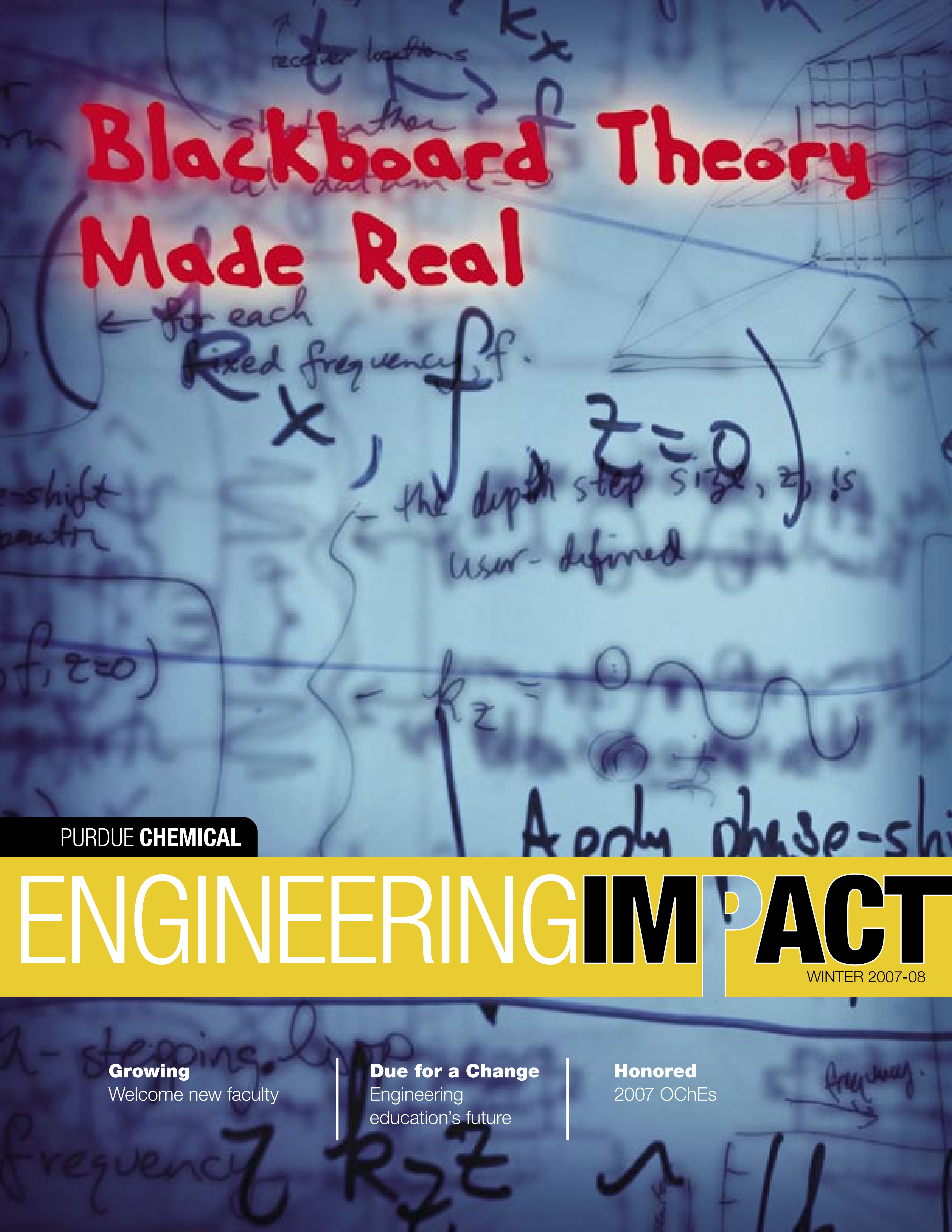

Blackboard Theory Made Real

PURDUE **CHEMICAL**

ENGINEERING**IMPACT**

WINTER 2007-08

Growing
Welcome new faculty

Due for a Change
Engineering education's future

Honored
2007 OChEs

up front

On My Mind

Welcome to the latest *Chemical Engineering Impact* magazine! In this issue, we focus on our educational innovation. Read about our Fundamentals Laboratory, a pioneering hands-on laboratory experience for juniors, and about our faculty and alumni who are leading the way in engineering education. We're pleased that our school's faculty continues to refine and reshape our curriculum and programs to maintain the university's leadership position in chemical engineering education.

This past summer, we launched an NSF-supported Research Experience for Undergraduates (REU) program to provide outstanding undergraduates from Purdue and across the country an opportunity to conduct research alongside our faculty. The story of one of our REU students is included.

We invite you to visit us in Forney Hall when you are on campus. Come see our beautiful and functional addition! The older building is currently under renovation, and most of it will be completed during the next year.

Our vision remains to be the premier source of well-educated chemical engineers and high-impact research in the world. That vision can only be achieved with your help and involvement. We are ushering in a new period of unbounded growth and potential in chemical engineering at Purdue. And we will continue to celebrate our progress with you.

Also, please detach and complete the enclosed mailer and send us your news. Future editions of our magazine will include a section on alumni news that's based on your replies.

We hope to see you on campus soon!

Arvind Varma
R. Games Slayter Distinguished Professor and Head

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

School of Chemical Engineering

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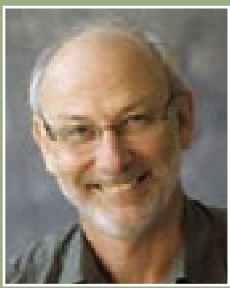
Welcome To Our New Faculty!

Dr. James D. Litster



James Lister comes to us from the University of Queensland, where he served as the director of the Particle and System Design Center, the head of the Department of Chemical Engineering, and the head of the School of Engineering. Litster's research interests are in the area of particle technology, including particle design and formulation for pharmaceutical applications. He also has interests and experience in implementing educational innovations.

Dr. Julie C. Liu

After completing her postdoctoral studies at the University of Massachusetts Medical School, Julie Liu will join the ChE faculty as an assistant professor in January 2008. She received her doctoral degree from the California Institute of Technology in 2006. Liu's research interests are in biomaterials, tissue engineering, and protein engineering.

Alumni Notes

Antonios G. Mikos
(PhD '88) received the 2007 Alpha Chi Sigma Award for Chemical Engineering Research from AIChE, recognizing him for pioneering contributions to biomolecular engineering, tissue engineering, biomaterials, and drug delivery systems. Mikos is the J. W. Cox Professor of Bioengineering and a professor of chemical and biomolecular engineering at Rice University.

E. Terry Papoutsakis
(MSChE '77, PhD '79), the Eugene DuPont Professor of Chemical Engineering and DBI fellow at the University of Delaware, received the 2007 James M. Van Lanen Distinguished Service Award from the Biochemical Technology Division of the American Chemical Society.

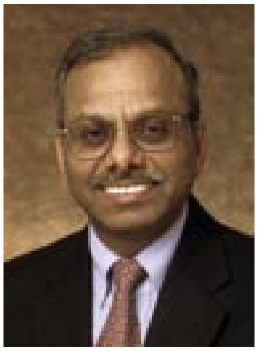
Julia M. Ross
(BSChE '90) received the 2007 ASEE Sharon Keillor Award for Women in Engineering Education. The award recognizes her exceptional contributions as a researcher, educator, and administrator. Ross is currently professor and chair of the Chemical and Biochemical Engineering Department at the University of Maryland.

Jennifer Sinclair-Curtis
(BSChE '83), professor and chair of the Department of Chemical Engineering at the University of Florida, received the 2007 Particle Forum Lectureship Award in Fluidization from AIChE. The award recognizes an individual's research contributions in the field of fluidization and fluid-particle flow technology.

Vern W. Weekman Jr.
(BSChE '53, PhD '63) was one of three recipients of an honorary doctorate in engineering from Purdue on May 12th, 2007. Weekman, a member of the National Academy of Engineering, was recognized for his distinguished career in the energy and petrochemical industries, and for his leadership in AIChE.

Faculty Notes

Agrawal Receives IRI Achievement Award



Rakesh Agrawal, the Winthrop E. Stone Distinguished Professor, was selected as the 2007 Industrial Research Institute (IRI) Achievement Award recipient. The award recognizes accomplishments in individual innovation and creativity that contribute broadly to the development of industry and to the benefit of society.

Honored by Gifts

On June 30, 2007, then Purdue president Martin Jischke hosted a special celebration in the Forney Hall of Chemical Engineering to honor a great alumnus from the School of Chemical Engineering and his wife who are helping Purdue accomplish its vision for the future.

At the celebration, Jischke stated that Purdue has long been home to one of the great engineering colleges in the nation and, in fact, the world. He emphasized that we should not rest: Purdue Engineering should continue striving to push the boundaries of technology and education even farther, and have an even greater impact on the world in the years ahead.

Bob and Adeline "Coc" Henson have given Purdue's School of Chemical Engineering more than $6 million to continue this bold vision for the school and college. In recognition of their generosity, the new atrium in the Forney Hall addition, where the June celebration took place, was named the Robert T. Henson Atrium. Bob Henson (BSChE '34) is an entrepreneur who co-founded Flexible Products in 1951. By the time it was sold to Dow Chemical in 2000, it had grown to become one of the largest polyurethane suppliers in North America.

The celebration culminated with Jischke presenting one of the Purdue's highest honors to the Hensons: the President's Council Pinnacle Award. In 1989, Bob received the school's first Outstanding Chemical Engineer Award.

Bob and Coc Henson

Robert T. Henson Atrium

Every Gift Counts

Alumni gifts to the School of Chemical Engineering are critical, and each gift makes a tremendous impact on the school. With state funding decreasing, ChE operates (excluding salaries) essentially entirely using gifts from alumni and friends. This includes running student laboratories, purchasing computers and software, programs, and awarding scholarships. We are proud to have such loyal and generous alumni who value the education they received at Purdue. Many thanks to all for the many contributions and investments made on behalf of future chemical engineers. ■ **Shari Schrader**

To make your gift online, visit http://engineering.purdue.edu/che and click "Giving."

We're Due for a Change

Christopher Bowman
(BSChE '88, PhD '91)
is the associate dean for research and the Patten Endowed Chair of Chemical and Biological Engineering at the University of Colorado at Boulder. He received the American Society of Engineering Education Curtis W. McGraw Award in 2000, the American Institute of Chemical Engineers Allan P. Colburn and R. H. Wilhelm awards, and the "Inventor of the Year" award from the University of Colorado in 2003.

The last issue of *Impact* talked about the increasing importance of establishing international connections for students and faculty—not only within the sphere of education, but also research.

I would like to continue the discussion by suggesting that the stage is set perfectly for an upheaval within engineering education to occur throughout the next 20 years. Statistics from the National Science Foundation ominously warn that those who earned their science and engineering degrees in the 1960s and 1970s are reaching the latter part of their careers, leaving a significant void to be filled within the nation's science and engineering infrastructure.

With the age demographics of the current engineering population and the expected growth of internationalization, the educational approach to engineering needs to evolve rapidly to accommodate increasing numbers, while simultaneously developing educational programs that enable graduating engineers to serve a diverse range of global customers.

These developments will occur at both the undergraduate and graduate levels, with chemical engineering likely to experience additional turmoil associated with determining its role in the biological engineering arena.

The coordination of industry, academia, and government efforts to recruit and increase the number of diverse students entering the engineering profession is critical to maintaining the United States' technological leadership. As those increasing numbers of students arrive on campus, each one will require more individualized training—from customized educational programs that facilitate more significant international exposure and education to individualized research experiences for every student that facilitate education in the discovery-based learning process to a broader educational program that enables students to tailor their education.

Engineers will need to be trained to succeed in a far more diverse environment, with diversity among the people and cultures with which they will work and in the problems they will be asked to solve. It is clear that the most important problems of the next generation will rarely arise from—or be solved by—engineers from a single, relatively narrow discipline. Rather, chemical engineers, as they have been throughout their history, will be called on to serve as technical intermediaries at the highest levels.

Because of its unique access to resources, its traditional educational excellence, and its well-established connections throughout the international chemical engineering community, Purdue has a tremendous opportunity to lead the nation in these changes. ■

Blackboard Concepts Come to Life

Chemical Engineering's new fundamentals lab gives abstract theory real meaning.

By Lee Lamb

Point-and-Click Generation

There are 14.5 million students enrolled in colleges and universities across the United States, and most are educated in typical classrooms with a blackboard or whiteboard, row after row of desks, and a professor taking questions from blank-faced students trying to understand the "stuff" written in white chalk on the board.

"Most people prefer visual learning and have better retention when it's used. Students must actively grapple with the material," says Phil Wankat, the Clifton L. Lovell Distinguished Professor of Chemical Engineering, who holds a joint appointment in Engineering Education and is a co-author of *Teaching Engineering*. He urges engineering professors to think better of using the traditional lecture as a stand-alone.

Purdue's freshman engineers were born the year the personal computer was introduced to the public. A Pew Research poll in 2002 found that 20 percent of today's college-aged population began using personal computers at the age of five, and that all had begun using a computer by the age of 16. Jim Caruthers, professor of chemical engineering, calls this the point-and-click generation—one in which the computer has replaced the workbench and the tools used by professional engineers educated in the 19th and 20th centuries.

Caruthers recalls his own youth when his dad took him out regularly to work on cars. "My dad showed me how to change a spark plug, change the car brakes. We went out and did mechanical things together," he says. "Today's engineering student often has never touched anything mechanical with their hands prior to joining Purdue. They come here and get lecture courses and more than likely don't touch anything until their senior year."

Fifty or 60 years ago, engineering education was hands-on. But the rising cost of higher education (especially in chemical engineering, where the cost of handling chemicals has become more expensive) and cuts in government funding have led to the erosion of experiential learning. Practically speaking, large laboratories—where students early in their academic careers can have hands-on experiences—are money pits, in terms of the cost of people and space.

"Definitely, the cost of the people to run a lab is the most important consideration," Caruthers explains. "Another course in the curriculum means needing another faculty member to teach and additional technicians to run the experiments."

American universities today also have different missions—where research often takes priority over education. With the cost pressures of having a dedicated learning laboratory and an ever-expanding university mission, hands-on learning has become less of a priority. Until now.

Problem Solved

When Chemical Engineering's new Forney Hall addition was under construction in 2002, it gave the school a chance to rethink its curriculum. "What we were working on then was a delivery process," says Caruthers. "How can we deliver a hands-on education in a way that's cost-effective in terms of space and cost of instructors and technicians to run it?"

Folks in the school had a light-bulb moment, and the idea of the Fundamentals Laboratory was born—an ideal delivery mechanism for hands-on learning to supplement the theory students learn in their lecture courses. The lab, which was put to the test during its first round of classes last year, teaches students through active demonstration of lecture concepts. "We're able to illustrate four basic principles in three courses using the same lab and technician, and we need no new faculty members because this is just added into the existing curriculum," says Caruthers.

"In the usual lecture format that dominates engineering education, students are generally led to learn most basic concepts without the opportunity to see a visual demonstration of how they manifest in real-life experience," says Arvind Varma, the R. Games Slayter Distinguished Professor and head of Chemical Engineering. "Consequently, the concepts are left ill-understood, making the understanding of more advanced courses even more difficult."

The ultimate purpose of the fundamentals lab is to give students examples of what's happening in the lecture—and why it makes sense.

"For some students, blackboard education is fine. But for most, a hands-on component is an essential piece," says Caruthers. "I can stand at the board and say, 'This is the conservation-of-energy principle,' and know in my heart that it works. I can write the algebraic equation and show data from the literature, but ultimately the student will not understand why in the world it matters.'"

Abstract Theory Made Tangible

The three courses the lab serves are fluid mechanics, heat and mass transfer, and reaction engineering. In essence, the fundamentals lab brings the hard-to-grasp blackboard concepts of these courses to life.

"In each of these courses, we have four experiments that, again, illustrate very basic principles," explains Caruthers. "In lecture we might discuss the basics of heat conduction and how heat moves down a pipe or rod. Then we'll go into the lab and measure the phenomenon."

From Monday to Thursday, students use the lab and do their experiments in a number of sessions. On Friday, the lab is empty, giving time for the technician to set up eight new experiments and put the old ones in a storage area next to the lab. The process repeats itself 12 times over the course of the semester.

David Corti, associate professor of chemical engineering, was the school's second professor to use the lab last semester with 88 students. "The lab is in a sense an interactive demo—students see these equations learned in class happening in front of their own eyes," he says. "I hope it also demonstrates that we deal with equations not for the sake of doing math, but that equations actually describe what's going on."

The lecture-with-lab combination does more than bring the abstract to life. It teaches valuable lessons to the students, mainly that getting measurements in a lab is a difficult process and requires careful and sometimes slow experiments. "Students don't think about how time-consuming it is to get important data," says Corti. "The students are now getting more experience working in teams, and in writing lab reports. This is an important educational component that was lacking for the most part in how we taught these courses in the past."

Corti and Caruthers both agree that the lab is also a positive experience for the teacher. It allows for more student and teacher interaction, which gives the professor a better way to engage students that can't be done in a lecture.

As one student notes in the always candid class survey: "I think the lab is a GREAT learning tool. It helped me to match the theory and lecture material with the real world. It should be kept." ■

Simulating Graduate School

Research experience gives a preview of graduate school to undergraduates.

When two materials are brought together, the surface between them is called an interface. But, what do you call it when you bring 11 students from around the country and 11 faculty members from the Schools of Chemical and Mechanical Engineering together? At Purdue, it's called the Research Experience for Undergraduates (REU). But the undergraduate students involved just call it an amazing opportunity.

For chemical engineering junior Claire Kubinski, the chance to spend a summer conducting research with her faculty mentor, Jim Caruthers, was a blessing in disguise. "I was having difficulty procuring an internship for the summer, and I was starting to get worried," says Kubinski. "Caruthers suggested I work with him through the REU program. It's great it worked out that way; the experience was incredible."

According to Steve Beaudoin, professor and associate head of chemical engineering, who helped implement the program, the focus of the REU is to get students excited about interfaces, an area of research that is extremely important in both the near and long term. "We recruited students from around the country and put them in an interdisciplinary environment. We tried to make the program like a real graduate school experience," he says.

This meant students involved in the program had the opportunity to help design and conduct an experiment and also analyze and discuss the results. "The research I conducted over the summer dealt with the viscoelastic deformation behavior of materials," explains Kubinski. "The material I used in all of my testing was polymethylmethacrylate, also known as Plexiglass."

Not only did students conduct their own research, but they also gave oral presentations to their peers and guests at a symposium that was held at the end of the summer. "I was never what you would call an apt public speaker," says Kubinski. "So, the presentation allowed me to work on my speaking and communication skills on a technical level and develop confidence in front of a technical audience that I am sure will help me in the future."

Beaudoin hopes that the benefits don't stop there for the students involved: "I expect that some of these students will end up as coauthors on journal articles. Many of them will be coauthors on presentations at technical conferences and perhaps some will end up on patents. We tried to set it up so the students would be making significant contributions to the field." Kubinski's research is already being used by Rebecca Martin, a graduate student in chemical engineering, who is using the data in her thesis.

"It was exciting to be able to contribute to the engineering community even though I am still an undergraduate. Kubinski says, "I got to spend my summer doing something that was worthwhile and mattered. The experience really helped me to grow and opened up so many possibilities for my future. Because of this experience, I'm pretty sure that my next step will be graduate school." ■ **Kristen Senior**

2007 Outstanding Chemical Engineers

Pierre R. Latour (MSChE '64, PhD '66)

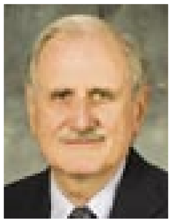
Pierre Latour is the founder and current president of CLIFFTENT, Inc., and serves as director of Advanced Extraction Technologies, Inc.

Latour began his chemical engineering career by earning his bachelor's degree from the Virginia Polytechnic Institute and both a master's and doctoral degree from Purdue.

Latour has served more than 60 companies in positions ranging from marketing coordinator to consultant to executive. And, in addition to CLIFFTENT, he is the co-founder of these companies: Biles & Associates (1971); Setpoint (1977); and Setpoint Japan (1984). He devoted 18 years as a vice president at Setpoint before retiring to lead CLIFFTENT.

Latour was named *Control* magazine's Engineer of the Year in 1999.

Duncan A. Mellichamp (PhD '64)



Duncan Mellichamp is an emeritus professor of chemical engineering at the University of California, Santa Barbara (UCSB). He earned his bachelor's degree from Georgia Tech in 1959, PhD from Purdue in 1964, and has been a devoted faculty member at UCSB for 40 years. He is the author of more than 100 research publications on process modeling, large-scale systems analysis, and computer control.

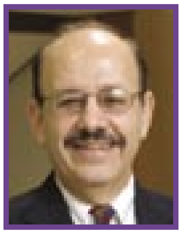
From 1997 until his July 2003 retirement, he served as special assistant to Henry Yang, chancellor of UCSB, who previously served as the dean of Purdue Engineering.

Mellichamp and his wife, Suzanne, recently endowed an undergraduate scholarship in Purdue's School of Chemical Engineering.

Read more on our home page at: engineering.purdue.edu/ChE

Engineering Human Breath

Chemical engineering research benefits those with respiratory illness.



The next time you take a breath—and you will breathe an average of 20 times a minute—think of Elias Franses, a professor of chemical engineering.

For the last 20 years, Franses has focused his attention on human lungs, a departure from the field that brought him to the Purdue faculty in 1979. At that time, he was a specialist in interfacial phenomena and surfactants as applied to enhanced oil recovery. A few years later, though, funding for oil research was cut back, and he took a detour into applications of engineering to problems in medicine. What he thought might be a two-year distraction has turned into a two-decade fascination with human lungs.

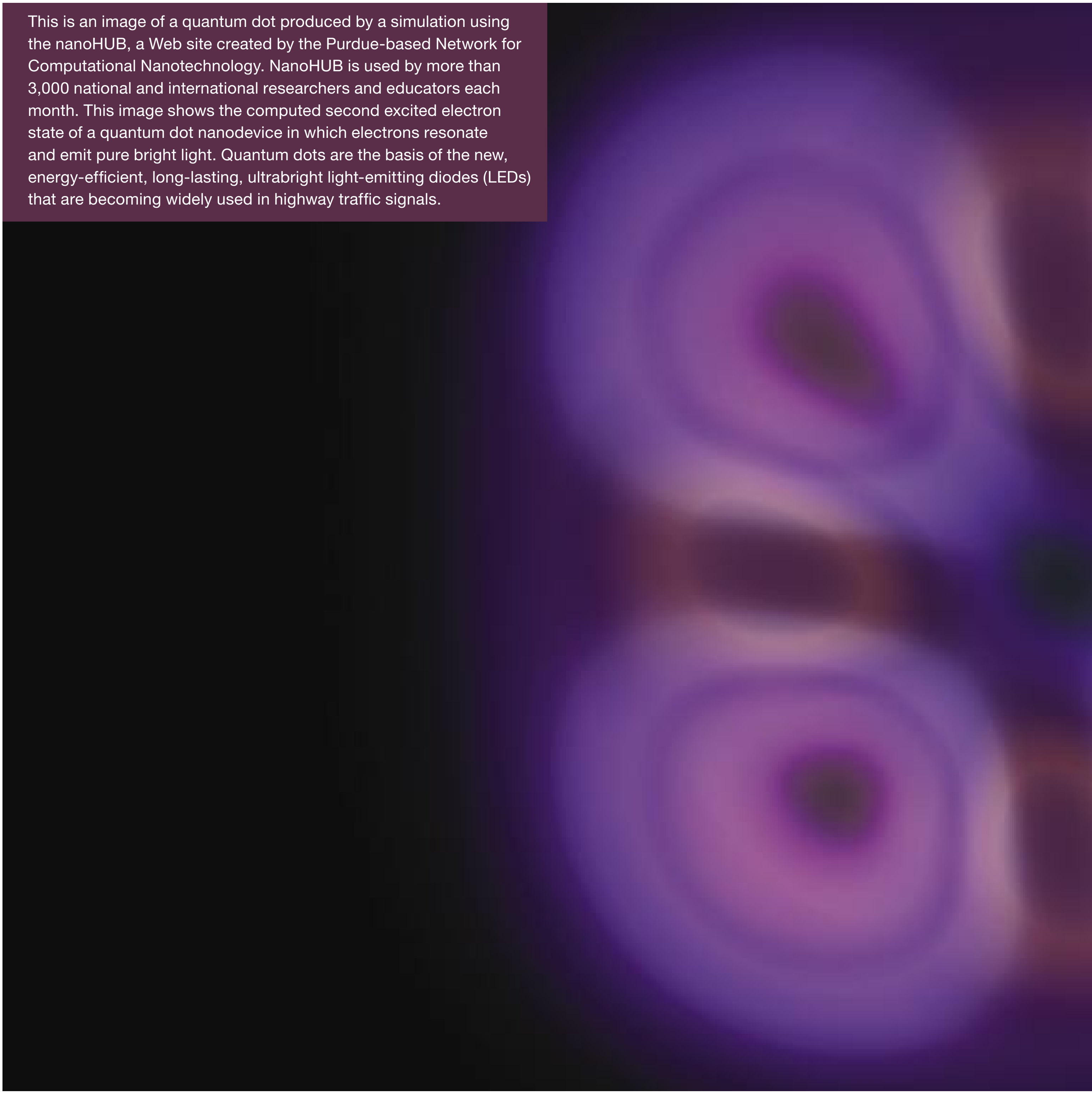
Franses studies the equilibrium and dynamic adsorption and dynamic surface tension of aqueous surfactants, lipids, and proteins. This also has applications for biosensors, food processing, and medicine.

Lung surfactants, which maintain the surface tension of the lungs' alveoli (air sacs), are essential to the functioning of the human respiratory system. Premature babies are born without adequate amounts and can die from Respiratory Distress Syndrome. In adults, lung injury and diseases like those associated with lung cancer can lead to the harmful release of serum proteins to the alveoli and protein adsorption. These proteins inhibit adsorption of the lipid ingredient of lung surfactant. Without the stabilizing force of this surfactant, the lung alveoli can collapse.

Using principles of chemical engineering such as thermodynamics and transport phenomena, Franses is studying the way that lipids travel in the lungs' alveoli. He hopes that his research will one day lead to new replacement therapies, such as that delivered in aerosol form, or new formulations, for those who suffer from respiratory illness.

In crossing the line between medicine and engineering, Franses is careful to maintain his role as an engineer in the process: "My style is to do research that complements medicine rather than mimics it. It is to bring engineering into medicine." ■ **Linda Thomas Terhune**

aperture



This is an image of a quantum dot produced by a simulation using the nanoHUB, a Web site created by the Purdue-based Network for Computational Nanotechnology. NanoHUB is used by more than 3,000 national and international researchers and educators each month. This image shows the computed second excited electron state of a quantum dot nanodevice in which electrons resonate and emit pure bright light. Quantum dots are the basis of the new, energy-efficient, long-lasting, ultrabright light-emitting diodes (LEDs) that are becoming widely used in highway traffic signals.