who tended to earn degrees in fields like public policy. Instead, Pandey pursued computer science and chose the University of Minnesota because of the strength of its program.

"I had some kind of futuristic idea," he recalls, "that one day computer science would play a key role in transforming the country."

His graduate studies focused on data mining, databases, software engineering and networks. In one research project—which later became his Ph.D. project—he examined a software engineering approach in which tasks are assigned to two-person teams. Instead of being redundant, Pandey found these teams actually performed better and made fewer mistakes.

In 2003, Pandey earned a Ph.D. in computer science. He returned home to find his country being transformed by technology such as mobile phones, PCs, the Internet, broadband connections, and Internet banking.

He was well positioned to make the most of these advances. Pandey served three years as managing director of Maharashtra State Electricity Distribution Company Ltd Maharashtra, which is the largest electrical distribution company in India and serves 10 percent of the country.

He applied his computer science skills to attack one of the utility's most vexing problems: its huge losses. The company billed for only about 65 percent of the electricity it supplied; the remaining 35 percent disappeared into a "black hole" due to malfunctioning meters, tampering or neglect.

Using data mining techniques, Pandey and his colleagues analyzed patterns and identified the root causes such as malfunctioning meters, tampering, and inspectors who hadn't bothered to actually do meter readings. These findings sparked a series of reforms, including third-party verification and requiring inspectors to use photos to document meter readings. According to Pandey, losses have been reduced to 20 percent.

Similarly, in his new job as chief information officer of Maharashtra State (Indian civil servants

> "I had some kind of futuristic idea that one day computer science would play a key role in transforming the country [India]."
>
> —AJAY PANDEY

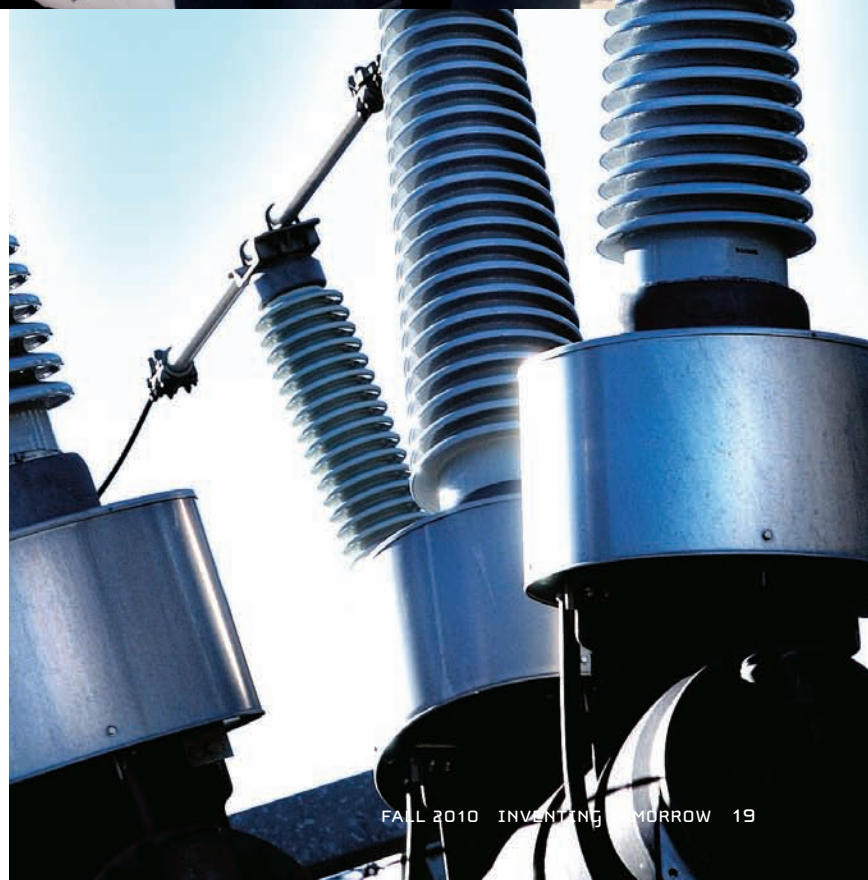
rotate between departments every few years), he helped the tax department analyze data to detect abnormalities and reduce tax evasion.

His department advises 30 government agencies and Pandey hopes to use information technology as a tool for easier public access and more transparency in government. He has shepherded departments towards an e-vision for electronic government.

Pandey still retains close ties to Minnesota. His wife, Namita Sahay, who earned a master's in computer engineering from the University, works as a software engineer at Medtronic and Pandey often returns to the Twin Cities to visit.

Pandey says he approaches problems with the template he learned as a Ph.D. computer scientist: review the current standards, identify deficiencies, solve them, and explore the future scope.

"I tend to think very logically," he said. "OK, why is this happening? Can one use technology to deal with the problem? How it can be done in a very different way?" ■



Stimulating RESEARCH

WRITTEN BY **JUDY WOODWARD**

PHOTOS BY **JOSH KOHANEK**

THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 IS SUPPORTING COLLEGE OF SCIENCE AND ENGINEERING FACULTY RESEARCH PROJECTS THAT MAY HELP STIMULATE ECONOMIC RECOVERY

Martin Saar, assistant professor of geology and geophysics, and graduate student, Jimmy Randolph, have devised an ingenious "two-for-one" strategy to simultaneously produce renewable energy and to reduce the presence of harmful carbon dioxide in the atmosphere.

> "All else being equal, using carbon dioxide gives you roughly double the electricity output efficiency compared to using water."
>
> —MARTIN SAAR

One of the projects is an ingenious plan to create a "double dividend" in producing geothermal energy; another involves basic research into the mechanical properties of one of the most deadly of brain cancers; a third involves a major scientific initiative dedicated to investigating the fundamental building blocks of matter. These are the sort of cutting-edge scholarly projects that give the College of Science and Engineering its reputation as one of the nation's leading resources for pure and applied scientific research. But now these three projects—as well as the research of many other scholars at the University of Minnesota—are fulfilling an additional purpose. They're also helping to put America back on track economically after the recent recession.

As part of the massive American Recovery and Reinvestment Act of 2009 [ARRA] the University of Minnesota has received grants totaling about $164.1 million from what is popularly known as "stimulus funds." Researchers within the College of Science and Engineering have earned the biggest chunk of that money—some $57.5 million, according to Tim Mulcahy, University of Minnesota Vice President for Research.

Support from the stimulus funds was to go to research projects that—in the language of the bill itself—result in "measurable outcomes… that promote the goals of the Recovery Act." The charge to the College of Science and Engineering was clear. Create science that will eventually help create jobs and prosperity. "University of Minnesota research has been successfully commercialized in a broad range of industries, including biosciences, green technologies…and many others," said Mulcahy. "This track record gives us every reason to believe that our research…will help launch companies that will provide economic vitality, jobs, and tax revenues for the state."

The research projects funded under ARRA are as varied as the many paths to national economic recovery. "I know a couple of young, non-tenured faculty members whose research was jump-started by the stimulus funds," said Mos Kaveh, associate dean for research and planning for the College of Science and Engineering. There are also major scientific initiatives like the NOvA detector facility. [See story on page 23] "NOvA is really big science," explains Kaveh, "and big science requires major funding."

To date Mulcahy notes, the ARRA funding has helped "create or preserve more than 100 jobs at the University." And that doesn't even begin to address another of the stimulus funds' long-term impacts on the state's economy. Pointing out that the University grants almost half the science and engineering degrees earned in the State of Minnesota, he added, "Those students will go on to become valued contributors to Minnesota's economic vitality."

MARTIN SAAR: Research heats up

One of the young faculty members whose research might well have been jump-started by the stimulus money is Martin Saar, College of Science and Engineering assistant professor of geology and geophysics. Saar and graduate student, Jimmy Randolph, have devised an ingenious "two-for-one" strategy to simultaneously produce renewable energy and to reduce the presence of harmful carbon dioxide in the atmosphere. Their idea is to use CO_2 in place of water in the production of geothermal energy.

The "ah-ha" moment came to Saar while on a drive to northern Minnesota. "In the car, we talked about a project we'd just completed on geological CO_2 sequestration," he said. That's the process that removes harmful carbon dioxide emissions from fossil fuel sources by injecting them into geologically stable subsurface rock formations. "But Jimmy's main project is geothermal energy production," he continued. As the two scientists discussed both projects, they began to think about their complementary aspects and "eventually we connected the dots."

Shown above is a heater for fluid-flow and reaction experiments investigating the chemical interactions between geothermal working fluids, such as water or CO_2, and host-rock minerals.

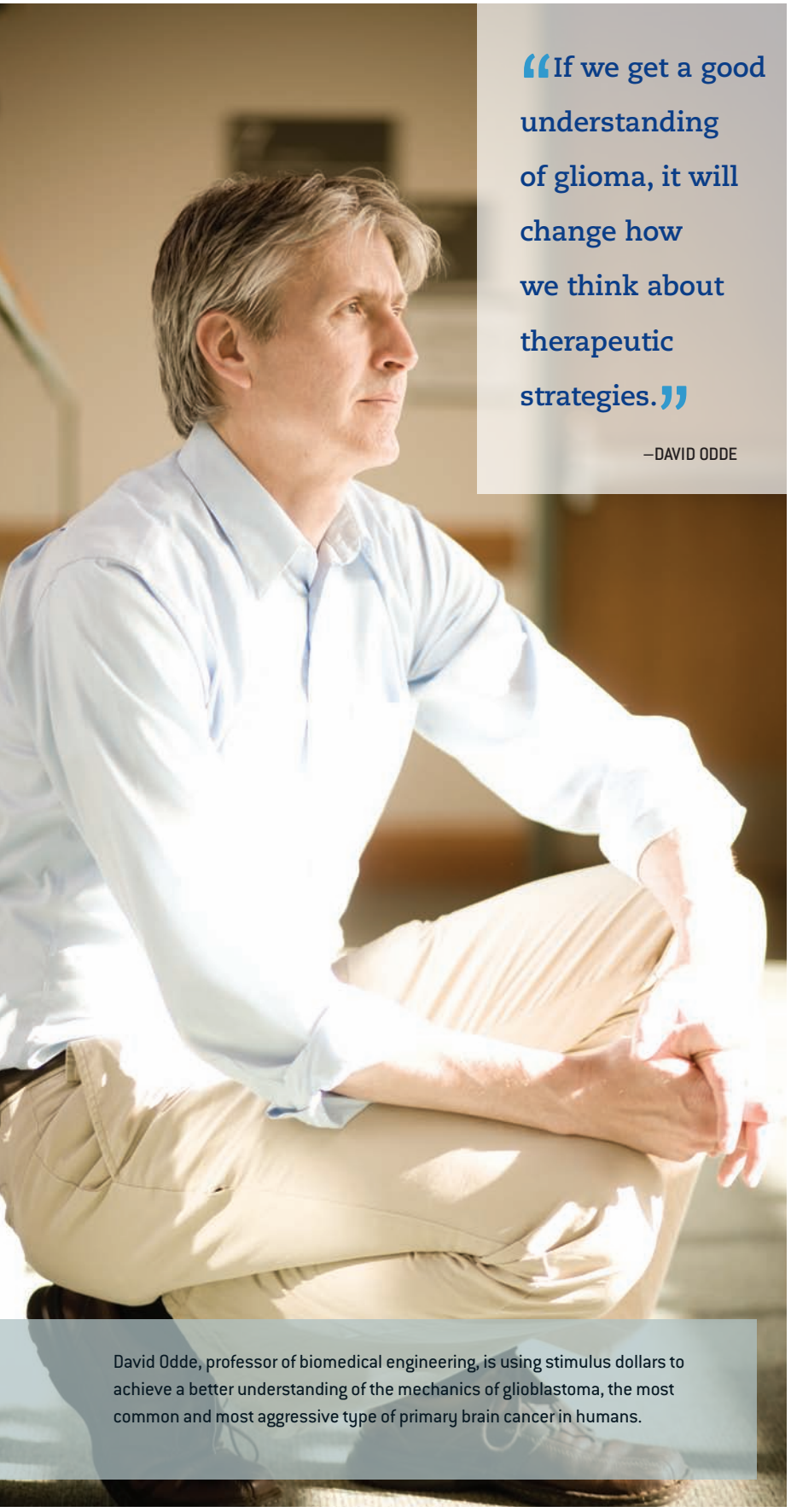
Water is the traditional working fluid used to transfer geothermal heat from the earth's interior to its surface for power production. But why not accomplish the same goal by building a geothermal power plant that is based on the partial recirculation of sequestered and geothermally heated carbon dioxide? Such a plant, said Saar, "would have a net negative carbon footprint…Geothermal heat captured this way not only does not emit CO_2, but would actually sequester CO_2 from sources like coal-fired or ethanol-producing plants."

He adds that there are other advantages to using CO_2 in place of water. "All else being equal," he said, "Using carbon dioxide gives you roughly double the electricity output efficiency compared to using water." That might allow geothermal electricity generation in regions where underground temperatures are too low to use water for economic electricity production.

Another argument for using CO_2, explains Saar, involves hydrofracturing, the process by which a hot dry underground rock formation is deliberately "cracked" to create an artificial reservoir in what's known as an enhanced geothermal system (EGS). The problem is that hydrofracturing can trigger small earthquakes. "Our CO_2-based system does NOT hydrofracture," he said, noting that the drawbacks of EGS were driven home when "they had to shut down systems in Switzerland, Germany and Northern California all within one week last December" in part because of small earthquakes.

Saar is excited about the economic potential of his work. "If Minnesota establishes itself in this technology, it could lead to jobs in the long run," he said. Beyond the immediate academic positions generated by the basic research, Saar looks forward to a day when designing and constructing power systems using CO_2 technology might become a 'Made in Minnesota' industry. "The University's Office for Technology Commercialization is in vigorous pursuit," he notes of possibly forming a start-up company based on Saar's and Randolph's research.

"If we combine fundamental research with real-world applications, we can really make a difference in terms of the environment as well as energy efficiency and security," he added.



> "If we get a good understanding of glioma, it will change how we think about therapeutic strategies."
>
> —DAVID ODDE

David Odde, professor of biomedical engineering, is using stimulus dollars to achieve a better understanding of the mechanics of glioblastoma, the most common and most aggressive type of primary brain cancer in humans.

DAVID ODDE: Understanding cell movement

If Saar's work focuses on large-scale problems of energy production systems, by contrast David Odde, biomedical engineering professor in the College of Science and Engineering, concentrates on the smallest units of living matter.

"How do cells sense the mechanical properties of their environment?" is the question posed by his work.

Odde is an expert on the shape and movement of cells in response to the underlying "stiffness" of their tissue environment. In the past, he has investigated how the underlying mechanical stiffness of their environment can affect the differentiation of neurons.

Now, in collaboration with neuro-oncologist Steven Rosenfeld of Columbia University, Odde is using stimulus money to apply his expertise to achieve a better understanding of the mechanics of glioblastoma, the lethal brain cancer that killed more than 12,000 people in 2009, among them Senator Ted Kennedy.

"It's the migration of tumor cells that kills people with brain cancer," said Odde, "but glioma cells migrate differently in vivo than in vitro." The problem for those studying the mechanics of the disease is to get glioma cells under laboratory conditions to behave more like glioma in a living creature.

One approach is to study glioma cell migration "in silico," as Odde says, by creating computer models to simulate the movement of the cells against underlying tissue environments of varying "stiffness."

The kind of deep understanding of glioma cells that his research can produce has tremendous potential implications for clinical work, explains Odde. "If we get a good understanding of glioma," he said, "it will change how we think about therapeutic strategies."

Odde envisions his research one day promoting what he calls a "Roach motel" approach to glioma therapy. By understanding how cancer cells migrate throughout the brain, it might someday be possible to develop a device that would manipulate the mechanical environment of brain tissue to induce cancer cells to take the one-way trip to no-exit eradication. And that, in turn, could provide growth for an important sector of the Minnesota economy.

"We have a very strong biomedical device industry in Minnesota," he said. "Devices are researched, developed, and produced here."

Hope for the therapeutic promise of his work is exciting, but what keeps Odde engaged on a day-to-day basis is the sheer pleasure of discovery. "We find something that cuts against what we expected," he said, "and yet it's true. I like that." ■

NOvA project construction moves forward

By far the largest single recipient of stimulus funds within the College of Science and Engineering is the NuMI Off-Axis Electron Neutrino Appearance (NOvA) detector facility, a state-of-the-art laboratory for investigating the role played by sub-atomic particles called neutrinos in the origins of the universe.

Ground was broken on the new facility near the Ash River in northern Minnesota in May 2009. Since then, the blasting work necessary for the massive 50-foot deep detector area has been completed, and construction has begun on other aspects of the project, which will be ready for preliminary business in spring 2011, said Bill Miller, laboratory supervisor. By the following summer, said Miller, "we'll have a completed detector."

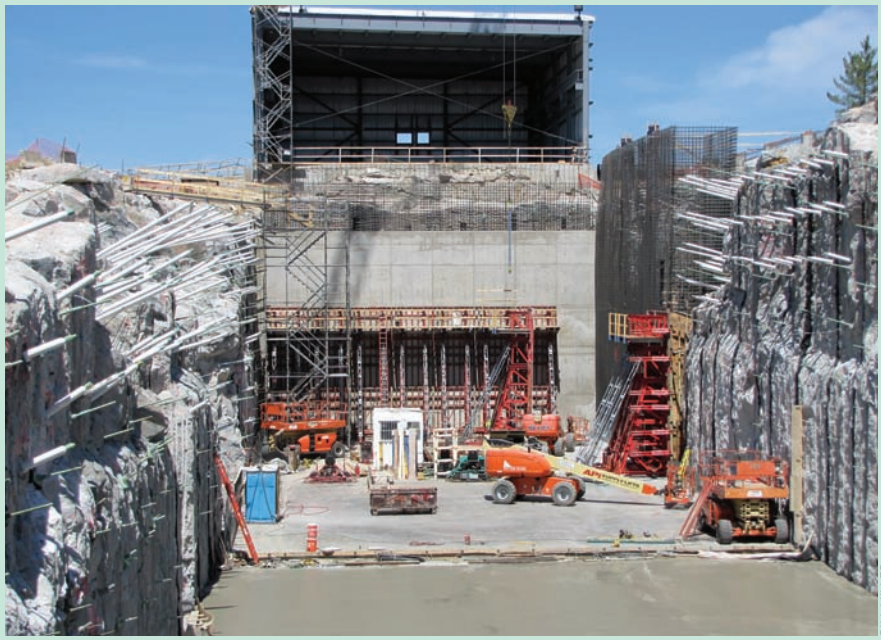
Eventually, a neutrino beam from Illinois' Fermi Lab will be directed to the NOvA site straight through the Earth, a nearly 500-mile journey, which will take less than three milliseconds. The project will help scientists answer questions about the neutrino's unique role as an elementary particle that may be simultaneously matter and antimatter.

Miller says that stimulus funds have put the project on a faster track than might otherwise have been expected. "We received much more money up front," he notes. "This allowed us to shorten the time schedule it took to get the building ready since the site prep and building work could all happen at the same time."

The NOvA project is intended to advance our understanding of the nature of matter itself, but the more than $40 million of stimulus money that it has brought to the University will also address some very practical economic concerns as well. In addition to involving scientific staff from some 28 institutions, NOvA will bring new jobs to the local economy of rural northern Minnesota. "Construction of the facility," said Miller "is expected to generate 60 to 80 jobs plus purchases of materials and services from U.S. companies." That's in addition to local staff that will be hired to maintain the facility and the 150 student jobs that are expected to be created by producing the 12,000 extruded PVC modules—each weighing a thousand pounds—that will be shipped to Ash River, glued together, and filled with scintillator oil, which is the actual medium used to track the progress of the elusive neutrinos.

Stimulus to the economy is desirable, of course, but the chief payoff of the project will always be scientific. "Our main goal," said Marvin Marshak, University professor of physics, "is to understand the matter/antimatter asymmetry in the universe." He adds, "The thing about basic research is that most of what gets done has little practical application. But, on the other hand, the economic impact of things that do have practical application is so major...but only in retrospect do we recognize it."

BILL MILLER

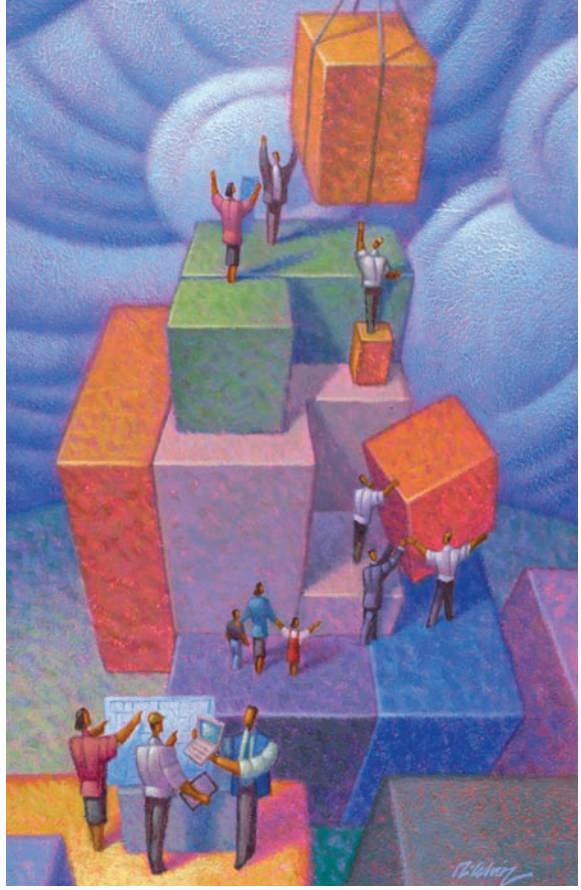


BILL MILLER

(Above) The north wall of the detector pit is in place. (Below) A larger view of the detector pit with concrete floor being laid. The construction is expected to generate 60 to 80 jobs in northern Minnesota.

ALUMNI REPORT
KEN FLOREN
CSE ALUMNI SOCIETY PRESIDENT

Mission—Create an engaged community



To create this strong vibrant organization of alumni members and friends who are engaged with the College of Science and Engineering, your participation and involvement is needed.

OUR COLLEGE'S ALUMNI SOCIETY was officially established 56 years ago as a constituent society of the Minnesota Alumni Association. During all those years, much has changed in how we communicate with our members, conduct our activities, and implement our programs, but the one thing that has remained constant is the basic mission of our organization—to cultivate an engaged community of alumni and friends to advance education, research, and outreach activities within the College of Science and Engineering.

Over the five years that I have served on the College of Science and Engineering Alumni Society Board of Directors, I have had the opportunity to become involved in setting the direction for our organization.

Every few years, the board of directors reviews the bylaws, goals, strategic plan, and programs to see if we are on the right path for the future. If not, we identify what needs to change.

We just completed that task this past summer, and I personally want to thank the eight members who volunteered for the job. Despite each committee member having a demanding day job, we met several times, which was a significant investment of their time. Throughout the process, our focus was to set our strategy toward achieving the goals below, which is the basis for our overall mission:

- To increase alumni engagement within the College of Science and Engineering and the University of Minnesota communities by enriching our students' experience at the University.
- To create a lifelong affinity by our students for the College of Science and Engineering as well as for their individual college disciplines. This is the objective that I have been most deeply involved in during three of my five years.
- To stimulate the interest of K-12 students in science, technology, engineering, and math (STEM). Our objective is to increase the numbers of students who choose STEM subjects as a career.
- To encourage industry partnerships with the College of Science and Engineering.

To create this strong vibrant organization of alumni members and friends who are engaged with the College of Science and Engineering, your participation and involvement is needed. There are many opportunities available that range from a few hours to a few years, depending on your level of interest.

For example, our award-winning Mentor Program, which kicks off each fall, is where you can inspire a young mind by just giving a few hours. It can be as simple as a telephone conversation, reviewing a resume, participating in a mock interview, or inviting a student to tour your facility.

Other activities include helping with student recruitment, offering career advice to students, participating in K-12 outreach initiatives, joining reunion planning committees, supporting the University's legislative network, and numerous other ways. The needs are great, and it takes many dedicated alumni to meet the goals of the Society and of the college.

The College of Science and Engineering Alumni Society is comprised of alumni who care deeply about the University and who have a passionate mission for advancing STEM education, research, and outreach activities.

As we celebrate our college's 75th anniversary this year, many events will recognize our college's long tradition of excellence. I encourage you to become an engaged alumnus.

For more information, visit the College of Science and Engineering website at cse.umn.edu or contact Alumni Relations Coordinator Liz Stadther at 612-626-1802 or via email at stadt001@umn.edu. ■

Volunteer for CSE Mentor Program

INSPIRE A CURRENT science and engineering student by volunteering for the College of Science and Engineering Mentor Program this academic year.

Once mentors and students are matched, they are asked to meet two to four hours per month during the academic year by phone, email or in person. The method of communication is decided between the mentor and the student.

The program begins with an initial meeting in October where students meet their alumni mentors, and ends with a wrap-up in April.

Mentoring relationships are intended to:

- be professional in nature;
- help students make the transition from an academic environment to the world of work;
- offer an opportunity for professional development, networking and an exchange of ideas between experienced professionals and the next generation of leaders.

To learn more about the program or to volunteer, please contact Liz Stadther at 612-626-1802 or via email at stadt001@umn.edu.

Stay connected by updating contact information

AS WE RELY more on electronic communications, help us to reach you by adding or updating your email address, and other contact information. This will help to insure that you receive relevant information from the College of Science and Engineering about news, upcoming events, and activities.

Visit cse.umn.edu, click on Alumni & Donors, then Alumni Services. There, you'll find a link entitled "Update your contact information now," which you can complete to add or change your information.

Paint the Town Gold this fall

RHONDA ZURN

Goldy Gopher and a future gopher share their maroon and gold spirit at the 2009 College of Science and Engineering Homecoming celebration, which was attended by more than than 800 alumni, family, and friends. Join us for this year's celebration on Oct. 1, hosted by Dean Steven L. Crouch and members of the CSE Alumni Society. The event—featuring food, student groups, and an opportunity to reconnect with friends and faculty—will be followed by the Homecoming parade, pep fest, and fireworks at the TCF Bank Stadium. Details will be sent soon and posted on our website.

Pichler receives alumni award

COMPUTER ENGINEERING alumnus Jim Pichler (CompE '92, M.S.S.E. '03) has been awarded the University of Minnesota Alumni Services Award recognizing his volunteer service to the University.

Over the years, Pichler has demonstrated his strong belief in giving back to the University of Minnesota. As president of the Institute of Technology Alumni Society (now the College of Science and Engineering Alumni Society), he led the organization and its committees to an Outstanding Society of the Year award from the University's Alumni Association. He also serves on the Department of Computer Science and Engineering's industry advisory board.

Among his accomplishments, he led the CSE Alumni Society K-12 Outreach Committee to expand its collaborative effort with Tech Fest, an annual event hosted by The Works, a children's museum located in Edina, Minn. The event showcases College of Science and Engineering departments and student projects.

In addition, he created a new CSE alumni society board communication committee that is leading the way toward an expanded volunteer program for CSE alumni; and has supported a multitude of activities for the college.

"Jim brings dedication and high energy to all of his endeavors, including a wide range of support activities for our college and the University of Minnesota. He has been a strong advocate and ambassador for this institution," said Dean Steven L. Crouch.

CSE Alumni Society
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

csealum@umn.edu
cse.umn.edu
612-626-1802
800-587-3884

Support students for careers of tomorrow

You'll be helping to turn a young student's scientific and engineering interests into a career they'll love, and benefiting our state and nation at the same time.

ON OCTOBER 19, 1935, in the midst of the Great Depression and during a time of great turmoil, the Institute of Technology was formed. Led by Samuel Lind, who served as the first dean, the college opened its doors to approximately 100 faculty members and approximately 1,974 undergraduate and 266 graduate students, creating a unique and innovative institution that combined earlier schools of engineering, mining, architecture, and chemistry.

Seventy-five years later, the Institute of Technology has changed and grown to become one of the top engineering schools in the nation. We now have more than 400 faculty members, 4,745 undergraduate and 2,699 graduate students, and a new name that better describes what we're all about—the College of Science and Engineering.

Today, our college is comprised of 12 academic departments offering a wide range of degree programs in engineering, science, and mathematics, which are tailored for the careers of today and tomorrow. Above all, our faculty, research associates, and students—among the best at the University, with an average ACT score of nearly 30—are leading the way in finding solutions to pressing global problems such as energy security, the environment, human health, and infrastructure.

As our college has grown, so has the cost of a world-class education.

In 1935, students paid $90 per academic year for tuition. This academic year, students will pay $12,288 in tuition and fees. The trajectory that started rising over the last decade is heading ever higher as a result of increased costs and a drastic reduction in state support.

Since 1999, tuition has doubled at the University of Minnesota. And last fall, for the first time in our history, the University drew less in state support than it collected in tuition.

With an average student debt load of more than $22,000, today's young adults who borrow money for college will be encumbered for years after they graduate. Increasingly, our students must rely on scholarships in order to attend college.

Thanks to the generous support from alumni and friends of the college, many College of Science and Engineering students have been fortunate to receive scholarships. Many have expressed how grateful they are about not having to worry about working to pay for tuition; instead they can focus on their studies. However, there is still a great need. Very few students can afford to pay for college without some form of educational financing.

I would like to encourage all of our alumni to help the next generation of scientists and engineers gain access to a world-class science and engineering education by making a gift in the amount that is right for you. You'll be helping to turn a student's scientific and engineering interests into a career they'll love, and benefiting our state and nation at the same time.

The University of Minnesota still offers a 1:1 match for donors wishing to endow scholarships at the $25,000+ level. Donors may also give to College of Science and Engineering Student Affairs Scholarships in any amount. Please consider helping the next generation of College of Science and Engineering students achieve their dream of becoming a scientist or engineering by making a scholarship gift.

As the College of Science and Engineering celebrates it 75th anniversary this year, we reflect on the tremendous leadership that has made the college what it is today. Our college's history encompasses the story of this great University as well as countless numbers of stories of individual achievement, of our students, alumni, faculty, staff, benefactors, and friends. Join us for one or more of the planned 75th anniversary celebration events that are listed on the opposite page. ■

Donors give generously

MORE THAN 5,400 College of Science and Engineering alumni, friends, corporate, and foundation donors gave gifts and pledges to the college this past fiscal year, totalling nearly $11 million.

Of the total received, $4.2 million was designated for academic program and faculty support; $3.9 for undergraduate student scholarships; $1.5 for graduate student fellowships; and nearly $1 million for research.

"In these current economic conditions, we are very pleased with the support shown by our donors," said Steven Crouch, dean of the College of Science and Engineering, "These gifts are crucial to maintaining our excellent programs, attracting top faculty and students, and supporting research that will solve pressing world problems."

Celebrate 75 years with us

THE COLLEGE OF SCIENCE AND ENGINEERING celebrates its 75th anniversary on October 19. You won't want to miss any of the following events that are currently being planned for alumni and friends. Be sure to mark your calendar. More information will be sent soon and updates will be posted to our web site at cse.umn. edu.

- **Homecoming Celebration**
  Friday, October 1
- **75th Anniversary Celebration on the mall**
  Tuesday, October 19
- **Science & Engineering Day**
  Thursday, February 24
- **50th and Golden Medallion Society Reunion**
  Thursday and Friday, May 5-6
- **Two public lectures**, planned for November and April (dates not yet set)

Student thankful for scholarship

Matthew Stolz

WHEN MATTHEW STOLZ came to the University of Minnesota, he did not expect to receive any scholarships.

However, after the College of Science and Engineering scholarship committee reviewed his strong academic record, Stoltz was awarded a Orville D. and Kathleen M. Johnson Scholarship before entering his freshman year.

"I was definitely surprised," Stolz said. "I was really pleased to have something like this right away when I started here."

Coming to the University from Forest Lake, Minn., Stolz said he knew he would have to work a large number of hours to keep up with tuition costs, which prompted him to start school working three different jobs. After he received news of being awarded the scholarship, Johnson was able revise his initial plan.

"It meant that I could work less and still afford the tuition," said Stolz.

With his tuition worries lessened, Stolz, a junior majoring in mechanical engineering, is able to completely focus on working toward his degree, which he will complete in the fall of 2011.

Stolz said the Orville D. and Kathleen M. Johnson Scholarship Fund will make it possible for him to complete the program in four years.

"The scholarship made school less stressful and gave me more time to dedicate to studying," Stolz said. "Getting my degree will be that much easier, and I'll be done sooner than I anticipated."

New Opportunity for 2010: Convert Your IRA

ONE FREQUENTLY OVERLOOKED way you can fund a charitable contribution to the College of Science and Engineering is by using your Individual Retirement Account (IRA). In 2010, some changes were made regarding IRA accounts that may provide a giving opportunity for you. IRAs can now be turned into Roth IRAs regardless of your income—prior to 2010, you could only do this if your adjusted gross income was $100,000 or less.

Any amount you withdraw from an IRA is typically taxable income to you, so being able to have a Roth IRA that you can access tax-free is a great advantage to you. A Roth IRA allows you to take funds from the plan income tax–free if you meet certain conditions, and you never have to take mandatory withdrawals during your lifetime.

When converting, you'll have to pay income tax on the IRA amount you convert, but you can pay half the taxes in 2011 and half in 2012. If your IRA is currently worth less than what it used to be, perhaps due to a market decline, it may be an opportune time to convert to a Roth. If it is worth less when you convert it, you'll pay tax on a smaller amount.

Contact your tax advisor and take this opportunity to expand your philanthropic desires by making a tax-deductible gift to the College of Science and Engineering to help offset the taxes generated by the Roth conversion. For more information, please contact Kim Dockter, external relations director, at 612-626-9385 or dockter@umn.edu.

DEVELOPMENT TEAM

The College of Science and Engineering's experienced development team can help you determine your best options for supporting the college.

Kim Dockter
External Relations Director
612-626-9385
dockter@umn.edu

Jennifer Clarke
Senior Development Officer
612-626-9354
jclarke@umn.edu

Steven Corkery
Corporate Relations Director
612-625-6798
scorkery@umn.edu

Anastacia Quinn Davis
Senior Development Officer
612-625-4509
aqdavis@umn.edu

Sally Euson
Senior Development Officer
612-625-6035
euson@umn.edu

Mary Mahto
External Relations Assistant
612-626-7637
mahto005@umn.edu

Kathy Peters-Martell
Senior Development Officer
612-626-8282
kpeters@umn.edu

Jennifer Pogatchnik
Senior Development Officer
612-626-9501
pogat005@umn.edu

Cheryl Pruden
External Relations Associate
612-624-5537
pruden@umn.edu

Office of Development
College of Science and Engineering
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

csedevelopment@umn.edu
cse.umn.edu
612-624-5537
800-587-3884

TO MAKE A GIFT

To support a project you've read about in *Inventing Tomorrow* or to designate a gift for any purpose, you may contact a development officer directly or call 800-587-3884 for more information.

Fluid dynamics research helps world

SAFL's rich legacy inspires future solutions for a wide range of world challenges and concerns

TUCKED AWAY ON AN ISLAND in the Mississippi River, a mile from campus, University scientists and engineers have been developing innovative solutions to the world's water and energy-related problems for more than 70 years.

Researchers at the St. Anthony Falls Laboratory (SAFL) apply their expertise in fluid dynamics to a wide range of concerns, such as optimizing renewable energy resources, restoring rivers and deltas, investigating impacts of climate change on lakes and streams, and improving designs for life-saving medical devices.

Visionary beginnings

While the University first explored developing a civil engineering hydraulic laboratory at St. Anthony Falls in 1908, it was not seriously pursued until the early 1930s. Their interest was sparked by Lorenz G. Straub, who came to the University in the fall of 1930 inspired by the hydraulic laboratories he studied in Germany. He envisioned a University-based institute that would not only serve as a place of education, but simultaneously pioneer new methods in water resources management.

Straub's vision became reality when President Franklin Roosevelt established the Works Progress Administration in 1935, enabling the University to begin constructing the lab on Hennepin Island the next year.

SAFL HISTORICAL ARCHIVES

Completed in 1938, the lab was built to enable researchers to use the river's natural 50-foot drop at the falls to route water to experimental models throughout the building. Straub became the first director of the St. Anthony Falls Hydraulic Laboratory.

Since its inception, SAFL has attracted researchers from all over the world who come to conduct research in its unique experimental facilities. Hundreds of undergraduate and graduate students, visiting scholars, and postdoctoral fellows have collaborated and conducted studies, enriching the fields of environmental fluid mechanics and water resources on an international level.

Pioneering sustainable water resources management

Engineers at SAFL have contributed to some of the world's largest hydropower and irrigation projects of the last century, such as Mangla Dam in West Pakistan and Guri Dam in Venezuela.

Between 1963 and 1977, under the leadership of former directors Edward Silberman, Alvin Anderson, and John Ripken, SAFL's strengths lay in the areas of hydraulics, stratified flows, turbulence, and hydrology. The lab also aimed to intensify an already robust naval hydrodynamics research program, and did so by recruiting a leader in this field, Professor Roger Arndt, as SAFL's fifth director.

Although research in hydraulic and river engineering continued throughout the following decades, Arndt's tenure (1977-1993) emphasized integrating education with basic and applied research. Under his leadership, laboratory research

SAFL HISTORICAL ARCHIVES

Lorenz G. Straub

Dubbed "**The River Doctor**," SAFL's founder and first director Lorenz G. Straub was internationally known for his ability to diagnose and recommend solutions for complex hydraulic engineering problems. While he maintained strict control of the laboratory—insisting that suits and ties be worn even while working on experiments—Straub's dedication to the lab was unquestioned. He passed away at his desk in 1963.

SAFL HISTORICAL ARCHIVES

THEN

(Far left) In 1953, SAFL built and conducted studies on a model of the Mayfield Hydroelectric Dam on the Cowlitz River near Tacoma, Wash. The project was led by then-director Lorenz Straub and engineer Sigurd Anderson. (Left) Image of an early study in SAFL's main channel facility, which measures six feet deep, nine feet wide, and 275 feet long.

expanded into new areas, such as computational fluid dynamics, cavitation, and wind engineering.

A Place to Call Home

From 1993 to 2005, led by directors Gary Parker and Efi Foufoula-Georgiou, and as environmental concerns took center stage, SAFL remained a pioneer, adding new faculty with expertise in the areas of sedimentary geology, eco-biological fluid dynamics, and atmospheric boundary layers. The word "Hydraulic" was dropped from the lab's name and SAFHL became SAFL in 1995; the following year the Department of Geology and Geophysics was added as the second affiliated department.

Decade-long efforts to broaden the lab's focus of emphasizing collaborative research in environmental, geophysical, and biological fluid mechanics led to establishing the National Center for Earth Surface Dynamics (NCED) in 2002. A National Science Foundation-sponsored Science and Technology Center, NCED's vision to transform the management of ecosystems, water resources, and land use was a natural extension of SAFL's interdisciplinary character and marked a new era for the laboratory. A growing emphasis on problems at the intersection of fluid mechanics and ecology led SAFL to add Ecology, Evolution, and Behavior as its third affiliated department in 2005.

Research in the energy-environment nexus

The laboratory, currently led by director Fotis Sotiropoulos, is continuing its expansion into new research areas in the energy-environment nexus. In 2008, SAFL and NCED jointly established the Outdoor StreamLab, a one-of-a-kind experimental facility for stream restoration which attracts students and scientists worldwide. In 2009, the U.S. Department of Energy awarded a SAFL-led industry/academe consortium a major grant to conduct research aimed at helping the U.S. achieve its goal of 20 percent wind power by 2030. Along with other new programs in hydrokinetic power and algal-based biofuels, this grant has helped to establish SAFL as a national leader in renewable energy research and a major hub for collaborations between academia and industry.

"Today SAFL continues to serve Straub's vision by emphasizing academic excellence and research scholarship, while staying at the cutting-edge of fluid mechanics research," Sotiropoulos said. "We are inspired by our rich legacy as we move forward to tackle the major sustainability challenges of our time, adding new pages to the history of this unique research facility." ■ BY MAIA HOMSTAD

NOW

The St. Anthony Falls Laboratory is the world's only fluid-mechanics laboratory that uses a natural waterfall as its prime water source. Researchers from around the world conduct studies here to develop innovative and sustainable engineering solutions to major environmental, water resources, and energy-related problems.

MAIA HOMSTAD

COLLEGE OF
Science & Engineering

University of Minnesota
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

Nonprofit Org.
U.S. Postage
P A I D
Minneapolis, MN
Permit No. 155

University of Minnesota Printing Services is a proud Forest Stewardship Council chain-of-custody certified printing supplier.

Search How does urban design affect public health?

UNIVERSITY OF MINNESOTA
Driven to Discover℠

Search Results Impact on pollution and exercise

Julian Marshall, assistant professor of civil engineering, is researching how much pollution people breathe from specific sources and the health benefits from reducing those emissions. In one study, he found that a neighborhood's design can influence walking and other exercise activities, as well as exposure to air pollution. In other work, he found that urban sprawl often increases rates of driving, which can increase air pollution. Taken together, these studies explore how good urban design can help improve public health.