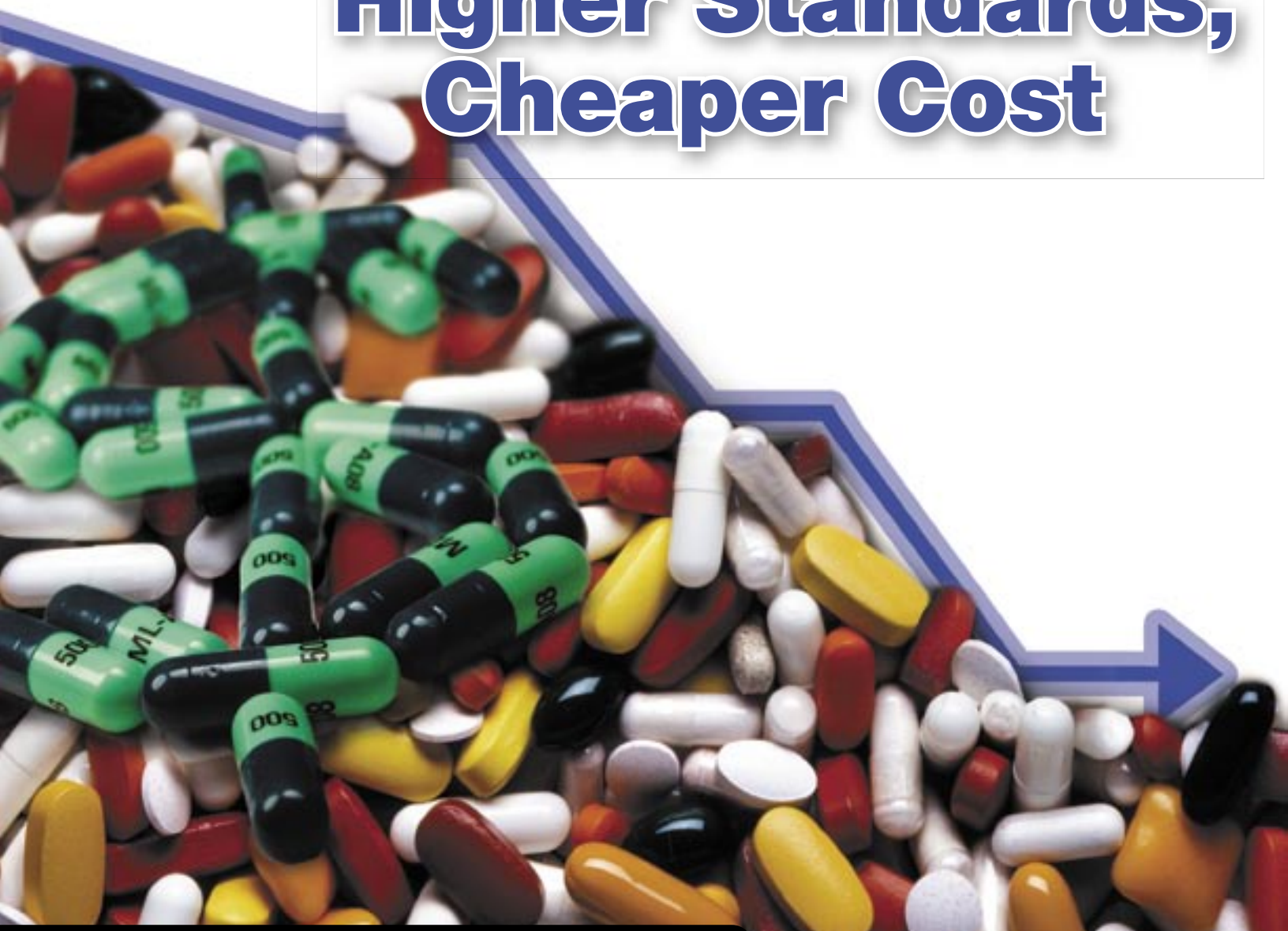
The Good News About Prescription Drugs

Higher Standards, Cheaper Cost



PURDUE **CHEMICAL**

ENGINEERING IMPACT

WINTER 2006-07

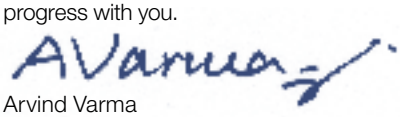
INSIDE THIS ISSUE:

On My Mind

Welcome to the new magazine for the School of Chemical Engineering. By partnering with the College of Engineering's alumni magazine, we will bring more focus to important topics in engineering—energy, healthcare, the environment—that impact our daily lives, and do so at a deeper and more personal level. In this inaugural issue, discover why it's an exciting time to be a chemical engineer and to be in chemical engineering at Purdue! We have added nine new faculty members since Fall 2003 and moved to a new $20 million Forney Hall addition in October 2004. Funded by the National Science Foundation, our new Engineering Research Center (ERC) for Structured Organic Composites is dedicated to researching and improving the way pharmaceuticals, foods, and agricultural products are developed, manufactured, and delivered throughout the world.

Continue to keep track of your fellow alumni on the school's Web site as well as read about all the exciting work of our faculty. This is also a special time because we are approaching the school's centennial anniversary of the chemical engineering curriculum. Please stay in touch, visit the school when you are on campus, and plan to join us for our centennial events in April.

Our vision remains to be the premier source of well-educated chemical engineers in the world. That vision can only be achieved with your help and involvement! We are excited about our future and our plans to excel as we grow. We will continue to share our progress with you.



Arvind Varma
R. Games Slayter Distinguished Professor and Head

Friday, April 13, 2007 (Gala Weekend)
Evolving Trends in Chemical Engineering Undergraduate Education: Opportunities and Challenges

Mark your calendar to celebrate 100 years of Purdue's chemical engineering curriculum. This day-long event includes tours of the Forney Hall of Chemical Engineering and Discovery Park. There will be a symposium and panel discussions about the historical evolution of Purdue ChE, innovative trends in engineering education, and the recruitment and retention of today's undergraduate students. The day concludes with a celebration dinner.

For more information, call (765) 494-4075. Information is also posted on our Web site at **https://engineering.purdue.edu/ChE**. Invitations will be mailed soon.

Tell Us What You Think

Share your Purdue memories, react to a story, or let us know your thoughts about a particular issue. Write to us at peimpact@purdue.edu. In doing so, you grant us permission to publish your letter in part or in whole in an upcoming issue. We reserve the right to edit letters for length and/or clarity.

PURDUE UNIVERSITY
COLLEGE OF ENGINEERING

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ChE Impact is published by the Purdue University School of Chemical Engineering for alumni, faculty, students, corporate partners, and friends. We welcome your comments. Please send them to the address at right:

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Faculty Honors

Winthrop E. Stone Distinguished Professor **Rakesh Agrawal** received the 2006 AIChE Award in Chemical Engineering Practice for his development of chemical processes and theory that have been implemented in numerous world-scale plants.

Ron Andres received the 2006 AIChE Nanoscale Science and Engineering Forum Award. The award was given for the first time last year, and Andres is the first academic to receive it.

The New York Catalysis Society awarded **W. Nicholas Delgass** its 2006 Excellence in Catalysis Award. The society recognized Delgass as a premier teacher, mentor, and collaborator whose "enthusiastic support of catalysis science and technology continues to inspire his many students, associates, and colleagues in the field."

Academic Advisory Board

The School of Chemical Engineering has formed an Academic Advisory Board to seek input on academic issues, which supplements the ongoing New Directions Industrial Advisory Council. It is expected to meet once annually. The inaugural board meeting occurred April 25-26, 2006.

The Academic Advisory Board members are (L-R): Ignacio Grossman, Rudolph R. and Florence Dean University Professor of Chemical Engineering, Carnegie-Mellon University; Michael Ramage, executive vice president, ExxonMobil (retired) Gregory Stephanopoulos, Bayer Professor of Chemical Engineering, MIT; Matthew Tirrell, Richard A. Auhll Professor and Dean of Engineering, UC-Santa Barbara; Alexis Bell, Warren and Katharine Schlinger Distinguished Professor, chair of Chemical Engineering, UC-Berkeley.

We're pleased to announce our alumni who've achieved distinction as leaders in their careers and who've shaped the profession:

2005 Outstanding Chemical Engineers

Robert Weist, BSChE '62

- Retired senior vice president of Amgen—the world's largest biotechnology company.
- Joined CPC International in 1967 as a senior patent attorney and then, in 1976, joined Abbot Laboratories as patent counsel for four divisions.
- Left Abbot Labs when a colleague formed a biotechnology company that would later become Amgen.
- Mr. Weist and his wife Sally recently established the Weist Foundation, seeding innovative approaches to education.

Arindam Bose, PhD '80

- Dr. Bose is the executive director of biologics strategy and alliance at Pfizer Global Research and Development.
- In the 1980s, Dr. Bose participated in the commercialization of processes for citric acid, penicillin, and recombinant chymosin—the first rDNA food additive approved by the FDA.
- He advanced Pfizer's biotechnology portfolio by forming global alliances.

Vincent Walter

Kenneth Morris (left) and G. V. “Rex” Reklaitis work to improve drug delivery processes.

MEDICINE

Given the agenda of the ERC for Structured Organic Composites, it could happen.

By **Linda Thomas Terhune**

Better malaria drugs. Faster treatment for cholera. Greater access to life-saving medicines. This could all be possible for populations in developing countries through work underway at the new Engineering Research Center (ERC) for Structured Organic Composites. The ERC, supported by a five-year, $15 million grant from the National Science Foundation, is dedicated to researching and improving the way pharmaceuticals, foods, and agricultural products are developed and manufactured.

The multi-university NSF center, a collaborative effort among Purdue, the New Jersey Institute of Technology, the University of Puerto Rico-Mayaguez, and Rutgers University, will draw from Purdue's strengths in pharmacy and engineering.

"By focusing on how to more efficiently manufacture structured materials in large quantities, we hope to find ways to keep drug costs down and make medicines more widely available around the globe," says G.V. "Rex" Reklaitis, Purdue's Edward W. Comings Professor of Chemical Engineering and the center's deputy director.

Purdue's Prabir Basu, executive director of the National Institute of Pharmaceutical Technology and Education—an 11-university research partnership with the Federal Drug Adminstration (FDA)—says that science, rather than politics or corporate policy, may hold the key to keeping drug costs down.

By improving the science and systems of manufacturing pharmaceuticals, engineers can help speed development and reduce costs. With existing technology, it currently takes 12 years—and as much as $1.7 billion—for a drug to travel the route from discovery to the pharmacy counter. Once a drug is approved by the FDA, the regulatory environment makes it difficult for companies to perfect the manufacturing process, inhibiting the introduction of cost-reducing improvements that other industries are free to make. The current high cost of drug production—and the regulatory environment—has become enough of a concern that advocates are working now to keep pharmaceutical research and manufacturing alive in the United States.

"There is a general concern that pharmaceutical companies will leave this country for cheaper manufacturing costs elsewhere," says Reklaitis, noting that Singapore, Ireland, and Puerto Rico offer enticing tax incentives.

Research at the ERC will focus on the structure of component materials, including particle shapes and sizes and the forces that bind them together, an area of science that is not well understood. Traditional product development methods use trial and error approaches to arrive at formulations with desired manufacturing and performance properties. Trial and error is costly. Researchers at the ERC will follow the lead of other industries and use mathematical models and simulations to predict performance and streamline the product development and manufacturing processes. Understandably, leading companies have an interest in the ERC's work; industry partners include Eli Lilly, Pfizer, GlaxoSmithKline, Abbott, PepsiCo-Quaker, and Merck.

continued on next page


Prabir Basu

The use of predictive models will ultimately increase efficiency in manufacturing structured materials in large quantities, which will reduce costs. Structured materials—medicines, fertilizer, and laundry detergents—consist of powdered solids that are glued together into tablets, capsules, or granular mixes.

In medicine, a 1-gram tablet may contain only 20 milligrams of active ingredient. The rest is filler and additives, called excipients, which are needed to deliver the active ingredient in a stable, usable form. Some excipients are used to "glue" the tablet together, some help it dissolve, and some may coat the tablet to prevent it from swelling with ambient moisture, according to Basu. Not much is understood about the properties of fillers, he says. But ERC modeling work could help solve the puzzle.

"Understanding the nature of these materials, how a molecular solid behaves, will provide a foundation for new manufacturing processes that are more predictable, consistent, and cost-effective," says Kenneth Morris, a Purdue professor and associate head of industrial and physical pharmacy and one of the center's leading investigators. Predictive models will allow companies to cut costs by more quickly identifying which drugs will succeed and which will fail.

The center will also explore new ways of delivering medicine, such as personalized medicine—custom pills gauged to a patient's specific weight and needs.

In addition to its research activities, the ERC will support educational initiatives including a new master's degree program in pharmaceutical engineering and is currently seeking funding for the support of new engineering faculty and graduate fellows.

The master's program would be under the direction of the Pharmaceutical Technology and Education Program funded by the State of Indiana's 21st Century Research and Technology Fund, seed money from the university administration, and support from Purdue's Center for Advanced Manufacturing. The interdisciplinary education effort would involve Industrial and Physical Pharmacy, Chemical Engineering, Mechanical Engineering, Materials Engineering, and the Dane O. Kildsig Center for Pharmaceutical Processing Research in the College of Pharmacy. Students could enter the program through either pharmacy or engineering tracks.

Purdue's unique combination of pharmaceutical technology, engineering, pharmaceutical analysis, pharmaceutical engineering, and regulatory education is unmatched, say program administrators. Drawing on these strengths, the new ERC will position Purdue to meet the educational and research needs of the pharmaceutical industry for years to come. ■

in my view

As someone who has spent 20 years in the pharmaceutical industry, I was extremely excited by the recent announcement of the new Engineering Research Center (ERC) that is described in this edition of *ChE Impact*. The new ERC for Structured Organic Composites focuses on improving methods for manufacturing pharmaceutical tablets and capsules. The National Science Foundation supports only a handful of ERCs, and Purdue's leadership role in this one gives us all another reason to brag about being Boilermakers.

The wonder of a career in the pharmaceutical business is the chance to contribute to improving the quality of people's lives. The responsibility that comes with that is to bring medicine to the marketplace with low risk and low cost. There is a compelling societal need for our industry to continue to be successful, but we won't be without new thinking and cutting-edge science.

That is why I am so encouraged by the fact that the ERC will be built on the collaboration of people from multiple disciplines and multiple universities. Both academia and industry are finding that today's exciting science and business opportunities are at the interfaces between groups. To successfully improve quality and cost, the people working in the ERC need to understand pharmacology, fluid dynamics, and materials science. They also need to understand the financial constraints and regulatory requirements.

In the pharmaceutical industry, chemical engineers are taking on more interdisciplinary roles as well. We find ourselves working on biotechnology and formulation processes more often than traditional chemical unit operations. We find ourselves working as much on business process improvement as physical process improvement. Because of our good analytical skills and our technical foundation, we are increasingly being asked to do technical transfers to third parties, quality and Six Sigma improvement projects, and even enterprise risk assessments.

Enterprises like this new ERC and Discovery Park give Purdue's students and faculty a chance to develop a range of skills. The future generations of Purdue Engineering students will no doubt learn some useful lessons by watching faculty work in collaborative and creative ways in both of those venues. The increasing emphasis on teamwork and improved engineering education methods will help round out the technical skills alumni and faculty have long demonstrated. My industry and most others are counting on it.

■ **Ellen Toblas**

Ellen Tobias is the executive director for health, safety, and environmental affairs for Eli Lilly and Company, headquartered in Indianapolis, Indiana. She graduated from Purdue in 1983 with a bachelor's degree in chemical engineering.

Engineers for the Global Community

Professors Mike Harris and Stephen Beaudoin work for a more inclusive, diverse student body.

The National Academy of Engineering reports that the engineering profession is changing to adapt to a world that, by 2050, will include 8 billion to 9 billion people living in developing countries—a world where, 20 to 30 years into the future, the most popular language on Earth will not be English. The academy projects big, broad changes in demographics, economics, and commerce. Due to these changes, the engineering student who's taught in our classrooms today will have a completely different scenario to work in tomorrow.

"Engineers will need to know how to address or solve a variety of problems, and that will mean working within diverse teams with varying perspectives," says Mike Harris, interim associate dean for undergraduate education and professor of chemical engineering. Stephen Beaudoin, professor of chemical engineering, adds, "Our students are employed by a worldwide business community. They have to be citizens of the world, and we have to provide them an early foundation to do so."

That's why Harris (as former chair of graduate recruiting in the School of Chemical Engineering) and Beaudoin are spearheading the school's efforts to recruit and retain graduate and undergraduate students who reflect today's populations. "I think we need to almost double the percentage of women and minorities in our classrooms and labs," says Harris.

The school is taking the initiative to broaden its student recruitment and diversity, an effort that's historically been made at the college level. "I'm taking a trip this fall to Houston [an area that is teeming with oil and gas companies hungry for chemical engineering graduates] to visit five schools in that area," says Beaudoin. "We're partnering with companies and high schools to find students and to get them excited about chemical engineering and Purdue. When students graduate from Purdue, they'll go back to our partner companies to work."

Harris says, "We are also making contacts with historically black colleges to recruit at those institutions, and we host students at Purdue each fall who are interested in the chemical engineering field."

A Great Place to Call Home

Campus climate is an important factor in recruiting underrepresented minority students. These recruits often ask if the campus is friendly for women and minority students.

"I tell students that Purdue is the founding site of the National Society of Black Engineers and is home to the nation's first Women in Engineering and Minority Engineering programs. They're often impressed," says Harris. "Although Purdue is struggling in minority recruitment, students who come here trust our program because they have the faculty and peer mentors and the organizations to support their work."

Beaudoin, a member of a university-wide diversity task force, is aware that issues of race, gender, and ethnicity have negatively impacted students on campus, but believes that students in Chemical Engineering feel at home and those incidences are rare.

In fact, Beaudoin and Harris say that students in the school work well with their peers to complete common goals—with the mentality that everyone is a Purdue student and colleague, regardless of background. Expectations among students, Beaudoin says, are based on formed relationships, not on status. "Having an attitude of acceptance and appreciation for all backgrounds is a vital component to the success of our students in their careers," he says. "Many minority students come here with an expectation that Purdue won't be welcoming, and our goal is to partner with the students and change that perception. I think we're succeeding."

Vincent Walter

Building diversity: Professors Mike Harris and Stephen Beaudoin with Talesha Hall.

Talesha Hall, a graduate student in Chemical Engineering with a prestigious NSF fellowship, came here from Baltimore because of the faculty and research. "After several visits, I felt the most comfortable about Purdue," she says. "During my time at Purdue, I've been able to get through difficult challenges with the help of my classmates. I also had some difficulty deciding if I wanted to continue on the PhD track. Professors Mike Harris and Steve Beaudoin were instrumental in keeping me on board."

She adds, "I would tell potential students that Purdue's chemical engineering program is very challenging, but the education and experience you receive is second to none."

Lee Lamb

Six Questions for Don Orr

Don Orr (BSChE '61, MSIA '65, Honorary Doctorate 2006) sat down with us to reflect on his time at Purdue, his distinguished 31-year career at Air Products, Chemical Engineering's future, and how he felt when receiving Purdue's honorary doctorate.

1962-1963	Lieutenant, U.S. Army Chemical Corps	1995	Krannert Distinguished Alumnus Award
1965-1997	Air Products and Chemicals, Inc.	2004	Purdue Engineering Alumni Association Service Award
1989	Distinguished Engineering Alumnus Award	2006	Honorary Doctorate, Purdue University
1993	Outstanding Chemical Engineer Award		

Q: What initially drew you to engineering and to Purdue?

I grew up in Wooster, Ohio, a small town south of Cleveland. In school, I enjoyed and did well in math and science courses. As I recall, there was a lot of favorable press about careers in engineering, and my father certainly encouraged me to look in that direction. Purdue seemed to be the best fit for a number of reasons and, in retrospect, a lucky decision. Almost everything I achieved in my career is attributable to things I gained at Purdue as an undergraduate and graduate student: a sound underpinning in the basics of chemical engineering and industrial administration, managing time, and a good work ethic.

Q: Any fond memories?

I have many fond memories of my time at Purdue, including some that weren't so good at the time: pulling "all-nighters," studying for a thermo or physics test, or enduring physical chemistry challenges from the infamous Herschel Hunt. Most of my free time at Purdue was spent working at the *Purdue Exponent* as a sportswriter (sports editor in my senior year) and as rush chairman of my social fraternity, Pi Kappa Alpha. But my best memory of Purdue is definitely meeting Nancy, my wife of 45 years. Another: working with Rex Reklaitis, Tina McConnell, and a great team of alumni on the successful capital campaign to build the new Forney Hall addition.

Q: Where did life take you after graduation?

After graduation, I worked six months as a refinery technical service engineer for Standard Oil of California, served a two-year commitment as a lieutenant in the U.S. Army at the Army Chemical Center in Maryland, and spent about a year with a natural gas pipeline company in St. Louis. I came back to Purdue for graduate school at Krannert. Afterwards, I went to work for Air Products and Chemicals headquartered in Allentown, Pennsylvania—retiring as senior corporate vice president.

Q: Tell us about your career at Air Products.

I spent 31 years at Air Products in various technology and management positions. During that period, Air Products grew from annual sales of $125 million to $6 billion, so there was a lot of change. Many of my jobs involved the development of new businesses and troubleshooting for existing businesses. Two important successes I'd note are extending our domestic chemicals business into a successful international business and recruiting and developing people to handle our rapidly growing businesses.

Q: What was your reaction to receiving the honorary doctorate?

It was a total surprise. I always considered that what I'd done in my career and for Purdue was expected and nothing out of the ordinary. Much of what I've accomplished resulted from my education and experiences at Purdue. My work on behalf of Chemical Engineering (and Krannert) is only a partial payback for the benefits I received. Needless to say, I consider the award to be a tremendous honor.

Q: How do you see Chemical Engineering responding to new challenges?

I've had a significant involvement with Purdue Chemical Engineering ever since graduation, and I've seen many changes as Purdue responded to a changing, competitive environment. A focus on industry needs, new technology, faculty recruitment, facility improvement, and funding have kept Purdue at the forefront of chemical engineering. But the world does not stand still, and Chemical Engineering will have to respond well to change. I have full confidence that the administration, faculty, alumni, and students will respond to that challenge.

■ **As told to Lee Lamb**

2006 Distinguished Engineering Alumni

Max C. Downham (BSChE '58):
Currently the executive director of the International College of Surgeons, Downham served previously as corporate vice president for NutraSweet, where he helped win FDA approval for the product and marketed it globally.

Robert N. Davis (BSChE '68):
Serving as Air Products and Chemicals' director of technology commercialization, Davis has led innovative products (one involving the potential commercial use of methane as transportation fuel), formed strategic alliances with other companies, and launched a diversity training program. ■ **Lisa Tally**

Purdue's AIChE Student Chapter Hosts Regional Conference

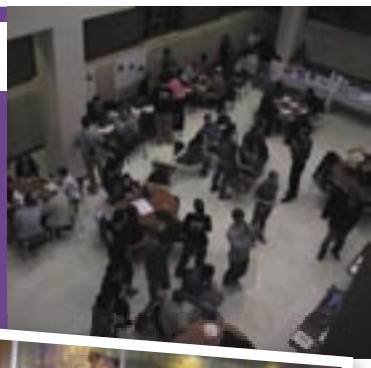
Purdue's student chapter of the American Institute of Chemical Engineers (AIChE) hosted the AIChE regional conference from March 31 to April 2, 2006. More than 150 students and professionals from nearby universities and companies attended the conference.

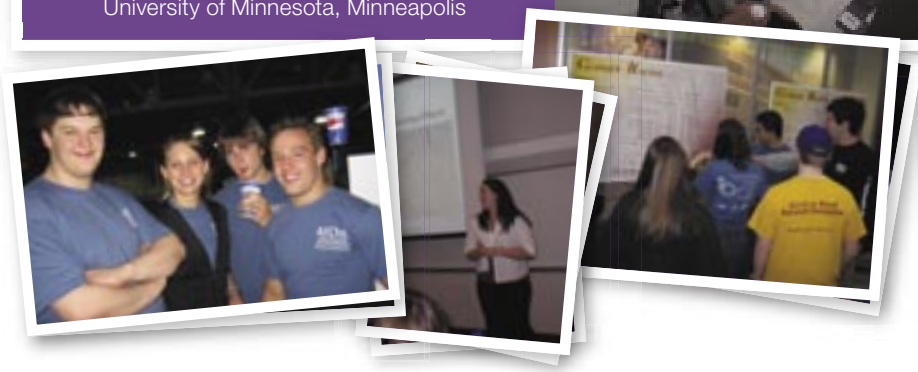
Purdue's Chemical Engineering students brought corporate professionals and students together to network, showcase their talents, explore the exciting frontiers of chemical engineering, and access the reservoir of knowledge and talent found in the Midwest's chemical engineering community.

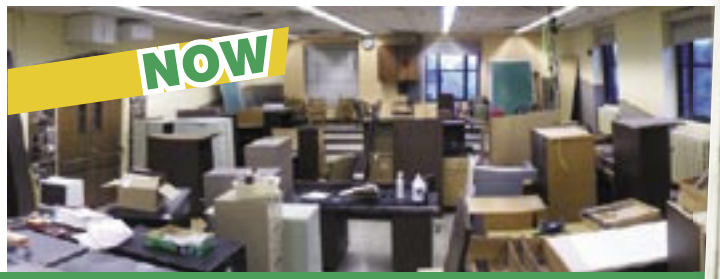
Events during the two-day conference included a tour of the Eli Lilly plant located in West Lafayette, a regional student paper competition, and the Chem-E Car competition—which provided chemical engineering students an opportunity to participate in a team-oriented design and construction of a small, chemical-powered model car. ■ **L.L.**

2006 AIChE North Regional Conference Universities in Attendance

Purdue University
University of Illinois, Urbana-Champaign
Michigan State University
University of Michigan
University of Dayton
University of Iowa
Ohio State University
University of Minnesota, Minneapolis







Before and after

Davidson Gift Gives Old Room a New Lease on Life

Chuck (BSChE '72) and Nancy Davidson's continued support of the School of Chemical Engineering is simply a way to return the favor. "Nancy and I have always believed in supporting our universities that helped prepare both of us for our future endeavors," says Davidson. "The driver for us is to help future students continue to receive the high-quality education that Purdue and its School of Chemical Engineering provide."

The Davidson gift that will help renovate room 302—currently a storage space for old desks and office furniture—into an executive board room is part of the larger effort to renovate the older wing of Forney Hall. Davidson explains, "We had been supporters of the new building construction, and we wanted to ensure that the entire renovation process is a success."

"The biggest impact this large executive conference room will have involves providing space to accommodate the number of people on our multidisciplinary research projects teams," says Arvind Varma, head of Chemical Engineering. "In addition, we'll have an appropriate space for faculty, staff, and student meetings, visitor presentations, and advisory council meetings." ■ **L.L.**

aperture

Cultured neurons are growing on a biomaterial surface designed to function as an interface between the cells and the electrodes of an implantable device. Together the neurons and the electrical device will be implanted into regions of the brain that are responsible for seizure. See page 13 (college side) to learn more about this Purdue Engineering research.