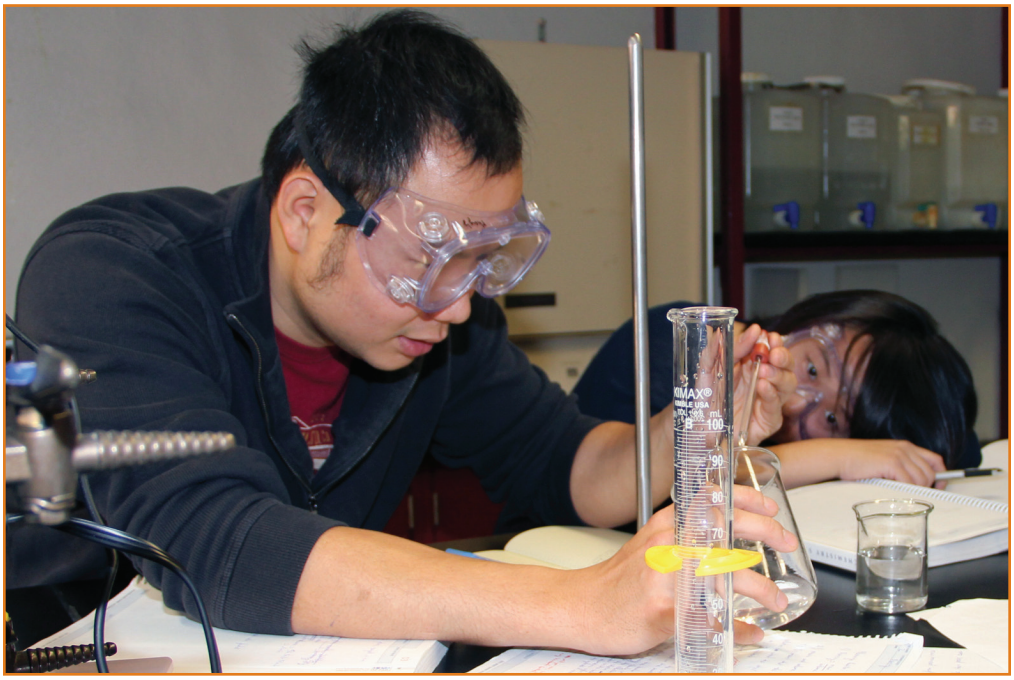
College of Science & Engineering
University of Minnesota

ChemNews

Department of Chemistry Newsletter
December 2011



Phong Ly (left) and Pa Vang, students in the Department of Chemistry's general chemistry lab, conduct a guided-inquiry experiment, working as a team to find solutions to the problems.

Guided inquiry transforms laboratories

Cookbook-style labs with students following step-by-step instructions for experiments are out for general chemistry courses at the University of Minnesota.

In their place are guided-inquiry laboratories where students design and conduct their own experiments, discover what works and what doesn't, make adjustments based on those discoveries, and try again. It is hoped that these guided-inquiry laboratories will help students think critically about what they are doing and why.

Professor Michelle Driessen, Department of Chemistry general chemistry director, is leading the initiative to transform general chemistry laboratory experiences for students. She has long been concerned about what students are learning, or not learning, in what

Guided-Inquiry: To Page 10

Chemistry focuses on being green

From research to classroom courses and laboratories, and scientific experiments, it is important to be green; however, it is not easy.

More and more, green chemistry is becoming a priority for professors and researchers in the Department of Chemistry.

Currently, there are two philosophical approaches toward teaching green chemistry, said William Tolman, Department of Chemistry chair. One involves teaching specific green chemistry courses. The other encompasses a comprehensive way of thinking that involves infusing green chemistry into all courses, research, and outreach.

"Because getting the concepts of green chemistry across to everyone is just too

Green Chemistry: To Page 4

what's inside

message from the chair

Building on our proud tradition . . .

"If we don't invest, if we don't attract and retain the best scientists, if we don't recruit and support the best young investigators and the best young minds, we absolutely will not discover new things. Instead, we will wither as a university. We will decline as a state." —President Eric Kaler, Inaugural Address, September 29, 2011

The above are just a few of the cautionary and, at the same time, inspirational words from our new president. With his inauguration this fall, we enter a new and exciting period at the University of Minnesota, and in particular in the College of Science & Engineering and its Department of Chemistry. As the articles in this issue of our newsletter attest, we've had a great year and we're poised to continue building on our proud tradition of outstanding teaching, research, and outreach and service to the community.

Noteworthy advances in the way we teach undergraduate laboratory courses were implemented this past year, including new green experiments in the organic laboratory under the direction of Professor Jane Wissinger, and an efficient and highly effective, guided-inquiry, group learning methodology in the general chemistry course under the direction of Professor Michelle Driessen. Last spring, Professor Marc Hillmyer and I introduced a new course for chemistry majors, *Green Chemistry*, that addresses a critical need for future scientists to take sustainability, toxicity, energy, and environmental effects into account as they solve the technological challenges we face.

Meanwhile, our faculty members continue to be recognized for their outstanding teaching, with new awards for excellence in teaching going to Professors Christopher Douglas, Ken Leopold, and Kent Mann.

Our students, faculty, and staff have been busy driving research forward, and these efforts have been rewarded with multiple interdisciplinary grants. Of note are the award of a highly competitive Center for Chemical Innovation phase 1 grant from the National Science Foundation to support the Center for Sustainable Polymers, and recognition from Waters Corporation of Joe Dalluge, Ph.D., for his research into diagnostic marker assay development relevant to cystic fibrosis, and his research as a collaborating member of the university's newly-created Center for Analysis of Biomolecular Signalling, which is led by Professor Christy Haynes.

Chair William Tolman

And we were happy to welcome a new faculty member to the department, Theresa Reineke, who now holds the Lloyd H. Reyerson Professorship. Her group specializes in the synthetic design, chemical characterization, and biological study of novel macromolecules.

Efforts to recruit additional faculty continue as undergraduate enrollments in our courses increase, and advances in chemistry knowledge are more necessary than ever to address important environmental and societal issues.

I'm very proud of the Department of Chemistry! We are educating the best young minds, recruiting and supporting the best scientists, and discovering great new things.

ChemNews
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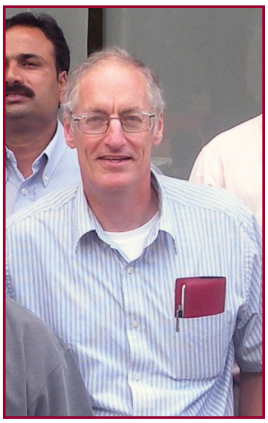
our alumni—where are they now?

Welcome to "Where are They Now?", which features alumni reflections on their current work and their experiences in the Department of Chemistry. Read more alumni Where are They Now? stories on our website at http://www.chem.umn.edu/alumni, and find out how you, too, can participate.

Thomas L. Guggenheim, Ph.D.



Thomas Guggenhein

Current position: principal process chemist for SABIC Innovative Plastics

Education: bachelor's degree in chemistry from St. Olaf College in 1978, and doctorate in physical organic chemistry from the University of Minnesota in 1983, under the tutelage of Paul Gassman

Research: doctorate research focused on solvolysis studying alpha cyano carbocations and synthetic methods

Work highlights: process development in the area of high temperature polyetherimide engineering thermoplastics. Currently, I am involved in pilot plant design and operation, plant optimization, hazard evaluations, wastewater treatment process development, and analytical method development. My technology work team was part of a cross-functioning team at SABIC that just won a *2011 Most Valuable Pollution Prevention MVP2* award from the National Pollution Prevention Roundtable in Washington, D.C.

What one thing from your experiences in the University of Minnesota Department of Chemistry prepared you for what you currently are doing or plan to do in the future?: Exposure to many subjects in chemistry and the interaction of people in my group and the department prepared me for any technical challenge while working with a diverse set of people.

More about me and my family: Wife Beth, who has a bachelor's degree in chemical engineering from the University of Minnesota; daughter Katie, a doctorate candidate in organic chemistry working for Mark Kurth (one of Professor Tom Hoye's students) at the University of California-Davis (UC Davis); daughter Kristen, attending graduate school in agricultural and environmental chemistry at UC Davis; and son John, in high school and a chemistry ace. Currently, I'm aging grudgingly, but enjoying work, hoops, and growing trees.

Alumnus receives achievement award

Patrick Gruber (right) receives his Outstanding Achievement Award from University of Minnesota Regent Richard Beeson.

Patrick R. Gruber, Ph.D., was honored with an Outstanding Achievement Award by the University of Minnesota Board of Regents. This award honors graduates who have attained unusual and noted distinction in their chosen fields, professions or public service, and who have demonstrated outstanding achievement and leadership.

Gruber earned a doctorate in chemistry and a Master of Business Administration from the University of Minnesota. He obtained a bachelor's degree in chemistry and biology from the University of St. Thomas.

Gruber is chief executive officer (CEO) of Gevo, which is based in Englewood, CO, and a leading renewable chemicals and advanced biofuels company. He is an award-winning scientist and a leader in the field of industrial biotechnology, including its applications to biological engineering, environmental science, biorefining, and biobased products. He is credited with inventing a commercially viable process for producing polylactic acid (PLA)—a biodegradable plastic made from corn. He is named co-inventor on 48 United States patents related to the production of PLA. In recognition of his innovative inventions, Gruber was inducted into the Minnesota Inventors Hall of Fame in 2003.

The Outstanding Achievement award honors Gruber as—

- an extraordinary visionary whose creativity, tenacity, and strategic business acumen in developing and commercializing green chemical production processes for renewable, plant-based products has transformed an industry;
- a revolutionary scientist whose paradigm-shifting contributions to the field of industrial biotechnology have been recognized with the Presidential Green Chemistry Award, the Discover Award for Environmental Innovation, the Lee W. Rivers Innovation Award, and the inaugural George Washington Carver Award from the Biotechnology Industry Organization recognizing significant contributions by individuals in the field of industrial biotechnology; and
- a transformational leader whose ability to make cross-disciplinary connections in identifying business opportunities, and to translate ideas into actionable plans, has inspired teams of scientists and engineers to exceed their own expectations in creating products and processes for a more sustainable society.

Chemistry focuses on being green

"Creating a green mind-set will get all of us thinking about each action that we take."

—Professor Jane Wissinger

Green Chemistry: From Page 1

important, we need to do both," said Tolman. That is exactly what the Department of Chemistry is doing—teaching specific green chemistry courses, and creating a comprehensive green chemistry mind-set that addresses the entire educational process, including courses, research, and outreach.

Creating a green chemistry mind-set for her colleagues and students has long been a passion for Professor Jane Wissinger, Department of Chemistry organic laboratory director. Green chemistry is benign by design, she said. It entails not using hazardous chemicals, or reducing or eliminating the generation of hazardous substances in the design, manufacture, and use of chemical products. Overarching goals encompass using chemistry to prevent pollution, to meet current needs for chemical products without jeopardizing future needs, and to focus on renewable, sustainable resources.

Reaching beyond chemistry

Wissinger's green chemistry messages reach about 1,000 students per year, and extend far beyond the Department of Chemistry. Only about 120 of those students are chemistry or chemical engineering majors. The rest are focused on other disciplines such as biochemistry, biology, neuroscience, physiology, pre-health, ecology, or biology, society and the environment.

"We are not just sending the message to chemistry majors, but are showing many other students how green chemistry is relevant to their lives," said Wissinger. "It is important that they see how chemists are trying to address problems of sustainability."

Perfect environment

Because organic labs have historically required the use of chemicals and solvents resulting in exposure to and production of hazardous materials, the hands-on, active-learning style of the organic lab setting is the ideal venue to incorporate the principles of green chemistry. Wissinger is careful about choosing which green chemistry experiments to use in the labs, vetting them by colleagues, graduate students, and undergraduate students to ensure that they effectively generate green results: not all do. She asks students to identify how the 12 principles are met or lacking in the experiments that they perform.

Green experiments

Since 2002, Wissinger has been adding green experiments to the organic lab. One of these experiments involves the green synthesis of camphor, which is a versatile chemical compound found in nature. This novel experiment, developed in collaboration with Professor Andrew Harned and his graduate student Patrick Lang, not only satisfies 9 of the 12 principles of green chemistry, but also illustrates how the generated camphor product is used in an active research program. The development and successfully incorporation of this experiment was published in the *Journal of Chemical Education* in May

Green Chemistry: To Page 5

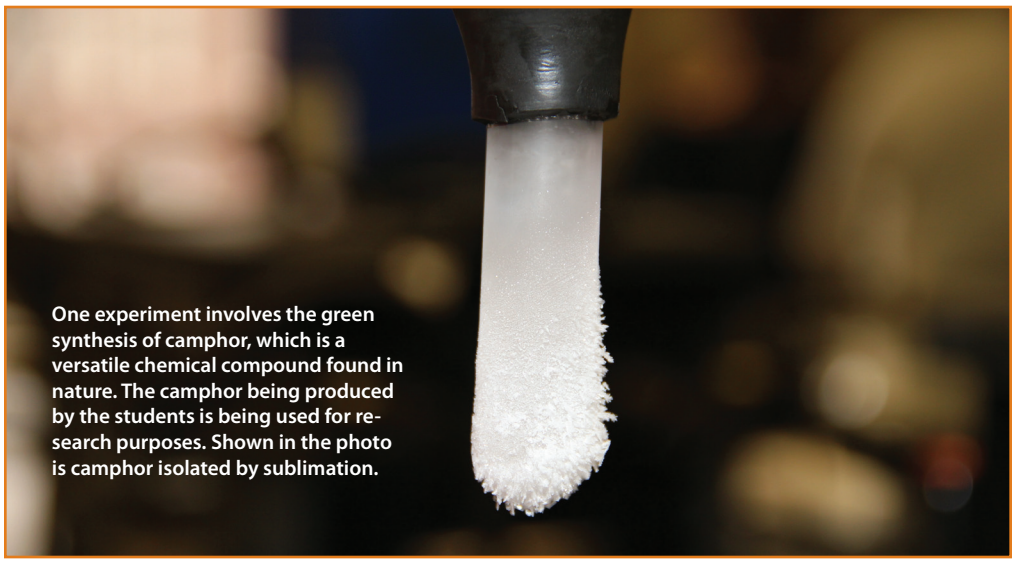
Professor Jane Wissinger uses the 12 *Principles of Green Chemistry*, which were defined in 1998 by Paul T. Anastas and John C. Warner, to guide her undergraduate organic laboratory course. Those 12 principles, paraphrased below, are:

- preventing waste, rather than treating or cleaning up after it has been created;
- designing synthetic methods to maximize the incorporation of all materials into the final process (called atom economy);
- using and producing nontoxic chemicals;
- designing safer chemicals;
- using safer solvents and auxiliaries (separation agents);
- designing energy efficient chemical processes;
- using renewable raw materials and feedstocks;
- reducing unnecessary waste-generating derivatives;
- using catalytic reagents that reduce waste when possible;
- designing for degradation by using chemical products that break down into innocuous products that are harmless to the environment at the end of their functions;
- using real-time analysis and in-process monitoring and control to minimize the formation of hazardous substances; and
- minimizing the potential for chemical accidents.

Chemistry focuses on being green

Green Chemistry: From Page 4

2011. Another example of an experiment recently added to the organic laboratory curriculum involves the use of liquid CO_2 for the extraction of the essential oil of cloves.



One experiment involves the green synthesis of camphor, which is a versatile chemical compound found in nature. The camphor being produced by the students is being used for research purposes. Shown in the photo is camphor isolated by sublimation.

Greening the labs

In addition to experiments, Wissinger also is focused on what she calls "greening the labs," reducing students' exposure to chemicals and reducing the amount of hazardous waste collected. For example, she is making a concerted effort to teach students how to wash glassware with the minimum amount of solvent, typically acetone, needed or to not use acetone at all. She has already noticed that the amount of acetone being using this fall is about a tenth of what used in previous semesters.

"Creating a green mind-set will get all of us thinking about each action that we take," said Wissinger.

Green chemistry curriculum

In addition to the laboratories, teaching a green chemistry course is part of the chemistry curriculum. Along with Professor Marc Hillmyer, Tolman developed a *Green Chemistry* course that was first taught last year. This course considers key aspects of green chemistry in modern research, academia, and industry. There is an overarching emphasis on relevant green chemistry implications for the environment, technology, and public policy. Students are taught the history, theories, and goals of green chemistry. Other topics taught in the course include the use of safer solvents, and minimization of hazardous by-products and catalysts.

Green research

Both scientists are involved in the Center for Sustainable Polymers, which is at the heart of green chemistry research at the university. Hillmyer is director of the center and one of the leading sustainable polymer science researchers in the world.

The center focuses its research on the challenge of creating advanced synthetic polymers (plastics) from renewable, natural, and sustainable resources instead of finite fossil fuels. Those resources include vegetable oils, starches, sugars, and terpenes (essential organic oils produced by plants, flowers, and conifers). Researchers are especially interested in materials that require low energy input, are non-toxic, and can be composted.

In addition to advancing cutting-edge polymer research at the university, the center focuses on forming partnerships with industries, teaching students about sustainable materials, and educating and engaging the public.

Two professors serve as editors of new scientific publication

Professors Timothy Lodge and Theresa Reineke are on the editorial team for a new American Chemical Society publication, *ACS Macro Letters*. Lodge is editor and Reineke is an associate editor.

ACS Macro Letters, a rapid-publication journal available exclusively online, will report major advances in areas of soft-matter science in which polymers play a significant role, including nanotechnology, self-assembly, supramolecular chemistry, biomaterials, energy, and renewable/sustainable materials.

The publication will make it possible for authors to publish their high-impact, peer-reviewed, research findings in all facets of polymer science within four to six weeks of submission. The journal aims to accelerate the pace of research and fuel new findings in the field by providing the research community with brief, focused, hot-topic articles containing information that researchers need to advance their own important investigations. It is also hoped that *ACS Macro Letters* will attract authors and readers from related disciplines. The first edition will be published in January 2012.

This new publication will complement *Macromolecules*, the society's leading journal in the field. Lodge serves as editor of *Macromolecules*.

Chemistry researchers receive IREE large grant of $695,000

Scientists Philippe Buhlmann and Andreas Stein received a $695,000 Initiative for Renewable Energy and the Environment (IREE) large grant to work on high energy density, nanostructured supercapacitors for electrical energy storage. They will be working with Professor William Smyrl from Chemical Engineering and Materials Science.

The researchers' energy project was one of five to receive an IREE large grant. IREE's large grants support integrated, multi-disciplinary research teams for up to three years.

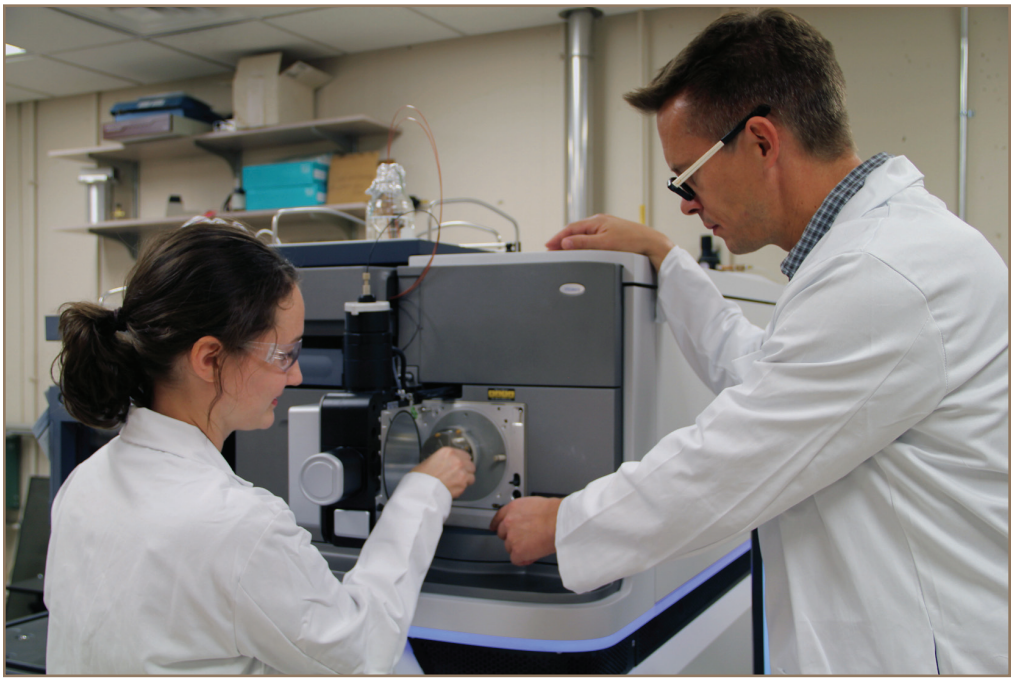
Mass spectrometry lab director receives innovation recognition

Waters Corporation has welcomed the Mass Spectrometry Laboratory into its Centers of Innovation Program. Waters honored the Mass Spectrometry Laboratory under the direction of Joseph Dalluge, Ph.D., for his research into diagnostic marker assay development relevant to cystic fibrosis and other diseases. He is also honored for his research as a collaborating member of the university's newly-created Center for Analysis of Biomolecular Signalling.

The Waters Centers of Innovation Program recognizes and supports the efforts of scientists facilitating breakthroughs in health and life science research, food safety, environmental protection, sports medicine, and many other areas.

Dalluge is attempting to understand the chemical basis of disease, molecular signaling, and adaptation. His research revolves around the use of leading edge liquid chromatography/mass spectrometry instrumentation for metabolite profiling, biomarker discovery, and advanced assay development, and for the detailed chemical characterization of biological systems as it relates to function.

He is looking at dissimilar biological systems and comparing them to find out how they might be different at the molecular level such as what characterizes a disease state versus a non-disease state, the differences between an aging cell versus a young cell, or cells exposed to an inflammation agent versus cells not exposed to inflammation agents.



Joseph Dalluge, Ph.D., director of the Department of Chemistry's mass spectrometry laboratory, which was honored by the Waters Corporation's Centers of Innovation program, works with graduate student/research assistant Audrey Meyer at the Waters Sunapt G2 Mass Spectrometer.

Department researchers form Center for Analysis of Biomolecular Signalling

Cells in the body send chemical signals to each other in complex ways that govern everything from immune response to blood clotting and muscle firing. Those chemical signals are complex and their behavior is relatively unknown.

To explore these critical phenomena, scientists with bioanalytical expertise have formed a new center within the Department of Chemistry—the Center for Analysis of Biomolecular Signalling (CABS)—to explore and define biomolecular signalling at the tissue, cell, and subcellular levels.

The center encompasses collaborative research projects among professors Edgar Arriaga, Michael Bowser, Philippe Buhlmann, and Christy Haynes, and Joseph Dalluge, Ph.D., mass spectrometry laboratory director. The scientists' research projects will be focused on developing and implementing novel analytical tools to study biomolecular signalling.

Researchers receive funds for state-of-the-art microscope

College of Science & Engineering (CSE) professors, including Professor R. Lee Penn from the Department of Chemistry, are among those receiving university research investment funding for key infrastructure improvements and additions that will support research.

More than $12 million derived from the university's share of technology commercialization royalties will provide funds for a variety of key infrastructure enhance

Microscope: To page 7

Professor R. Lee Penn and other College of Science & Engineering professors have received university research investments funds to acquire a state-of-the-art electron microscope.

Microscope: From Page 6

ments, ranging from imaging instrumentation, to multimedia facilities, sophisticated data analysis equipment, and performance space for the arts.

Penn, along with other CSE co-investigators, are acquiring a new generation, state-of-the-art, aberration-corrected, high-resolution analytical scanning and transmission electron microscope. This electron microscope will fill a critical need for a cutting-edge instrument to push the limits of researchers' understanding of the fundamentals of nanoscale materials via atomic, and sub-atomic level imaging and spectroscopy.

The effort to obtain this funding was led by Principal Investigator K. Andre Mkhoyan from the Department of Chemical Engineering & Materials Science. In addition to Penn, co-investigators include Steve Campbell, Electrical and Computer Engineering; Allen Goldman, Physics; Uwe Kortshagen, Mechanical Engineering; and Chris Leighton, Chemical Engineering & Materials Science.

CSP gets major grant for plastics research

Research on creating more environment-friendly, cost-efficient plastics from natural and renewable materials got a boost with a $1.5 million grant over three years from the National Science Foundation (NSF) Centers for Chemical Innovation program to the University's Center for Sustainable Polymers.

The Center for Sustainable Polymers, under the direction of Professor Marc Hillmyer, focuses its research on the challenge of creating advanced synthetic polymers (plastics) from renewable, natural, and sustainable resources instead of finite fossil fuels. Those resources include vegetable oils, starches, sugars, and terpenes (essential organic oils produced by plants, flowers, and conifers). Researchers are especially interested in materials that require low energy input, are non-toxic, and can be composted.

In addition to advancing cutting-edge polymer research at the university, the center focuses on forming partnerships with industries, teaching students about sustainable materials, and educating and engaging the public.

Hillmyer said that the newly established Center for Chemical Innovation will help Minnesota become a leading global center of excellence in sustainable polymer science and greatly expand the Center for Sustainable Polymers' capabilities to make significant research contributions.

Over the next three years, the already-successful Center for Sustainable Polymers will work to achieve its new goals, which may make it eligible for even more funding. The NSF Centers for Chemical Innovation program is a two-phase program. Successful centers receiving the three-year phase I funding are eligible for phase II grants that provide up to $40 million over 10 years.

The Center for Sustainable Polymers, under the direction of Professor Marc Hillmyer, has received a $1.5 million grant for continued research on creating more environment-friendly, cost-efficient plastics from natural and renewable materials.

Professors receive grant for international research

Professors Laura Gagliardi and Christopher Cramer, co-principal investigators, have received a National Science Foundation (NSF) International Collaborations in Chemistry (ICC) award of $485,000 for three years. The grant will enable them to engage in research with Professor Jonathan Nitschke from the Department of Chemistry at Cambridge University in the United Kingdom.

Their research will encompass assessing the fundamental factors affecting binding and recognition in the aqueous host-guest chemistry of small- to moderate-sized organic molecules inside self-assembling, metal-templated cages.

The knowledge created by this research will shed light on a range of critical phenomena, from how proteins bind substrates within their active sites to how new catalytic transformations might be carried out within purposefully designed hosts.

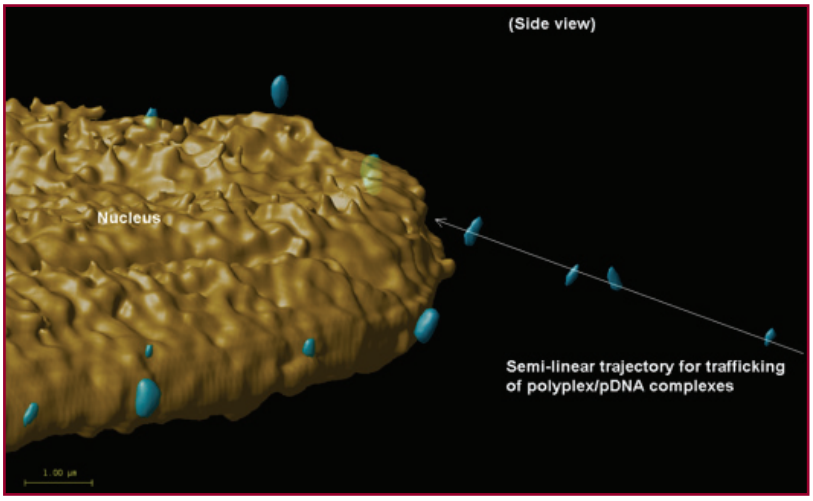
This interdisciplinary research will provide training opportunities and international research experiences for junior researchers. In addition, code/software implementing the new models will be available to the greater scientific community.

This research is supported jointly by the NSF Macromolecular, Supramolecular, and Nanochemistry (MSN) Program and the Chemical Theory, Models and Computational Methods Program in the Division of Chemistry.

cutting-edge, innovative research

Illuminating the Cellular Mechanisms of Polymer-Mediated Drug Delivery

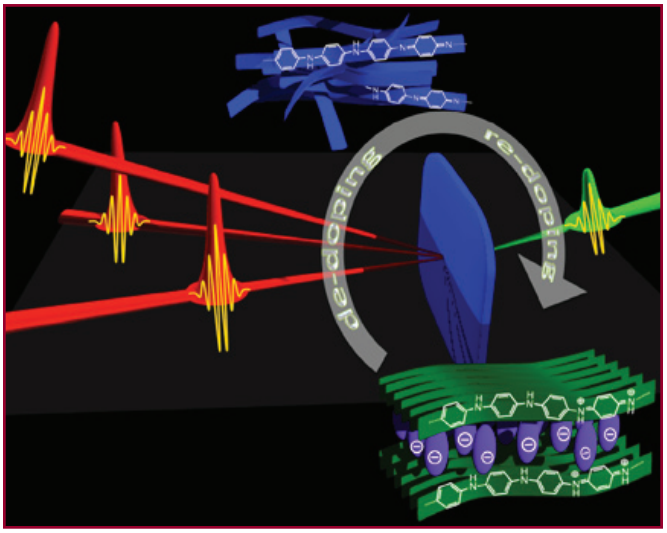
Professor Theresa M. Reineke



The wealth of information being obtained from genomic, proteomic, and glycomic research is allowing researchers to unravel the intricate genetic and epigenetic mechanisms associated with human health and disease. The intracellular delivery of nucleic acids and therapeutics to study these processes offers unprecedented promise for revolutionizing biomedical research and novel drug development. Delivery vehicles, such as biocompatible polymers, are being studied for enhancing delivery efficacy and target specificity to increase drug potency and decrease side effects. However, the delivery vehicle plays a central yet elusive role in dictating the efficacy, safety, mechanisms, and kinetics of gene regulation/drug efficacy in a spatial and temporal manner; thus, having a far-reaching impact in health-related research. The Reineke laboratory has developed several novel carbohydrate-containing polymers that have shown outstanding affinity to encapsulate polynucleotides and drugs into colloidal nanoparticles (polyplexes) and facilitate highly efficient intracellular delivery without toxicity. Both step growth and controlled radical polymerization techniques are used to yield a comprehensive series of polymers that contain various mono-, di-, and oligosaccharide moieties copolymerized with ethyleneamine units. A large focus of the Reineke lab also is to decipher the intracellular trafficking pathways of these colloidal nanoparticle delivery vehicles. Live cell confocal microscopy imaging techniques are being used to examine the intracellular trafficking of the nanosystems in cultured cells. Three-dimensional data processing techniques are being developed to surface render confocal images, allowing researchers to visualize the spatial and temporal distribution of polyplexes within the cellular environment. This information is being related back to the influence that polymer structure has on cellular delivery in an effort to predict polymer/nanoparticle behavior in the cellular environment.

Static and Dynamic Structural Memory in Polyaniline Thin Films

Professor Aaron Massari, graduate students Audrey Eigner and Brynna Jones, and undergraduate student Bryce Koprucki

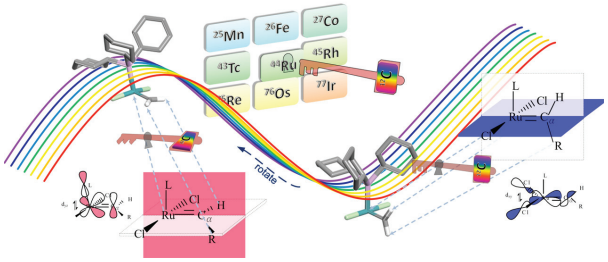


Polyaniline is a popular organic material that can be chemically altered to conduct electricity through a process called doping. The conductivity of thin films of this polymer can be readily switched between conductive and non-conductive states by treatment with weak bases such as ammonia gas. This switching process is not perfectly reversible for reasons that are not fully understood, although it is often attributed to static morphological changes. In this work that was highlighted in the July 14, 2011 edition of the *Journal of Physical Chemistry B*, the Massari group used two-dimensional infrared (2D-IR) spectroscopy to characterize the fast molecular motions in polyaniline films over the course of a conductivity switching cycle. The researchers found that molecular dynamics primarily on the time scale of a few picoseconds (10^{-12} seconds) mirrored the reversible changes in film conductivity, while slower dynamics on the tens of picoseconds time scale were insensitive to the doping state of the polymer. It was also noted that very fast dynamics on a time scale of a few hundred femtoseconds were altered irreversibly, and were likely to be of the same origins (or perhaps the partial cause of) the irreversibility of the film conductance switching. This experimental work supports the notion that charge conduction in organic materials is not only dependent on the ways in which molecules are packed together, but also the manner in which they are able move. It is hoped that this work will provide information to researchers about what molecular motions they need to control when creating new synthetic polymers.

cutting-edge, innovative research

Unlocking Grubbs Catalysts Reactivity Differences

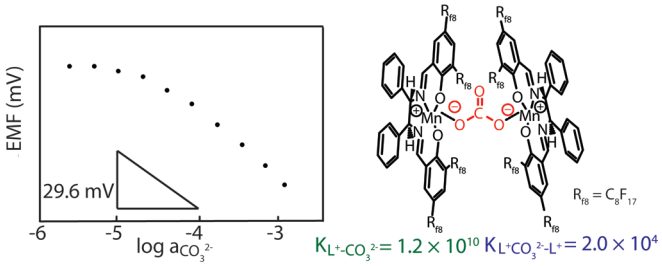
Research led by senior investigator Professor Donald Truhlar



In recent years, a new-generation density functional, called M06-L, has been able to predict the correct ligand effect on the bond energy for real catalysts. Researchers applied it to explore the Grubbs-type metathesis reaction. The questions of how ruthenacarbene ligands effect catalytic metathesis, and the reason for the slow initiation of the Grubbs-II catalyst and the associated inverse relation between organophosphine dissociation and catalytic activity have been controversial and still are not fully understood despite numerous experimental studies and considerable theoretical effort. For many years, theory was not able to address quantitative issues in catalysis because of the high costs of studying realistic catalysts. Calculations in which the catalyst was oversimplified (e.g., replacing organophosphines with unsubstituted phosphines) were untrustworthy because it is known experimentally that such substitutions have a profound effect on the chemistry. Furthermore, reliable electronic wave function methods applicable to small molecules are too expensive to apply to typical real catalysts, and popular density fnctionals have had difficulty providing a balanced view of all the interactions. In the present work, researchers report a density functional study of realistic Grubbs-type metathesis reaction using the M06-L density functional. A key issue that researchers examined is the pivotal role of the carbene orientation in the structural evolution accompanying catalysis—its effect on the energy of organophosphine dissociation and the key later steps of olefin binding and ruthenacyclobutane formation. The results unambiguously show that the energetics and kinetics of rotameric states of ligands are critical for the inverse relation between organophosphine dissociation rate and catalytic activity. The carbene rotamer acts as toggle switch triggering the dissociative mechanism that produces the active catalyst, thereby explaining the long-puzzling differences of first- and second-generation Grubbs catalysts on a unified basis. Because the slow initiation of Grubbs-II catalysis systems is the major issue impeding progress on further improvement of these Nobel-class catalysts, the researchers believe that their decisive finding (i.e., that the carbene rotamer state explains the slow initiation) will stimulate considerable future work on improved catalyst design. Consideration of the barriers to rotameric state interconversion may open a new venue in understanding the stereochemistry of Grubbs olefin metathesis as required for synthesis of polymers with spatially controlled properties. Other researchers include Professor Hsiao-Ching Yang from Fu-Jen Catholic University in Taiwan, Yan Zhao, Ph.D., from the Hewlett-Packard Development Company in Palo Alto, CA, and Yen-Chin Huang and Professor Tien-Yau Luh from the National Taiwan University in Taiwan. This research was published in *Organometallics*.

Million-Fold Improvement in Selectivities With Fluorous-Membrane Carbonate Sensors

Professor Philippe Buhlmann and graduate student Li D. Chen



Because HCO_3^-, CO_3^{2-}, and CO_2 coexist in aqueous solutions, accurate and quick determinations of total CO_2 content are required for physiological, industrial, and environmental analysis. A need for measurements in blood plasma arises in clinical chemistry since they are used to detect and monitor electrolyte imbalances. Currently, available sensors suffer from long response times and poor selectivity. A concern is interference from salicylate, which is a metabolite from common headache pills and is found in many clinical samples. Researchers have developed electrochemical sensors for carbonate that reduce the interference from chloride and salicylate by two and six orders of magnitude, respectively. This breakthrough in carbonate sensing was made possible by the use of fluorous sensing membranes. Because of their extremely low polarity and polarizability, fluorous media are the least polarizable condensed phases known to mankind, and solvate potentially interfering ions poorly. Selectivity for carbonate is achieved by use of fluorophilic manganese(III) salen complexes, developed originally for biphase catalysis by collaborator Gianluca Pozzi from the Istituto di Scienze Tecnologie Molecolari in Milano, Italy. The exceptional selectivity of fluorous membranes doped with these carbonate receptors suggests their use not only for sensing, but also for separations of carbonate from other anions and might even be useful for the energy-efficient sequestration of carbon dioxide. Preliminary results on these novel carbonate sensors were reported in March 2011 by Li at the Pittsburgh Conference of Analytical Chemistry. A manuscript reporting sensor characteristics and quantitatively describing the stoichiometry and stability of the receptor–carbonate complexes has been submitted to the *Journal of the American Chemical Society*.

Guided inquiry transform

Guided-Inquiry: From Page 1

are called verification labs. In those traditional laboratories, students follow a specific set of instructions to conduct their experiments and confirm scientific concepts. Students are required to do A, then do B, and so on, and to document every step, Driessen said. They then are graded on how close they come to getting the "correct" results.

"Sometimes they didn't come close to getting the expected results for any number of reasons such as a probe not calibrating correctly, contaminated chemicals, or simply because things were just not working that day," she said.

Most troubling to Driessen, however, was the reality that too many students, after completing a three-hour lab and getting the correct results, still did not know what they had done or why.

"They were just following instructions, and not using any higher-order thinking skills," said Driessen.

Instead, Driessen wants students to understand chemistry concepts, to understand what they have done when finished with the experiments and why, and to have fun while doing it.

Using a guided-inquiry approach, students are given a problem, given the time and tools such as chemicals and equipment that they need, and then are pointed in the right direction to find out for themselves the solutions to the problem.

Research leads to transformation

The transformation of the Department of Chemistry's laboratories came after a lot of reflection, research, and first-hand observation. One of the first things Driessen did was to ask the department's professors what they wanted students to take away from a general chemistry laboratory experience. Three themes emerged from that query: students need to be familiar with basic lab equipment and chemistry concepts; be able to graph and analyze data; and be able to design experiments and problem solve on the fly if things don't go as planned.

She also conducted a literature survey, reviewing a number of guided-inquiry laboratory manuals. That led her to a manual developed by Melanie Cooper, professor of chemistry education at Clemson University. Cooper is renowned for her work on improving teaching and learning in large enrollment general chemistry courses, focusing on how students learn to construct and use experiments, problem solve, and understand concepts. Driessen is using Cooper's Cooperative Chemistry Laboratory Manual to guide the redesign of her labs. This past winter, Driessen also spent time at Clemson observing, first hand, what a guided-inquiry lab is like in reality with Barb Lewison, Clemson lab director.

"I want students to understand chemistry concepts, to understand what they have done when finished with the experiments and why, and to have fun while doing it."

—Professor Michelle Driessen

Learning through summer lab experiences

A group of 112 students participated in the department's first guided-inquiry lab this summer. This transition first involved the training of four experienced teaching assistants—David Boyce, Amanda Maxwell, Kaustubh Mote, and Emily Pelton. Each had a group of 28 students that they worked with. After each lab, they debriefed, examining and reflecting on what needed to be changed with this new approach, what worked, and what didn't. Perhaps the most difficult part for the teaching assistants was not providing the students with answers. Instead, they served as coaches, empowering the students to think about possible solutions, design and conduct experiments to test those solutions, and be OK with adjusting those experiments if things didn't work as expected.

Teaching assistants' roles

Those first-hand experiences helped the four experienced teaching assistants conduct a hands-on orientation for and serve as mentors to this year's new teaching assistants. Driessen checks in with the teaching assistants frequently, asking what types of

Guided-Inquiry: To Page 12

chemistry laboratories

This past summer, four experienced teaching assistants—David Boyce, Amanda Maxwell, Kaustubh Mote, and Emily Pelton—played pivotal roles in transforming general chemistry laboratories from verification to guided-inquiry experiences.

Although they faced challenges, overall the teaching assistants like the new guided-inquiry labs, which they feel are much more beneficial and educational for students. They think that the students are learning more, are developing a scientific curiosity, are using problem-solving and critical-thinking skills, are thinking independently, and are more comfortable in laboratory settings.

This is how a lab should be run, said Kaustubh, with the students developing plans of action to solve the problems, carrying out those plans, assessing the approaches used and the results, and reporting their findings.

The focus of guided-inquiry labs is on the thought process and improving experimental design skills rather than following directions exactly, or even getting particular results, Amanda said. David agrees, noting that the key to the new lab format is to let students plan and execute their own solutions to the experiments, and truly learn how to experiment by developing multiple solutions to their projects.

"I think that developing this new lab format will be tremendously beneficial to students as they proceed through the chemistry curriculum," said Emily. "By introducing students to laboratory problem-solving in chemistry at the introductory level, students will be better able to face the problem-solving challenges presented by upper-level chemistry labs. In addition, the new lab format offers students opportunities to develop skills that are applicable beyond the walls of Smith Hall. . . . Students are learning how to work cooperatively in groups, develop written and oral presentation skills, develop time management skills, and develop confidence in problem solving," she said.

Teaching Assistant Amanda Maxwell (left), acting as a coach in guided-inquiry labs, helps Alyssia Morley.

It is hard for the teaching assistants to avoid providing answers to the students, to act more as coaches than answer keys. As coaches, the teaching assistants strive to be positive and encouraging. It is sometimes difficult to not tell students that they are doing things incorrectly or that something they are trying won't work.

"Sometimes it is difficult to not tell the answer," said Kaustubh, "especially when students are getting frustrated when experiments don't work . . . . It is hard to get students who feel very frustrated to think about the lab. It is challenging to not answer, 'What do I do next?' without appearing unhelpful."

It is important for the students to realize that they are capable of answering their own questions, to make them think for themselves, and to have them become independent learners. The teaching assistants' first responses to students' questions are to ask: Have you looked it up? What resources could you use to find the answers?

"I encourage them to experiment for themselves," said Amanda. "Even if they start off in a direction that I know will not work, they can still learn from the experience."

All of the teaching assistants feel that students are learning more in the guided-inquiry laboratories. "I was amazed by how enthusiastic and creative my students were," said Amanda. "They often thought of methods for solving a problem that I never would have considered. It is exciting to see the expressions on students' faces when they are finally successful at an experiment that they have attempted several times. . . . The success is sweeter because of their initial struggle, and the chances that they retain what they learned is much greater," she said.

Guided-inquiry labs

Guided-Inquiry: From Page 10

questions the students are posing, if they are seeing greater understanding by the students about what they are doing, and if the students are gaining more confidence in and feeling more comfortable with the creative process.

Driessen has noticed that the students are receptive to the nudges of the teaching assistants, and that there seems to be a lower anxiety level for these students who are not expected to get to the "correct" results within the set period of time. Like traditional labs, rigor is very much a component of the guided-inquiry labs with students expected to make valid attempts to solve the problems. The students are also in teams of four, which they stay in throughout the course. They must work cooperatively on the problems, exchange ideas with each other, and assume different leadership roles during each project.

A student's perspective

Patrick Murphy, a pre-med student, took the guided-inquiry lab this summer and now is enrolled in a Chem 1022 verification lab. "In verification labs, you summarize your observations, but don't critically think about what you are doing," he said.

He much prefers the guided-inquiry lab. Patrick said that formulating strategies on how to solve the problems reinforced what he learned in his lecture class and through the textbook. While the guided-inquiry labs were ahead of what was being discussed in lectures, they helped facilitate his understanding of the material. "We had to figure out how to do things, and we were really forced to know what we were doing. . . . I really enjoyed the challenges, and found the [guided-inquiry] labs so much more compelling and interesting than the lab I am taking now."

Importance of evaluation

Evaluation of the effectiveness of the guided-inquiry lab is important, said Driessen. She is participating in the Office of Information Technology Faculty Fellowship Program, working with others across disciplines at the university to explore possibilities and best practices in technology-rich learning environments. One part of Driessen's project is to use an evaluation instrument to measure and evaluate students' confidence in their problem-solving abilities.

She also is gathering anecdotal information from students and teaching assistants. Patrick's suggestions for improvements or

"I really enjoyed the challenges, and found the [guided-inquiry] labs so much more compelling and interesting than the lab I am taking now."
—Pre-Med Student Patrick Murphy

modifications encompass logistics for the guided-inquiry labs such as providing students with opportunities to become familiar with the laboratory workspace, equipment, and other tools. Students also need good time management skills, he said. "As a team, you have to plan your experiments, develop procedures, and communicate with each other—and that takes time."

Future of guided inquiry

Currently, the guided-inquiry lab is being used in general chemistry 1021. It will expand to general chemistry 1022 this spring.

Driessen is not the only one interested in guided-inquiry laboratories. So is Professor Jane Wissinger, organic lab director. This past summer, she co-lead a workshop on *Teaching Guided Inquiry Chemistry Labs*, exploring the roles of teaching assistants in such labs, and the practicalities of transforming traditional laboratory experiments. She offers some hands-on, active learning experiments in the organic labs.

"We really want our students to understand scientific concepts when finished with our laboratories, and to learn that the scientific process is creative and fun at the same time," said Driessen.

This new approach is a plus for the Department of Chemistry and its students, said Chair William Tolman. "This new way of teaching better approximates what goes into research and gets students to better understand what they are doing in the laboratory," he said. "Moreover, by having students work in teams of four, resources are shared, thus saving money and enabling us to increase overall enrollments. For the department, it's a win-win-win: better learning at lower cost to larger numbers of students."

faculty honors & awards (alphabetically ordered)

Christopher Cramer


Christopher Cramer

Professor **Christopher Cramer** received the *2011 Horace T. Morse-University of Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education*. This honor is awarded to exceptional candidates nominated by colleges in their quest to identify excellence in undergraduate education. In addition to honoring individual faculty members, the award contributes to the improvement of undergraduate education at the university by publicizing the honorees' work to serve as resources for the whole faculty. Cramer is one of seven faculty members from across the entire university chosen to receive the Morse Alumni Award this year.

Each year since 1965, the University of Minnesota has recognized a select group of faculty members with the Morse Alumni Award. Since 1990, 12 faculty members from the Department of Chemistry have received this honor, including current faculty members David Blank, Mark Distefano, Thomas Hoye, Doreen Leopold, Ken Leopold, and Kent Mann.

Mark Distefano


Mark Distefano

Professor **Mark Distefano** received the University of Minnesota's *2011 Distinguished McKnight University Professorship*. This professorship recognizes and rewards the university's most outstanding mid-career faculty members. Recipients are honored with the title Distinguished McKnight University Professor, which they hold for as long as they remain at the University of Minnesota, and receive a grant of $100,000 that can be used to support their scholarly activities.

Professor Distefano was chosen based on the following criteria: the level of distinction and prestige that his scholarly work brings to the university; the merit of his achievements and the potential for greater attainment in the field; the dimension of his national or international reputation, including leadership efforts in interdisciplinary or collaborative initiatives; the extent to which his career has flourished at Minnesota and his work and reputation are identified with Minnesota; the quality of his teaching and advising; and his contributions to the wider community. He is one of four university professors to receive the prestigious honor this year.

Of the 69 professorships awarded by the university thus far, the Department of Chemistry holds 11—more than any other department. Current faculty members who also have received this high distinction include George Barany, Christopher Cramer, Timothy Lodge, Marc Hillmyer, J. Ilja Siepmann, Andreas Stein, and William Tolman.

Christopher Douglas


Christopher Douglas

Professor **Christopher Douglas** was awarded a *2011 DuPont Young Investigator Award*, which will support his ongoing work on discovering new small molecules for application in organic photovoltaic cells. This award includes a $75,000 research grant over three years. In addition, Douglas will share his research with DuPont's scientists at an annual seminar. This highly competitive award honors scientists for their novel and creative research, and the potential impact of their research on the global scientific community.

Along with Professor Kenneth Leopold, Douglas also received the *2010-11 Outstanding Professor Award in Chemistry from the College of Science and Engineering*. Undergraduates in the college selected the two Department of Chemistry professors to receive this honor in recognition of their exceptional instruction during the academic year.

Christy Haynes


Christy Haynes

In recognition of her contributions to the field of bioanalytical and nanoparticle chemistry, Professor Christy Haynes was chosen to receive the *2012 Pittsburgh Conference Achievement Award* from the Society for Analytical Chemists of Pittsburgh. She will be honored at a special symposium at Pittcon 2012 in March.

Haynes: To Page 14

faculty honors & awards (alphabetically ordered)

Haynes: From Page 13

Haynes also received the *2011 Royal Society of Chemistry Joseph Black Award*. This award honors a young scientist in any field covering the practice and teaching of analytical science. Haynes was honored for her work on leveraging the core principles of analytical chemistry to gain insight into pressing toxicological, immunological, and ecological questions. She will deliver lectures at up to four venues in the United Kingdom from September 2011 to May 2012, and will receive her award medal at a symposium around one of she lectures. She also received £2000.

Kenneth Leopold

Kenneth Leopold

Along with Professor Christopher Douglas, Professor **Kenneth Leopold** received the *2010-11 Outstanding Professor Award in Chemistry from the College of Science and Engineering*. Undergraduates in the college selected the two Department of Chemistry professors to receive this honor in recognition of their exceptional instruction during the academic year.

Along with Professor Kent Mann, Leopold also was selected as co-winner of the *Brasted Award for Excellence in College Chemistry Teaching from the Minnesota Section of the American Chemical Society (ACS MN)*. This award is given every three years for outstanding contributions to undergraduate education. Professors Leopold and Mann were both cited for their excellence and enthusiasm for teaching, especially the large, first-year, undergraduate, general chemistry course, for serving as advisers and mentors to undergraduate students, and for introducing undergraduates to research projects in their groups. Both have received several awards for undergraduate teaching.

Timothy Lodge

Timothy Lodge

Professor **Timothy Lodge** was selected as the *2011 Turner Alfrey Visiting Professor at the Michigan Molecular Institute (MMI)*. Lodge is a leading researcher in understanding and controlling nano- and micro-structures that result from combining dissimilar polymer materials in new ways. At MMI, Lodge taught a course, delivered research seminars, participated in one-on-one and research group discussions, and visited sponsoring organizations.

Kent Mann

Kent Mann

Along with Professor Kenneth Leopold, Professor Kent Mann was selected as co-winner of the *Brasted Award for Excellence in College Chemistry Teaching from the Minnesota Section of the American Chemical Society (ACS MN)*. This award is given every three years for outstanding contributions to undergraduate education. Professors Leopold and Mann were both cited for their excellence and enthusiasm for teaching, especially the large, first-year, undergraduate, general chemistry course, for serving as advisers and mentors to undergraduate students, and for introducing undergraduates to research projects in their groups. Both have received several awards for undergraduate teaching.

R. Lee Penn

R. Lee Penn

Professor **R. Lee Penn** was named a *resident fellow of the University of Minnesota's Institute on the Environment (IonE)*. During her three-year appointment, she intends to build collaborations with faculty in microbiology, civil engineering, and other fields and organize scientific conference presentations related to advancing understanding of the impact of nanotechnology on microorganisms and other ecologically relevant life forms.

Faculty Honors & Award: To Page 15

faculty honors & awards (alphabetically ordered)

Valerie Pierre

Lawrence Que Jr

Donald Truhlar

Victor Young

Faculty Honors & Awards: From Page 14

Valerie Pierre

Professor Valerie Pierre was named the *Edward I. Stiefel Lecturer for the 2012 Metals in Biology Gordon Research Conference*, which is an honor that is given to outstanding biological inorganic chemistry young investigators. Pierre will present her latest metallobiochemistry research at the 2012 Metals in Biology Gordon Research Conference, which is scheduled for January 22, through January 27, 2012, in Ventura, CA.

Lawrence Que Jr.

Professor **Lawrence Que Jr.** was elected a *2011 Fellow of the American Chemical Society (ACS)*. This designation honors those who have distinguished themselves in multiple areas, including promoting the science and the profession of chemistry, and service to the American Chemical Society. Five faculty members now have been chosen to receive this honor, including Donald Truhlar in 2009, and Christopher Cramer, Timothy Lodge, and William Tolman in 2010.

Que also received the *2011 Royal Society of Chemistry Inorganic Mechanisms Award* for his seminal contributions to the mechanistic understanding of dioxygen activation by nonheme iron enzymes. He will deliver lectures at up to four venues in the United Kingdom from September 2011 to May 2012, and will receive an award medal at a symposium around one of his lectures. He also received £2000.

Donald Truhlar

Professor **Donald Truhlar** received the *Distinguished Alumnus Award* from his alma mater—Saint Mary's University of Minnesota, Winona. This award honors an alumnus for his outstanding and distinguished professional achievements. Truhlar earned his bachelor's degree in chemistry from Saint Mary's University in 1965, and his doctorate from the California Institute of Technology in 1970. He joined the Department of Chemistry faculty in 1969. He is one of the top physical chemists in the world, receiving many prestigious awards and honors for his teaching, mentorship, research, and contributions to the scientific community.

Victor Young

Victor Young, Ph.D., X-ray Crystallographic Laboratory director, was elected as a *delegate to the International Union of Crystallography (IUCr) 22nd Congress and General Assembly by the United States National Committee for Crystallography*, which was conducted this summer in Madrid. Young represented the United States at the General Assembly and reported back on the outcomes of the meetings. He was one of about 80 delegates worldwide charged with the responsibility of reviewing the work and bylaws of the IUCr, electing members of the IUCr Executive Committee and Commissions, electing a new three-year term president, and deciding on the venue for the 2017 Congress.

Celebrating Innovation

Six professors—**George Barany, Christopher Cramer, Marc Hillmyer, Thomas Hoye, William Tolman,** and **Donald Truhlar—**were honored at an Office of the Vice President for Research *Celebrating Innovation* event. Celebrating Innovation honored researchers whose work has been patented, licensed to a company, or used to form a start-up company. Cramer and Truhlar were honored for their license of AMSOL Version 7.0—a semiempirical quantum chemistry program; Barany was honored for his patent, Detection of Nucleic Acid Sequence Differences Using Coupled Ligase Detection and Polymerase Chain Reactions; Hillmyer and Tolman were honored for their patent, Polymer Synthesis from Macrocycles; and Hoye was honored for his patent, Structural, Behavioral Characterization, and Synthesis of Attractants for Migratory Lamprey.

scholarships

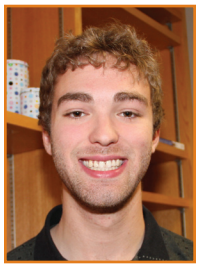
David A. and Merece H. Johnson Scholarships were awarded to senior chemistry majors who have shown outstanding academic achievement—**Shengsi Liu, Zhen Liu, Julian Lo, Michael Nagy, Alex Schrader**, and **Yue Zhou**. **Shengsi** is from Nanchang, Jiangxi, China. His career goals are to become both a researcher in the field of environmentally friendly energy and catalysis, and an educator. **Zhen** is from Shanghai, China. She wants to go to graduate school or have a career in analytical and biochemistry. **Julian** is from St. Louis, MO. After graduate school, he hopes to become a professor and researcher. He is also the recipient of the *J. Lewis Memorial Prize*. **Michael** is from Janesville, WI. He is interested in polymer and organic chemistry, and plans to use chemistry in a pharmacy career. **Alex** is from Eagan, MN. He is interested in polymer chemistry, particularly bio-renewable materials, and plans to have a career in research. **Yue** is from Suzhou, China. She plans to work in the petroleum industry after she graduates.

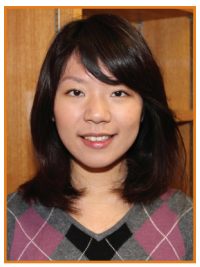

Shengsi Liu


Zhen Liu

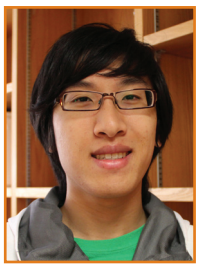

Julian Lo


Michael Nagy

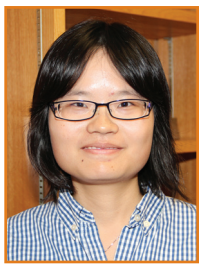

Alex Schrader


Yue Zhou

Doctors Michael and Kate Barany Scholarships were awarded to two senior chemistry majors who have shown outstanding academic achievement—**Jonathan Dang** and **Phillip Goldblatt**. **Jonathan** is from Maplewood, MN. He plans on attending graduate or medical school, but no matter which he chooses, chemistry will play an integral role. **Phillip** is from Arlington, VA. He is interested in organic chemistry, and plans to apply for graduate school, working toward his doctorate.


Jonathan Dang


Phillip Goldblatt

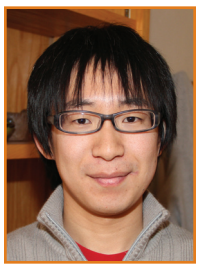

Lai Zhang

Lloyd W. Goerke Scholarship was awarded to a junior chemistry major who has shown outstanding academic achievement and who has financial need—**Lai Zhang**. **Lai** is from Guangdong (Canton), China. She wants to study chemistry in pharmaceutics, particularly macromolecules.

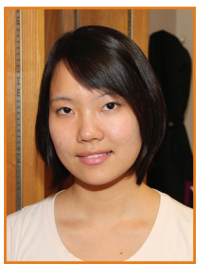
George T. Walker Scholarships were awarded to two junior chemistry majors who have shown outstanding academic achievement and who have financial need—**David Ford** and **Xiaolu Zheng**. **David** is from Blaine, MN. He wants to be chemical engineer. **Xiaolu** is from China, and would like to research chemical compounds from natural plants for medical uses.


David Ford

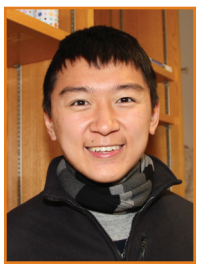

Xiaolu Zheng


Tomohiro Kubo

Robert C. Brasted Memorial Fellowship—a fellowship as well as a part time apprenticeship in the Department's General Chemistry Program—was awarded to an outstanding junior chemistry major who has expressed an interest in a teaching career in chemistry—**Tomohiro Kubo**. **Tomohiro** is from Tokushima, Japan. He is interested in the possible functions and applications of polymers, and plans on attending graduate school for a doctorate in polymer science.


Jua Choi


Shyam Rajan Iyer


Robert Gao

Thomas DuBruil Memorial Awards were given to sophomores who have demonstrated outstanding achievement in undergraduate research in chemistry—**Jua Choi** and **Shyam Rajan Iyer**. **Jua** is from Seoul, Korea. In the future, she wants to get involved in research projects for designing organic structures and finding synthetic mechanisms. **Shyam** is from India, but lived in China most of his teenage years. He plans on attending graduate school, studying either chemistry or chemical engineering.

CRC Freshman Chemistry Achievement Award sponsored by the CRC Press, Inc. This prize consists of the latest CRC Handbook of Chemistry and Physics and is awarded for outstanding scholastic achievement in freshman chemistry—**Robert Gao**. **Robert** is from Minnetonka, MN. He is pursuing a career as a physician, and looks forward to applying his knowledge of chemistry in his study of biochemistry and the mechanisms of action within the human body.

scholarships

J. Lewis Maynard Memorial Prize in Advanced Inorganic Chemistry Award given to a sophomore for outstanding scholastic achievement in advanced inorganic chemistry—**Julian Lo**. Additional information about Julian is under the *David A. and Merece H. Johnson Scholarships*.


Ross Kerner


Mark Strom


Matthew Urberg

Merck Index Award sponsored by Merck & Co., Inc. This award consists of the latest edition of the Merck Index and is given for outstanding scholastic achievement in organic chemistry—**Ross Kerner** and **Mark Strom**. **Ross** is from Roseau, MN. He studies the physical chemistry of highly conjugated organic molecules, and uses concepts in organic chemistry about conjugation, electron transfer, crystallizations, and conformations in his work with organic semiconductors. **Mark** is from Rochester, MN. He plans on attending graduate school to earn doctorates in medicine and biochemistry.


Megan Matta


Ross Kuchta

Wayland E. Noland Scholarship was given to a full-time undergraduate transfer student majoring in chemistry who show academic promise—**Matthew P. Urberg**. **Matthew** is from Blue Earth, MN. He particularly enjoys organic chemistry, and plans to be involved in research in the food industry.


Anwar Zahar


Seunghwan Kim

Wayland E. Noland Second Scholarships were given to full-time undergraduate transfer students majoring in chemistry who show academic promise—**Megan E. Matta, Ross Lawrence Kuchta**, and **Anwar Wayne Zahar**. **Megan** is from Shoreview, MN. She enjoys chemistry because it is applicable to a variety of subjects, including her hobby interest of designing sets and special effects props for theater productions. "You need to know a decent amount of chemistry to get a good looking zombie." She hopes to attend graduate school and get a job in industry. **Ross** is from Marshall, MN. He is interested in physical and quantum chemistry, especially concerning nanomaterials, laser chemistry, and quantum information/computing. He hopes to pursue a doctorate and continue as a postdoctorate researcher, working on emerging technologies like quantum computers and nanoscale engineering. **Anwar** is from Saint Paul, MN, and his parents are Moroccan. He enjoys chemical reactions, and plans to use chemistry as much as possible because it is something that fascinates him.

George B. and Mary Ann Bodem Scholarship was given to a new student with academic promised interested in pursuing a degree in chemistry—**Seunghwan Kim. Seunghwan** was born in Texas, but grew up in Jinju, Korea. He enjoys studying chemistry. He wants to become a dentist, and has discovered that biology and chemistry are closely related.

If you have questions, would like to make a gift to a scholarship or fellowship fund, or need assistance in making a gift, please contact Kathy Peters-Martell, External Relations officer, Department of Chemistry, at kpeters@umn.edu or 612-626-8282. Also, visit the department's website giving page, http://www.chem.umn.edu/giving/.

Alumnus honors Professor Ellis with scholarship

Steven Hentges, Ph.D., has endowed a scholarship in honor of Professor John Ellis—the Professor John E. Ellis Scholarship.

Hentges graduated from the University of Minnesota in 1976 with a bachelor's degree in chemistry. He was a National Science Foundation undergraduate research participant during the summer of 1974, and conducted research in Professor Ellis' group for about two years. Hentges still holds the undergraduate record for co-authoring the most articles from research done in Ellis' research group—three. He received his doctorate from Stanford University where he worked with Nobel laureate K. Barry Sharpless.

In establishing the scholarship endowment, Hentges notes that as a teacher, mentor and friend, Professor Ellis was an important influence in helping him reach his undergraduate educational goal. "More importantly, the opportunities that he provided [for me] to develop while at the university provided a strong foundation [for me] to succeed in graduate school and a career in the chemical industry," Hentges wrote.

The scholarship award will be given to students with academic promise who have an interest in majoring in chemistry. This scholarship qualifies for a match from the University of Minnesota, doubling the impact of the gift. To contribute, visit the department's giving page.

donor listing section

2010-11 Donors to the Department of Chemistry

The Department of Chemistry thanks the many generous alumni, faculty and friends listed below for their donations to support the department in fiscal year 2010-11. These gifts enhance our academic program and research while providing invaluable support and opportunities for our undergraduate and graduate students. We are grateful for your support.

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This listing includes all donations to the Department of Chemistry received from July 1, 2010, through June 30, 2011.

Grateful for your support

Another school year is underway for our hardworking students and dedicated faculty. We are delighted to welcome our talented undergraduate and graduate students back to campus; many of whom are scholarship and fellowship recipients thanks to the donations of our generous alumni and friends.

We are so grateful for the many ways our alumni support the Department of Chemistry, from establishing scholarships and fellowships to helping students finance their education, donating countless volunteer hours, and providing many gifts for the enhancement of the academic program and supporting specific projects. With your support, we will continue to attract the best and brightest students to the Department of Chemistry, and ensure the continuation of the groundbreaking research that is shaping our state and the world. The need for well-educated scientists has never been greater.

Please join us in helping to prepare the next generation of scientists and engineers through your involvement and financial support—it's a vital investment in the future.

—Kathy Peters-Martell

Department honors the legacy of Bryce Crawford Jr.

Bryce Low Crawford Jr., a retired Department of Chemistry professor and renowned scientist, died on September 16, 2011. He was 96. He joined the department in 1940, and became a full professor of physical chemistry in 1946. He was chair of the department from 1955 to 1960, and was dean of the graduate school from 1960 to 1972. He retired in 1985.

He loved studying molecular vibrations and force constants, and the experimental side of molecular spectroscopy and molecular structure. During World War II, Crawford worked in research on rocket propellants, making significant contribution to rocketry, and the development of solid propellants for the much larger rockets that evolved after the war.

Crawford received many honors during his career. In 1982, the American Chemical Society (ACS) honored him with the Priestley Medal, its most prestigious award, in recognition of his many contributions to chemistry. In 2004, he was named a Fellow of the Society for Applied Spectroscopy for his contributions to the advancement of spectroscopy and its applications. In 1950-51, he was a Guggenheim Fellow at the California Institute of Technology and a Fulbright fellow at Oxford University. He was a Fulbright scholar in Japan in 1966.

He held the distinction of membership in three honorary science academies—the National Academy of Sciences, the American Philosophical Society, and the American Academy of Arts and Letters. He was actively involved in many professional associations, including serving as chair of an ACS committee on abstracts; as a leading member of the National Academy of Science; as chairman of the President's Committee on the National Medal of Science; and as a member of the Science Development Advisory Panel of the National Science Foundation.

The Department of Chemistry has established a Bryce L. Crawford Lectureship in his honor. To make gifts to this fund, go the department's website giving page.

Gassman family creates graduate student travel fund

The late Professor Paul Gassman and his family have long been generous supporters of the Department of Chemistry and its students. In 1993, they established the Paul G. Gassman Lectureship in Chemistry, which continues to enrich the chemistry program by bringing distinguished organic chemists to campus each year to present multi-day lectures.

The family has established a new fund to support the department—the Paul G. and Gerda Ann Gassman Graduate Student Travel Fund. This fund will provide one-time awards to exceptional, full-time chemistry graduate students involved in research projects in the field of organic chemistry to present their research findings at national or international conferences. The Gassman family established this fund because they understand and appreciate the value of the opportunities this will provide for graduate students, while creating a wonderful tribute to Paul and the work that he did throughout his career for the university and the field of organic chemistry. To makes gifts to this fund, go to the department's website giving page.

For more information or assistance on making a gift, please contact Kathy Peters-Martell, External Relations officer, Department of Chemistry, at kpeters@umn.edu or 612-626-8282. Also, visit the department's website giving page at http://www.chem.umn.edu/giving/.

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Theresa Reineke joins chemistry faculty

Professor Theresa M. Reineke has joined the department's faculty. With expertise in polymer science and gene therapy and diagnostics, Reineke is a world leader in the area of polymer/deoxyribonucleic acid (DNA) nanostructures for medical applications.

Reineke earned her bachelor's degree in chemistry/physics from the University of Wisconsin-Eau Claire, her master's degree in chemistry from Arizona State University, and her doctorate in chemistry from the University of Michigan.

After completing her doctorate, Reineke received a National Institutes of Health National Research Service Award to study the synthesis and biological characterization of carbohydrate-containing polymers for gene therapy. She conducted this research at the California Institute of Technology.

Reineke began her academic career as an assistant professor at the University of Cincinnati. Prior to coming to the University of Minnesota, she was an associate professor of chemistry at Virginia Tech and a member of its Macromolecules and Interfaces Institute.

Reineke serves on the Editorial Advisory Board of *Bioconjugate Chemistry*, the International Advisory Board of *Macromolecular Bioscience*, and as associate editor of a new American Chemical Society (ACS) publication, *ACS Macro Letters*. She also serves as chair of the Molecular Conjugates Committee of the American Society of Cell and Gene Therapy, and as a councilor for the ACS Division of Polymer Chemistry.

She has received numerous awards, including a Beckman Young Investigator Award, a Sigma Xi-Rieveschl Outstanding Young Investigator Award, a National Science Foundation (NSF) Career Award, an ACS Arthur K. Doolittle Award, and a National Research Service Award. In 2009, Reineke received the prestigious NIH Director's New Innovator Award, receiving a large, multi-year grant for biomedical research into new medicines.

Professor Theresa Reineke

The Reineke research group specializes in the synthetic design, chemical characterization, and biological study of novel macromolecules. Reineke's research is highly collaborative. She is interacting with colleagues in the NSF Materials Science and Engineering Research Center (College of Science & Engineering), the Clinical and Translational Science Institute (Academic Health Center), and the Center for Magnetic Resonance Research (Academic Health Center) to solve important problems in polymer synthesis and characterization, develop innovative gene therapies, and invent new methods for magnetic resonance imaging.