

THE BOND

DEPARTMENT OF CHEMICAL ENGINEERING & MATERIALS SCIENCE

Bio-Nano-Technology Leads the Way to Improved Industrial Products

Most engineers are familiar with biotechnology and nanotechnology. Now bio-nano-technology is having an impact. While there is ongoing research in various aspects of this technology, three MSU researchers are teaming up to make their own advances in the field. R. Mark Worden, professor, and Scott Calabrese Barton, assistant professor, both in the Department of Chemical Engineering and Materials Science, along with Claire Vieille, assistant professor in the MSU Biochemistry and Molecular Biology Center, recently received significant funding from the National Science Foundation (NSF) to create economical dehydrogenase enzyme electrodes for bioelectrocatalysis.

The project, called "Nanostructured Interfaces for Electrobiocatalysis," is funded through the Chemical, Bioengineering, Environmental, and Transport Systems Division (CBET) of NSF. CBET supports research and education in the rapidly evolving fields of bioengineering and environmental engineering and in areas that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. The funding runs for three years and has components for not only the research, but also for outreach programs for urban youth, participation in the research by undergraduate students, and training of graduate students in quantitative biology.

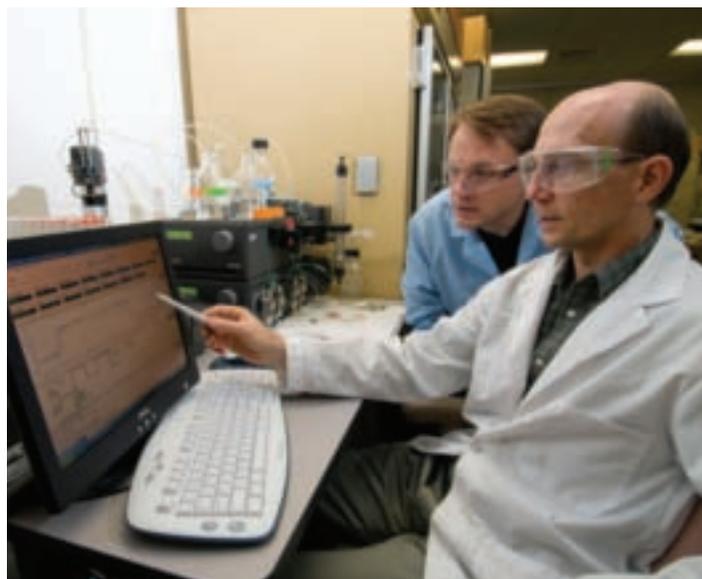
"The thrust of this and other research in the CHEMS Department is biorenewables," says Worden. "The department is considered a leader in this area with a depth of expertise that has led to funding for a wide range of projects." This project brings together the researchers' expertise in biochemistry, electrochemistry, nanotechnology, and mathematical modeling to develop a new process based on electricity-coupled chemical conversion. Experiments on the project are just getting underway.

The diversity and specificity of dehydrogenases found in nature offer the potential to produce a wide range of products, including chiral sugars, amino acids, alcohols, and steroids, as well as many pharmaceutical intermediates and specialty chemicals. However, the potential has not been fully realized due to high enzyme and cofactor costs and low volumetric reaction rates. "To overcome these challenges we are trying to create nanostructured enzyme electrodes that improve enzyme lifetime and increase enzyme retention," says Calabrese Barton.

The interdisciplinary research team also hopes to reduce the cost of the processing and amplify reaction rates using ultra-high surface area electrodes with efficient transport properties. They have already developed experimental and modeling tools needed to design, fabricate, characterize, and optimize nanostructured bioelectronic interfaces. "The goal is to integrate these capabilities to develop a fundamental understanding of the molecular processes governing bioelectrocatalytic interfaces based on dehydrogenases," says Worden.

As a first step, Vieille is isolating enzymes that are stable at high temperatures. Then the research team will employ these enzymes to carry out a variety of reactions. If successful, the applications are numerous, including biosensors and fuel cells, synthesis of specialty chemicals, and electricity generation for portable applications. "To make it happen we have to improve not only the enzymes, but also the environment in which they are employed," says Calabrese Barton. While Vieille will work to improve the enzymes used, for other aspects of the research they will rely on Worden's expertise in nanotechnology and biocatalysis and Barton's interest in electrochemistry and mathematical modeling.

continued on page 2



Mark Worden (right foreground) and Scott Calabrese Barton discuss progress on their new research project.



from the Chair

MARTIN HAWLEY

Every new year brings exciting possibilities. Here in the CHEMS department we look forward to all that 2009 will bring us.

There is an increasing emphasis in our department on research and its importance in solving today's problems and those of the future. New technologies are helping to spur more results that have practical applications. Our research themes are energy and sustainability, nanotechnology and materials, and biotechnology and medicine. According to the latest American Chemical Society rankings, our department ranks 11th in the nation in school spending on chemical engineering R & D, and our department research spending has tripled over the last six years. This is a tremendous accomplishment and a trend that I believe will continue. We are proud of all of our faculty members and their research as well as their dedication to developing knowledge and mentoring students.

The department welcomes David Hodge as the newest member of our faculty. He came to us in November after more than two years as part of the research faculty in the Department of Biochemical and Chemical Process Engineering at Luleå University of Technology in Luleå, Sweden. His primary research interests revolve around converting plant (lignocellulosic) biomass to fuels and chemicals with a particular focus on biotechnology and the forest products industry, which will be a good fit with other faculty doing research in these important areas.

Congratulations to Christina Chan and Ilsoon Lee! Christina was recently promoted to full professor, and Ilsoon has been promoted to associate professor with tenure.

We also welcome our new graduate students. These high-caliber students along with our cadre of postdoctoral candidates help to support the faculty in both research and teaching and are an integral part of the department. Young minds also bring enthusiasm, novel ideas, and new ways of looking at today's problems. Our goal, as always, especially in these turbulent economic times, is to help prepare students so they can be immediately productive in the workplace. We strive to continually improve our programs, so they have practical applications in real-life situations.

Alumni and industry partners also play important roles in the department. Thank you to the members of our Alumni Advisory Board for their important input that helps to bolster the department as a leader in chemical engineering and materials science.

Of course, much of the behind-the-scenes work of the department is done by our very capable staff. We greatly appreciate their work and support.

I wish you a very Happy New Year! 🌸

Bio-Nano-Technology (continued from page 1)

To initially develop the appropriate procedures and techniques the researchers are starting with a reaction system that produces mannitol from glucose using the heat stable enzyme mannitol dehydrogenase from the high temperature tolerant bacterium *Thermotoga maritima*. "This is a way to produce a high-value sugar," says Calabrese Barton. "Glucose is cheap; mannitol, which is used in chewing gum and toothpaste because it doesn't cause dental cavities, is expensive." This is just one example.

"We plan to use nanotechnology to bring different types of molecules close enough together that electron transfer and the desired chemical reaction happen," says Worden. "The high concentration of enzymes near the electrode and high rates of transport will give us novel active nanomaterials."

The research results, when available, will be distributed through conference presentations, peer-reviewed publications, and a project Web site. The research team also hopes to patent and commercialize the process.

Both Worden and Calabrese Barton agree that multidisciplinary collaboration on a project like this is crucial. "It's the best way to make progress," says Barton. Worden points out that so much is involved in the experimentation. "One person with expertise in one area cannot address all of the factors." 🌸

— Jane L. DePriest



CHEMS PhD student, Hao Wen (left), and Scott Calabrese Barton go over details of the bio-nano-technology research project. Wen received his BS degree in 2006 from Sichuan University.

Alumni Bond

2008 Red Cedar Circle Award



Terence K. Kett (MS '65, PhD '68) received the 2008 Red Cedar Circle Award at the annual College of Engineering Alumni Awards Banquet in May 2008. The award recognizes MSU chemical engineering and materials science alumni for their distinguished service to the profession and outstanding commitment to the community.

Kett was born in England, but his family immigrated to Chicago when he was 13. He obtained a BS in chemical engineering at Northwestern University ('64), and then came to MSU for graduate studies. While he attended Michigan State, two important things occurred: Kett became a citizen of the United States, and he met his wife, Betty (BA '67, Education). (Sadly, Betty passed away in 2006 after 38 wonderful years of marriage.)

Kett had a rewarding 34-year career at Exxon before retiring in 2002. He held many interesting and challenging management and executive positions. These included assignments throughout the United States, and in France and England. Of note was his involvement in the Exxon-Mobil merger where he was responsible for the design and sizing of the combined downstream engineering organizations of the two companies. Following the merger, he managed engineering offices located around the world (Houston, Toronto, London, Singapore, and Tokyo), providing project and technical support for ExxonMobil's 40+ refineries.

A dedicated Michigan State supporter, Kett served as a member of the Engineering Alumni Association Board from 1982 to 1986. He and Betty established an endowment at MSU to support students pursuing careers in math education. Although he lives in Houston, Texas, Kett avidly follows all Spartan sports and lives and dies through the ups and downs of every football and basketball game. Betty was even more avid, Terry says. He recalls the two of them getting up at 2:00 a.m. while living in England to listen to the radio as Magic Johnson and the Spartans won the NCAA title against Larry Bird and Indiana State.

Kett has two adult children, Dianne and Bill. His first grandchild, Jayna, was born shortly after Betty died in 2006. Terry is an elder at the First Presbyterian Church of Kingwood, Texas. He enjoys gardening, bird watching, and fishing, and loves all sports. He especially enjoys golf and plays several times a week. While he worked on his PhD at MSU, Kett and Martin Hawley played on the chemical engineering department's golf team, which consistently won the annual university four-man golf tournament (probably to the embarrassment of other chemical engineering faculty because Kett and Hawley were supposed to be too busy to play golf). At Northwestern, Terry was captain of the soccer team, and through the years he has managed various traveling town and county soccer teams. His son, Bill, continues to play today. 🌻

Advisory Board

The CHEMS Alumni Advisory Board is a volunteer group of business and engineering professionals. The vision of the board is to deliver value through experience to the students, faculty, and alumni of the department.

"The members of the Alumni Board are honored to be invited to share their professional experience with the CHEMS department faculty, staff, and students," says Joe Gentile, board chair. "Each of us recognizes the privilege of being even a small part of the department's extraordinarily vibrant, innovative, and focused academic and research programs. We are proud to be Spartan Engineers!"

Current advisory board members include:

Steve Auvil, Air Products

Joe Gentile, chair, retired from BP Amoco

Biman Ghosh, Diamond Innovations

Chester (Nick) Grant, retired from GM

John Hockstra, retired from Dow Chemical

Frank Jere, DTE Energy

Dick Kennedy, Allvac Inc.

Herbert Kirby, retired from Arcadian Corp.

Steve Klemm, Corium Manufacturing

Bill Larson, retired from GM

Matt Neurock, University of Virginia

Morris Place, Champion Technologies

Joe Pongracz, Agri-Fab, Inc. 🌻

Alums Enjoy Northern Michigan Golf Outing

The sun was shining and the weather was warm when the CHEMS department held a golf outing for alumni in July 2008 at The Kingsley Club in Kingsley, Mich.,. The event was hosted by alumnus Mike Dennon and Martin Hawley, chairperson of the department. Following a day of golf guests dined at the Traverse City Golf & Country Club. Hawley gave them an update on happenings in the department as well as information about current events at the college and the university. 🌻



From left to right: Chris Dendrin (caddy and grandnephew of Mike Dennon), Mike Dennon (BS '43 chemical engineering), Richard Brown (BS '71 mechanical engineering), Steven Ludka, Walter Ludka (BS '57 chemical engineering), Martin Hawley (BS '61, PhD '64 chemical engineering), Michael McDonald (BS '87 chemical engineering), Diana D'Angelo (BS '75 computer science), Michael Maasberg (MS '77 chemical engineering), Morris Place (BS '66 chemical engineering), and Mike Dendrin (caddy and grandnephew of Mike Dennon).

Faculty and Staff Bond

New Faculty



David Hodge joined the department this fall. Originally from Alabama, Hodge has a BS ('99) in chemical engineering with a specialization in pulp and paper engineer-

ing from Auburn University and worked for a year in a paper mill in Alabama. He received his MS ('02) and PhD ('05) from Colorado State University in chemical engineering with projects focusing on ethanol fermentation of 5 carbon sugars, optimal control of ethanol fermentations, and enzymatic conversion of plant biomass to fermentable sugars. Hodge worked at the DOE National Renewable Energy Laboratory (NREL) in Golden, Colo.,

during the last years of his PhD and continued there as a postdoc. For the past 2-1/2 years he has been part of the research faculty in the Department of Biochemical and Chemical Process Engineering at Luleå University of Technology in Luleå, Sweden. His research interests focus on converting plant (lignocellulosic) biomass to fuels and chemicals with a particular focus on biotechnology and the forest products industry.

Promotions



Christina Chan was promoted to full professor. She earned her PhD ('90) in chemical engineering from the University of Pennsylvania. Her

research interests include metabolism and diabetes, Alzheimer's disease, metabolic and tissue engineering, and system biology and bioinformatics.



Ilsoon Lee has been promoted to associate professor with tenure. He earned his PhD (2000) at the University of Delaware. His research interests include nanotechnology, bioenergy, alternative energy, biomimetics, polymers, optoelectronics, and anti-wrinkling applications. Lee is the project leader for research funded by the University Research Corridor (URC) for deriving improved ethanol from switchgrass and corn stovers. ❁

Endowments

Chevis Legacy Lives On Through Endowment

The Department of Chemical Engineering and Materials Science has received a substantial endowment from the estate of Paul P. Chevis, who died in January 2008.

Paul Chevis (BS '43) was the son of Lithuanian immigrants who came to the United States in the 1930s and farmed in Michigan. Paul was employed by General Motors for several years after graduation from MSU, and then founded Tawas Plating in Tawas City, Mich. His wife, Mary Jane, who preceded Paul in death, was his partner in the business and helped build the company, which they sold in the early 1980s.

Both Paul and MJ, as Mary Jane was known, were well respected and active in the Tawas community. He was a member of the Wurtsmith Air Force Base Liaison Committee, the East Tawas Men's Club, and Christ Episcopal Church, and was a director of the Peoples State Bank. MJ was a volunteer at St. Joseph, the local hospital. Both were longtime supporters of St. Joseph and founding members of the hospital's Samaritan Club. Paul and his wife loved farming, and they distributed vegetables from their garden throughout the town. They enjoyed entertaining and were known to host 30-plus guests at dinners, often entertaining soldiers from the local air base. Both played the accordion.

Paul's old-world values served him well. He was a conservative

spender, and was known for doing the job once and doing it right. He kept his farm machinery going for years by repairing and rebuilding it.

He was proud of his MSU degree. While his estate assisted other local charities, by far the largest portion, a gift in excess of \$1 million, came to the MSU College of Engineering. The Paul P. Chevis Endowed Fund is a discretionary fund to be used by the chair of the Department of Chemical Engineering and Materials Science to help in the areas of greatest need or opportunity. Because it will generate a substantial yearly cash flow, the Chevis Fund will have a long-term impact for the department.

"We know that Paul and his wife were accomplished and very generous during their lifetime," says Martin Hawley, chair of the department. "Paul was very proud of being a graduate of MSU's chemical engineering program. We sincerely appreciate their gift and it will be used in their memory to promote excellence in the department. Their legacy lives on." ❁



Paul and Mary Jane Chevis

Research Raises Michigan's Economic Spirits



Candy is dandy, but liquor is quicker – at least in terms of bolstering the state's economy. A new law allowing small distilleries to market and sell their products on-site is based on 11 years of research by **Kris Berglund**, University Distinguished Professor in chemical engineering and materials science and forestry. Micro-distilleries are expected to add more than \$400 million to Michigan's

economy, according to Michigan Representative Barb Byrum, sponsor of the legislation.

"Before this law was passed, distillers could not sell their products by the bottle or by the glass on premises," Berglund says. "Michigan now has the most producer-friendly law in the country. We're expecting a number of entrepreneurs to start distilling businesses here."

Berglund has been studying distilling processes and conducting how-to workshops since 1997, envisioning a bright future for micro-distilleries that were similar to beer microbreweries. Berglund provided extensive background information to Byrum as she was crafting the bill, and testified before both the House and Senate as they considered the legislation. Gov. Granholm signed the bill into law this past summer.

Public Act 218 creates a new license class that allows distilleries that manufacture less than 60,000 gallons a year to sell their goods on-site. The license costs \$100 annually.

"The new law gives distillers more options," Berglund says. "In the past, distillers could only sell their products through the liquor distribution system. Now they can set up retail operations on-site, much like breweries or wineries do. Berglund believes that distilleries are another piece of growing Michigan's bioeconomy. "We're taking renewable resources and turning them into a high-value, high-quality product." 🌱



Kris Berglund (right) watches as Gov. Jennifer Granholm signs Public Act 218. Bobby Mason, owner of the Michigan Brewing Company (left), and Michigan Representative Barb Byrum, sponsor of the legislation, look on.

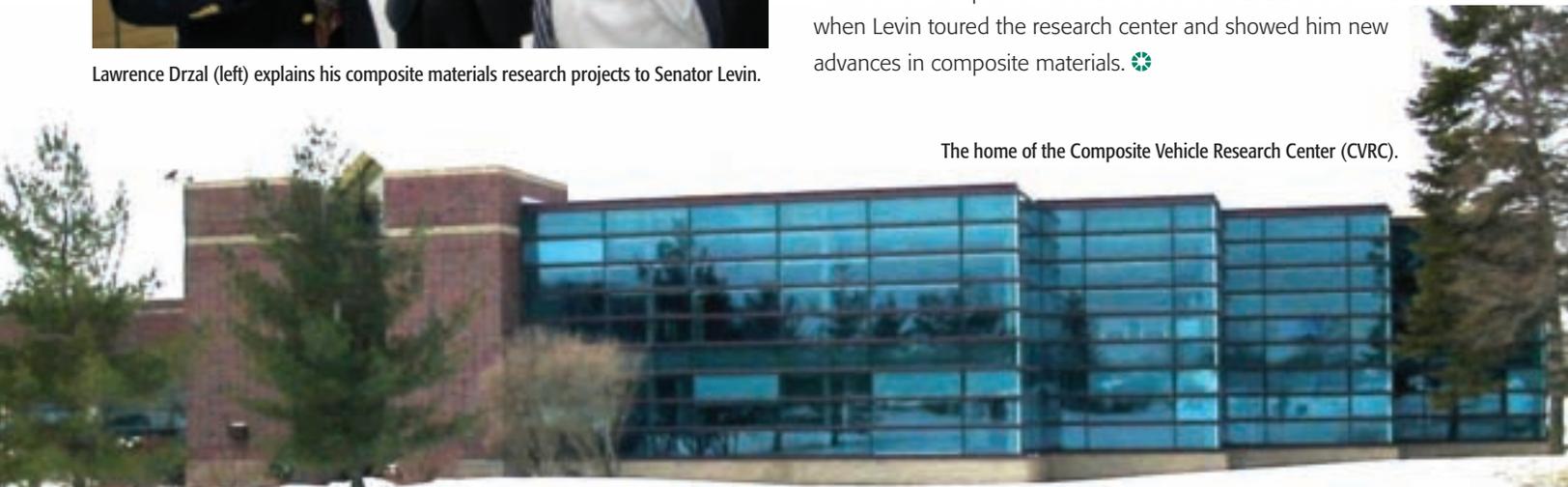


Lawrence Drzal (left) explains his composite materials research projects to Senator Levin.

Composite Vehicle Research Center

U. S. Senator Carl Levin visited the College of Engineering's Composite Vehicle Research Center (CVRC) in the fall of 2008. After a welcome by the dean and the provost, Levin toured the facility. Lawrence Drzal, University Distinguished Professor in chemical engineering and materials science and director of the MSU Composite Materials and Structures Center, was part of the group that founded the CVRC. Recent multi-million-dollar funding firmly establishes the CVRC and sets the stage for ongoing research on composite materials for vehicles. Drzal was on hand when Levin toured the research center and showed him new advances in composite materials. 🌱

The home of the Composite Vehicle Research Center (CVRC).



Student Bond

Gates Cambridge Scholarship Finalist



Robert J. Friederichs, a materials science engineering senior and Honors College student, has been selected as a finalist in the Gates Cambridge Scholarship competition.

The Bill and Melinda Gates Foundation established the Gates Cambridge Trust through a donation to the University of Cambridge.

The purpose of the trust is to award scholarships to enable young leaders and scholars to undertake graduate work at Cambridge. The scholarship covers the full cost of studying in Cambridge and may be held for one to four years of study. Friederichs and other finalists from the United States will interview for the scholarships in February in Annapolis, Md.

Friederichs, from West Branch, Mich., is also pursuing a master's degree while completing his undergraduate work. He was named a Goldwater Scholar in 2007. He believes baby boomers and others who are living longer lives will need joint replacement implants to be more wear-resistant, so his career goal is to earn an MD/PhD in biomaterials/biomedical engineering. He plans to conduct biomaterials research, practicing translational medicine by researching orthopedic implants. His research mentor is Melissa Baumann, associate professor of chemical engineering and materials science.

2008-2009 Von Ehr Scholars Named



James Von Ehr with CHEMS Von Ehr Scholars Danielle Vasko (left) and Gabriela Fratta.

Four freshman students have been named as the 2008-2009 Von Ehr Scholars.

Gabriela Fratta, Marshall, Mich., and **Danielle Vasko**, Livonia, Mich., are both majoring in chemical engineering. The other scholars are Tyler Gotch, Grand Rapids, Mich., and James Varchetti, Shelby Twp., Mich., who are majoring in computer science.

The James Von Ehr Scholars Program was established in 2006 by James R. Von Ehr II, a 1972 computer science graduate and entrepreneur. The \$1 million endowed scholarship fund benefits undergraduates of the College of Engineering.

National AIChE Scholarship Winner

Andrew Kraus, ChE senior, has been named one of 15 students nationwide to receive the Donald F. and Mildred Topp Othmer National American Institute of Chemical Engineers (AIChE) Scholarship award this year. This is a prestigious award

based on academic achievement and involvement in student chapter activities.

Kraus became involved in the MSU AIChE student chapter as a freshman by attending meetings and exploring what it meant to be a chemical engineer. Robert Ofoli, associate professor, is the adviser to the AIChE student chapter.

"After graduating from Catholic Central High School in my hometown of Grand Rapids, Mich., I came to MSU intent on choosing an engineering discipline," says Kraus. "After exploring chemical engineering from an academic and research standpoint, I knew it was for me."

He was on the MSU AIChE student chapter board for two years before taking on the role of president in his senior year. Because of a study abroad program that took Kraus to Sydney, Australia, he will be staying in the department for another year to finish his undergraduate degree. "A year is a small price to pay for a lifetime of memories," says Kraus.

He has worked in the environmental analytical laboratory at Prein & Newhof in Grand Rapids, as well as in research laboratories at MSU, the Van Andel Institute, and at the University of Arizona. ♻️

New Graduate Students

The department welcomes 24 new graduate students this year. They are:

Chemical Engineering:

Bhushnan Awate	Aaron Oberg
Betul Betul	Tim Petrik
Samantha Friedlander	EzhiImurugan Rangasamy
Ankush Gokhale	Nan Song
Mingjie Jin	Ryan Stoklosa
Hanzi Li	Wei Wang
Yangmu Liu	Daniel Williams

Materials Science and Engineering:

Zhe Chen	Apoorv Shaligram
Robert Friederichs	Yutian Shu
Mitchell Lerche	Eric Skoug
Debkumar Saha	Bite Zhou
Robert Schmidt	Jiang Zhu

2008 Etiquette Luncheon

Larian Scholars

This year 15 undergraduate CHEMS students received scholarships from the Larian Endowed Scholarship Fund. The scholarship was established in 1976 in memory of Maurice G. Larian, MSU professor emeritus of chemical engineering, for the benefit of outstanding CHEMS students at MSU.

Upon Professor Larian's death in 1974, a substantial amount of money was received from many friends and former students in his memory. The endowment has grown over the years, through gifts from his wife, Sara Larian Gifford, friends, and some successful chemical engineering graduates, particularly Michael Dennon (BS '43).

Larian was born in Armenia and came to the USA without financial resources. He worked long hours in his student days, as he depended on his earnings and scholarships for his support while studying for his BS and MS at Iowa State University and his PhD at the University of Minnesota. He was the epitome of a scholar, and a good but demanding teacher. His most memorable quality, however, was his sincere interest in and concern for his students. The students, in turn, treated him with great respect.

The 2008 scholars were treated to lunch at the University Club. Sara Larian Gifford joined in the festivities. This year's Larian Scholars include:

Rebecca Burns, Raul Dacomba, Teresa Deluca, Michael Dittmer, Jennifer Hall, Kayla Kalmbach, Andrew Kraus, Adam Loyson, Michelle Marinich, Joshua Matter, Allan Morris, Joshua Sinnaeve, Mark Swartzlander, Maria Tenorio-Bernal, and Brett Walczak. 🌸



Sara Larian Gifford (second row, center) enjoyed lunch with the 2008 Larian Scholars and department chair, Martin Hawley.

Have you ever been confused about which bread plate is yours at a formal business meal? Patty McNeil of First Impressions has the answer. "Put your thumb and index finger in a circle then hold out your other fingers on both hands," says McNeil. "When you put the fingers in line with the table they form a 'b' with your left hand and a 'd' with your right hand." That means bread on the left, drinks on the right. It was one of several hundred simple etiquette suggestions that impressed a group of chemical engineering students attending



Patty McNeil of First Impressions shows how to do a proper handshake and make introductions.

an etiquette luncheon as part of the ChE 301 (Chemical Engineering as a Profession) course. "The ultimate goal is to help students enhance their professional image and have confidence at business gatherings," says Daina Briedis, associate professor and the instructor for the course. This is the third year for the luncheon.

McNeil's presentation, which was given while students participated in the luncheon at the Kellogg Center, was interactive and garnered lots of student questions. Some of McNeil's topics included proper handshakes, tips for remembering names, exchanging business cards, and appropriate topics of conversation for business meals. The presentation also included professional dress, how to make introductions, and tips on international business etiquette.

Andrew Cooke, a ChE junior thought the information would be useful even outside business events. "We don't have anything like this elsewhere. It was very helpful," says Jamie Jagodzinski, a ChE junior. For Alita Aguiar, a senior from Australia who is at MSU on a Study Abroad program, the event gave her insight into American customs. "I especially liked the information on how to tell which bread plate is yours," says Aguiar.

Dow Chemical Company sponsored the event. "At Dow we recognize that the human element is essential to our success," says Mike McDonald with Dow Chemical. "Adding the human element to the periodic table changes everything. Bringing together chemical engi-



Patty McNeil had a simple example of how to tell which bread plate and which drinks are yours.

neers in an environment such as the Etiquette Luncheon allows students to understand the importance of interaction on a professional basis and how capturing the human element in business is essential." 🌸

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Class Learns Important Lessons at Lunch

Patty McNeil of First Impressions offered etiquette suggestions to CHE students as part of the CHE 301 (Chemical Engineering as a Profession). Complete story on page 7.



Homecoming Tailgate – October 4, 2008



Dr. Sami AL-Araji (BS '67, PhD '73 mechanical engineering), Iraq's Deputy Minister of Industry and Minerals (far right), talks with Satish Udpa and Martin Hawley during the Homecoming festivities.