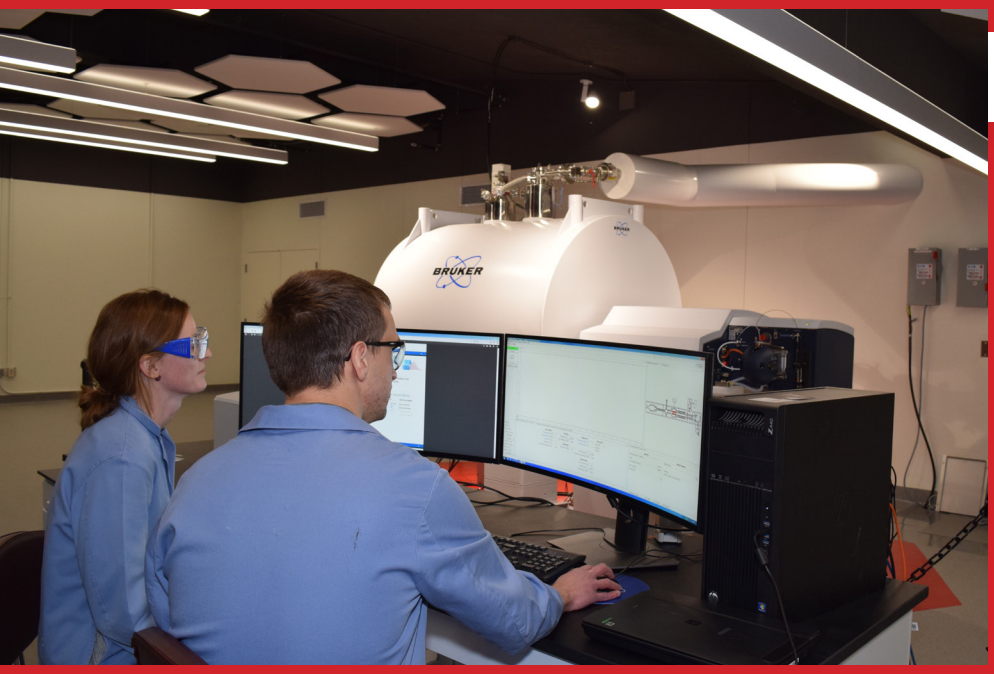
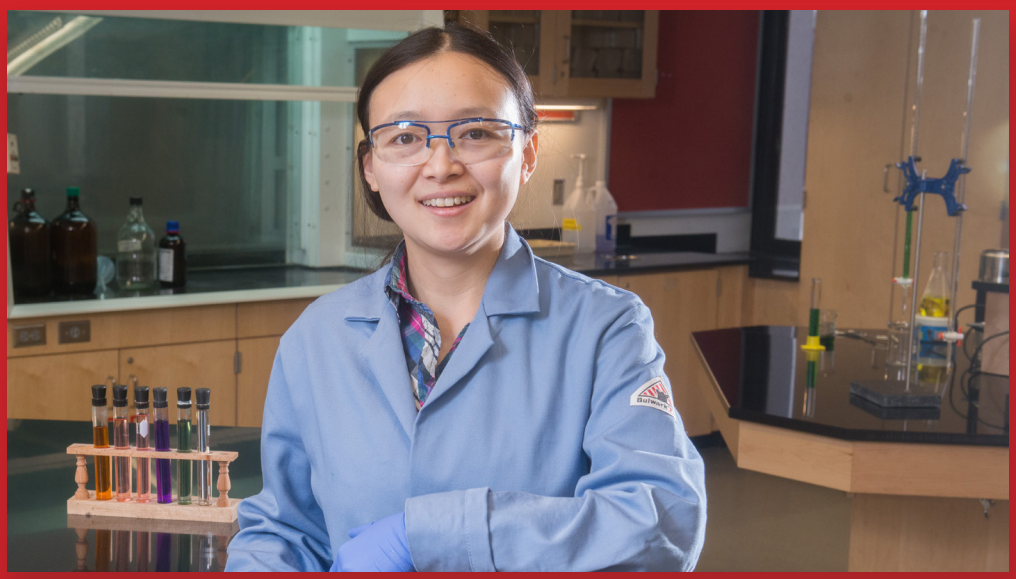
University of Nebraska–Lincoln Department of Chemistry

Alumni & Friends Newsletter

2019





CHEMISTRY

University of Nebraska Lincoln

Letter from The Chair

Alumni, Friends, and Colleagues,

We've had an extraordinarily busy and productive year! Federal support for research activity continues to grow and both the quantity and the quality of the Department's publication record remain strong. You will also note in the pages that follow that our faculty are being rewarded with a variety of state and national awards for their research, teaching, and service activities.

In the summer of 2018, we lost our Dean of Arts and Sciences, Joe Francisco, to the University of Pennsylvania. However, under the strong leadership of Interim Dean Beth Theiss-Morse, we embarked on an aggressive hiring plan that has allowed us to broaden our research portfolio in materials science and chemical biology. Support from our donors has been key to the success of the Department meeting our commitments to secure suitable start up packages. You will hear much more about our new Assistant Professors in next year's newsletter.

Additionally, we recently received good news about long-awaited renovations to our undergraduate laboratory space. In 2018, the Nebraska Board of Regents approved funding for the first of three phases of renovations that will dramatically improve the quality of the laboratory experience we can provide for majors and non-majors on the third and fourth floors of Hamilton Hall. A significant focus will be redesigned space for organic labs.

The 2018 calendar year included several special events. Among them was a Fall Mass Spectrometry symposium to celebrate the acquisition of our new 15 T FT-ICR, which became fully operational in the Spring. Additionally, we were fortunate enough to celebrate the inaugural "Reuben and Loretta Rieke Lectureship in Organometallic Chemistry." A well-attended banquet was held on campus on Thursday, November 1, followed by an outstanding lecture the following day by the one and only George Whitesides from the Department of Chemistry and Chemical Biology at Harvard University.

The Department is indeed proceeding through exciting and transitional times. The future remains bright, and I feel fortunate to play a supporting role in preparing for it. I hope you enjoy the contents of this year's newsletter. If you have the opportunity to do so, please visit us to see some of these changes for yourself!

Jody Redepenning

Professor and Interim Chair

Inside

David Hage

Craig Chandler | University Communication

Hage awarded Outstanding Research and Creativity Award

Melissa Lee
Central Administration

Hewett University Professor of Chemistry David Hage received a 2018 Outstanding Research and Creativity Award. The ORCA recognizes individual faculty members for outstanding research or creative activity of national or international significance. Hage is the sixth Department member to be honored with an ORCA.

"The University of Nebraska is one of the most important drivers of our state's economic competitiveness and quality of life. Our faculty, who are among the nation's leaders in what they do, deserve a great deal of the credit," Bounds said. "These faculty carry out our missions of teaching, research and service on a daily basis. I'm honored to serve among such dedicated and talented colleagues and to lift up their work to the university community and all Nebraskans."

Hage, who joined the University of Nebraska faculty in 1989, has carried out research at the interface of chemistry, biochemistry and clinical chemistry for more than 30 years. His work has focused on the creation and development of new detection and separation methods for chemical and biochemical analysis for important applications in the life sciences, pharmaceutical research and environmental testing. He has published more than 285 scientific papers, book chapters and books in these areas. He has also edited a handbook in the area of affinity chromatography, his field of scientific expertise, and he holds six patents in this area. In addition, Hage has written several college-level textbooks on the topic of chemical analysis.

Hage is currently editor-in-chief for the Journal of Chromatography B and is a fellow in the American Association for the Advancement of Science and the National Academy of Clinical Biochemistry.

Nebraska Chemistry ORCA Recepients

David Hage	2018
Xiao Cheng Zeng	2010
Pill-Soon Song	2000
Reuben Rieke	1995
Naba Gupta	1983
Norman Cromwell	1978

Zeng develops equation for designing clean-energy catalysts

Xiao Cheng Zeng
Craig Chandler | University Communication

New guidelines laid down by Nebraska and Chinese researchers could steer the design of less costly, more efficient catalysts geared toward revving up the production of hydrogen as a renewable fuel.

Nebraska's Xiao Cheng Zeng and colleagues have identified several overlooked factors critical to the performance of single-atom catalysts: individual atoms, usually metallic and anchored by surrounding molecular frameworks, that kick-start and accelerate chemical reactions.

The team folded those variables into a simple equation requiring what Zeng described as "back-of-the-envelope calculations." That equation should allow researchers to easily predict how the choice of atom and its surrounding material will affect catalytic performance. To date, researchers have often relied on time-consuming trial and error to find promising single-atom catalysts.

"All this (relevant) information can be easily gathered from a textbook," said Zeng, Chancellor's University Professor of chemistry. "Even before an experiment, you can quickly see whether it's a good way to make the catalyst. We're simplifying the process."
Using its equation, the team discovered several atom-framework combinations that approximate the performance of precious-metal catalysts – platinum, gold, iridium – at mere thousandths of the cost. One swapped out a platinum atom for manganese; another replaced iridium with cobalt.

"There are two (primary) ways to reduce the price of these catalysts," Zeng said. "One is to use as little of the metals as possible – so single-atom catalysts are the cheapest. The other direction is finding alternative metals like iron or aluminum or zinc that are very cheap."

Two of the team's atom-framework combinations can split water into its constituent parts: an oxygen atom and two hydrogen atoms, the latter of which can serve as a green fuel for vehicles and other applications. Two other catalyst candidates help oxygen atoms take on more electrons, priming them to bond with positively charged hydrogen atoms and form water – the desired byproduct of hydrogen fuel cells.

"Right now, this is not the prevailing way to produce hydrogen," Zeng said. "The industry still uses fossil fuels to produce hydrogen. It's just cheaper. So that's our motivation: lower the cost so that all these cleaner, fuel-producing reactions become (viable)."

The researchers found that the number and nature of atoms directly bonded to a single-atom catalyst can profoundly affect how it catalyzes chemical reactions. In some instances, the catalyzing atom might be attached to either three or four other atoms, each of which is itself part of a five- or six-atom ring. Every atom in that immediate network also has a known attraction to electrons, with the strength of that attraction further influencing catalytic performance.

The arrangement and qualities of those neighboring atoms matter, Zeng said, in the same way that an offensive line matters to a stationary, pocket-passing quarterback. And the team's new equation could act as a scouting report for researchers looking to amplify the strengths or cover the weaknesses of their personnel, he said.

For Zeng and his colleagues, that personnel consisted of more than 20 so-called transition metals that are generally worse than precious metals at catalyzing reactions. But the team showed that surrounding a cobalt, iron or other second-string atom with the right environment – sometimes a honeycomb of carbon atoms known as graphene, sometimes a network of nitrogen atoms – can elevate its performance.

"Every offensive line is different," Zeng said. "How do you make the quarterback function the best in that pocket? How do you find the best quarterback within different pockets?

"If you have a two-star quarterback, you need a better offensive line. But even a backup quarterback can perform well with the right line."

Zeng authored the study with colleagues from Beijing University of Chemical Technology. The study became just the second from a Big Ten institution to appear in the journal Nature Catalysis and was highlighted in Chemical and Engineering News, a magazine published by the American Chemical Society.

Scott Schrage
University Communication

New technique eases production, customization of soft robotics

Stephen Morin
Craig Chandler | University Communication

By helping rubber and plastic stick together under pressure, University of Nebraska-Lincoln chemists have simplified the production of small fluid-carrying channels that can drive movement in soft robotics and enable chemical analyses on microscopic scales.

The technique, which creates a stronger chemical bond between silicone and an unprecedented array of plastics, could greatly reduce the time, complexity and expense needed to produce and customize the microfluidic devices.

"We're really excited, because we're providing a (technique) to successfully integrate different materials in a way that is streamlined and supports numerous practical applications," said Stephen Morin, assistant professor of chemistry. "We think that can really offer new opportunities to the community."

In demonstrating those opportunities, the team used a basic software program to design microfluidic networks and a standard laser printer to map those channels onto a transparent Mylar sheet. After exposing the plastic sheet to ultraviolet light and submerging it in a solution, the researchers laid the sheet atop a silicone film and applied heat.

The plastic and silicone bonded strongly — except where pathways had been marked by the printer's ink. When the team pumped air or liquid into those unbound sites, the fluids flowed through them at rates dictated by the pressure being applied — pressures several times higher than what previous bonding techniques have withstood.

Soft robots and microscopic labs

Microfluidic networks can accommodate the flow and mixture of multiple liquids, essentially acting as a microscopic lab for analytical chemistry techniques that otherwise require conventional equipment such as beakers. Airflow through microfluidic channels can also direct the motion of soft-robotic arms, grippers and other components that show promise for remote surgery, space exploration and food processing.

"The analogy I use is: Would you rather have some sort of a soft gripper performing surgery on you, or would you rather have the Terminator do that," Morin said. "When the Terminator does it, if something goes wrong in the control-feed-

back loop, you have a big problem. But when you have the soft-robotic gripper doing that, if there's a problem, it just deflates like a balloon that's failed."

Manufacturers typically create microfluidic patterns by projecting light through customized masks onto a chemical-treated surface and then replicating that pattern into rubber, ultimately molding channels before overlaying them with plastic or glass. But many researchers must send their designs to specialized production facilities, often waiting a week or two for a mask to arrive. Modifying a design, even slightly, can mean another weeklong wait.

By contrast, the Nebraska team needed just an hour to produce a plastic-silicone segment featuring microfluidic networks. And unlike a more traditional method for bonding silicone to plastic, the team's technique allowed it to incorporate a large range of commodity plastics — inexpensive, easily accessible varieties that previously resisted bonding with silicone.

"We became interested in why there was a limitation in what plastics you could access, and what was going on chemically that was leading to that limitation," Morin said. "We were surprised to find that no one had really treated that problem thoroughly. We kind of took a step back and said, 'How can we encourage the surface chemistry to behave in a way that gives us very reliable, robust bonds?'

"People who had done anything like this before had relied on low pressures and open-channel designs, so they really weren't advancing the fabrication process of what you see in traditional microfluidics. Here, the chemistry has been worked out in a way that ... we can access these applications directly — print microfluidic devices, print soft-robotic devices."

Creases and Sharpies

Morin and his colleagues also demonstrated other advantages made possible by their bonding technique. The team showed that creasing a Mylar sheet before melding it with silicone can adjust the movement of resulting soft-robotic arms and grippers. Folding it several times at a 90-degree angle, for instance, made an arm curl more tightly. Creasing it at a 45-degree angle caused the arm to twist left or right, depending on which direction the researchers folded it. That level of on-the-fly versatility far exceeds what is offered by existing approaches, Morin said.

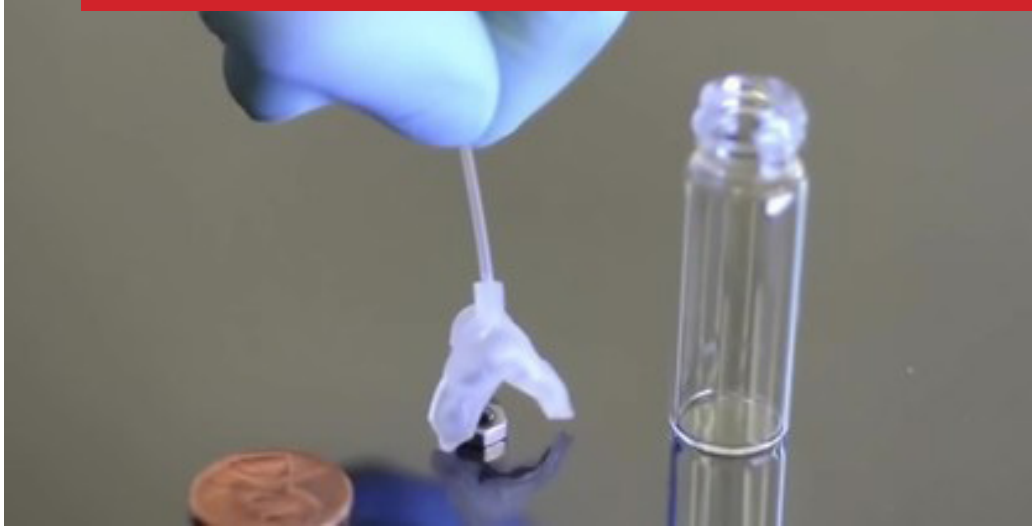
Because ink can prevent silicone and plastic from bonding, the team also modified an already-printed sheet — adding microfluidic channels to an existing design — simply by drawing on it with a marker. That capability, combined with the relative ease of production, could make the technique appealing to educators and science-oriented outreach groups, Morin said.

"We looked at it as an interesting opportunity to even further streamline the process, where you have some sort of a template that you could perhaps mail to different educational groups or workshops," he said. "And since you really only need an oven and a (UV) light source, you could potentially enable these groups to explore this kind of a technology, where they're literally customizing it by using a Sharpie."

The team detailed its work in the journal Advanced Materials. Morin authored the study with doctoral candidate Jay Taylor; postdoctoral researcher Karla Perez-Toralla; and Ruby Aispuro, an undergraduate student at California State University, San Bernardino.

The researchers received support from the National Science Foundation.

Morin and his colleagues have detailed a method for more strongly bonding plastics with silicones, offering new possibilities for fabricating fluid-carrying channels that are commonly used to direct the motion of soft robotic components.



Scott Schrage
University Communication

Marilyne Stains

Craig Chandler | University Communication

Lesson learned? Study by M. Stains & colleagues finds lectures still dominate STEM ed

An analysis of more than 2,000 college classes in science, technology, engineering and math has imparted a lesson that might resonate with many students who sat through them: Enough with the lectures, already.

Published March 29 in the journal Science, the largest-ever observational study of undergraduate STEM education monitored nearly 550 faculty as they taught more than 700 courses at 25 institutions across the United States and Canada.

The University of Nebraska-Lincoln's Marilyne Stains and her colleagues found that 55 percent of STEM classroom interactions consisted mostly of conventional lecturing, a style that prior research has identified as among the least effective at teaching and engaging students.

Another 27 percent featured interactive lectures that had students participating in some group activities or answering multiple-choice questions with hand-held clickers. Just 18 percent emphasized a student-centered style heavy on group work and discussions.

The predominance of lecturing observed in the study persists despite many years of federal and state educational agencies advocating for more student-centered learning, the researchers said.

"There is an enormous amount of work that has demonstrated that these (student-centered) strategies improve students' learning and attitudes toward science," said Stains, the study's lead author and associate professor of chemistry at Nebraska. "It's not just that they understand it better, but they also appreciate science more. They're not as scared of it, and they engage more easily with it.

"When you see that kind of effect, it makes you say, 'Why are we still doing it the other way?'"

One potential culprit captured by the study: Faculty may lack the training necessary to take advantage of smaller class sizes, open classroom layouts and other strategies meant to reduce the reliance on conventional lecturing. Lectures did occur less often in smaller than larger classes, the study found, and open layouts did correlate with more student-centered learning. But about half of the courses with those advantages still featured more conventional lecturing than interactive or student-centered teaching styles.

"When you talk to faculty, you often hear, 'I teach in an amphitheater. I could never do group work; it's just not practical. But if I had a small class, I could do it,'" Stains said. "But just because you have the right layout doesn't mean you're actually going to (promote) active learning. You need to be trained in those kinds of practices. If there's not a budget for professional development to help faculty use those environments, they're going to default to what they know best, which is lecturing."

The study did show that many faculty adopt multiple teaching styles throughout a semester. Among the faculty who were observed at least twice, 42 percent demonstrated two styles. Based on its data, the research team concluded that three or four classroom visits are needed to reliably characterize an instructor's approach.

"If your institution is really focused on student-centered teaching and visits your classroom only once a semester, on a day that you're lecturing, then you're going to fare poorly," Stains said.

Perception vs. reality

Much of the previous research into STEM instruction has relied on surveying faculty about their practices. Though the resulting data has proven valuable, Stains said, the flaws of human memory and perception inevitably find their way into that data.

"Surveys and self-reports are useful to get people's perceptions of what they are doing," she said. "If you ask me about how I teach, I might tell you, 'I spend 50 percent of my class having students talk to each other.' But when you actually come to my class and observe, you may find that it's more like 30 percent. Our perception is not always accurate."

So the research team decided to monitor STEM classroom practices with a commonly used protocol that involved documenting many types of student and instructor behavior during every two-minute interval throughout a class. An analysis that accounted for the prevalence of those behaviors allowed the team to identify seven instructional profiles, which were then categorized into three broad teaching styles.

Those efforts also led to the development of an application that runs essentially the same analyses conducted in the study.

"People can do their own measurements and see how they compare to this large dataset – see how either their department or college is doing – and say, 'This is where we stand. This is where we want to go.'"

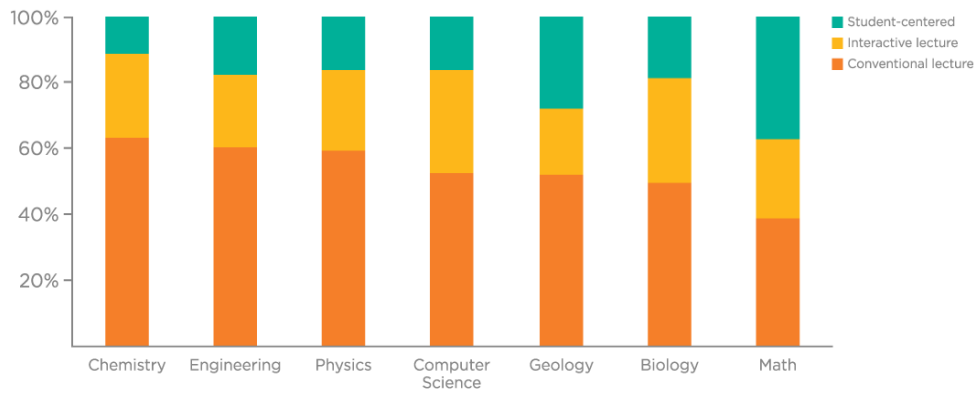
In the meantime, the study's scale and interdisciplinary nature make it a "reliable snapshot" of how STEM gets taught to undergraduate students in North America, its authors said.

"There are many universities that are interested in integrating student-centered practices into their undergraduate STEM curriculum," Stains said. "This could give them insights about what's probably going on in their classrooms if they're at a research-intensive institution."

Stains authored the study with colleagues from Auburn University; Simon Fraser University; the University of British Columbia; the University of Colorado Boulder; the University of Iowa; Armstrong State University; the University of California, Los Angeles; Otterbein University; the University of California, San Diego; the University of Michigan; the University of Calgary; the University of Virginia; the University of Maine; and Saint Mary's University (Halifax).

The research team received funding in part from the National Science Foundation and the National Institutes of Health.

Scott Schrage
University Communication



A breakdown of how teaching styles varied by STEM discipline.

Nebraska leads $11M study to develop radiation exposure drug

The U.S. Department of Defense has turned to the University of Nebraska to jumpstart the development of drug therapies to protect military service members from the effects of radiation exposure.

In an environment where for-profit pharmaceutical companies are often reluctant to embark upon financially risky drug discovery efforts, the unique four-pronged partnership established by the university and the Department of Defense could shorten the U.S. military's wait for drugs that prevent and counteract the effects of radiation exposure.

"It's an exciting collaboration among the federal government, our state university and two of its premier research campuses — University of Nebraska Medical Center and the University of Nebraska–Lincoln — and consultants from private pharma who are Nebraska alumni," said David Berkowitz, professor of chemistry.

This team operates under the auspices of the university's National Strategic Research Institute, one of 13 university-affiliated research centers. Nebraska has the lone research center entrusted by the military to work on chemical, biological, radiological and nuclear threats.

"This research represents the broad capacity of the University of Nebraska and its alumni consultants to tackle potentially hazardous radiation exposures around the world," said Lt. Gen. (Ret.) Robert Hinson, founding executive director of the National Strategic Research Initiative.

The University of Nebraska project for the Defense Health Agency, and in collaboration with Armed Forces Radiobiology Research Institute, has reached a second increment — potentially awarding nearly $11 million in federal funding over the next five years. Nebraska researchers will look for therapeutics candidates the U.S. military would need to protect troops from radiation in case of exposure, as in a nuclear accident or a nuclear weapons incident.

Leveraging the full, collaborative strength of a united university system — multiple campuses, a network of successful alums — directed by the Department of Defense, is something new for the university.

"I've never been involved with anything like that before," Berkowitz said. "This team came together as a joint vision between the team leadership and our (Department of Defense) funders and it's pretty unusual across the country to see such a public-private-government partnership."

In fact, the university hopes this opens the door to continued partnership with private pharma in the longer term, through identifying and developing therapeutic candidates that have dual-purposing potential, Berkowitz said. Berkowitz is co-primary investigator of the project, with Ken Bayles, professor of pathology and microbiology at UNMC.

Bayles said if private pharmaceutical companies are leaving a gap, the University of Nebraska is eager to step in.

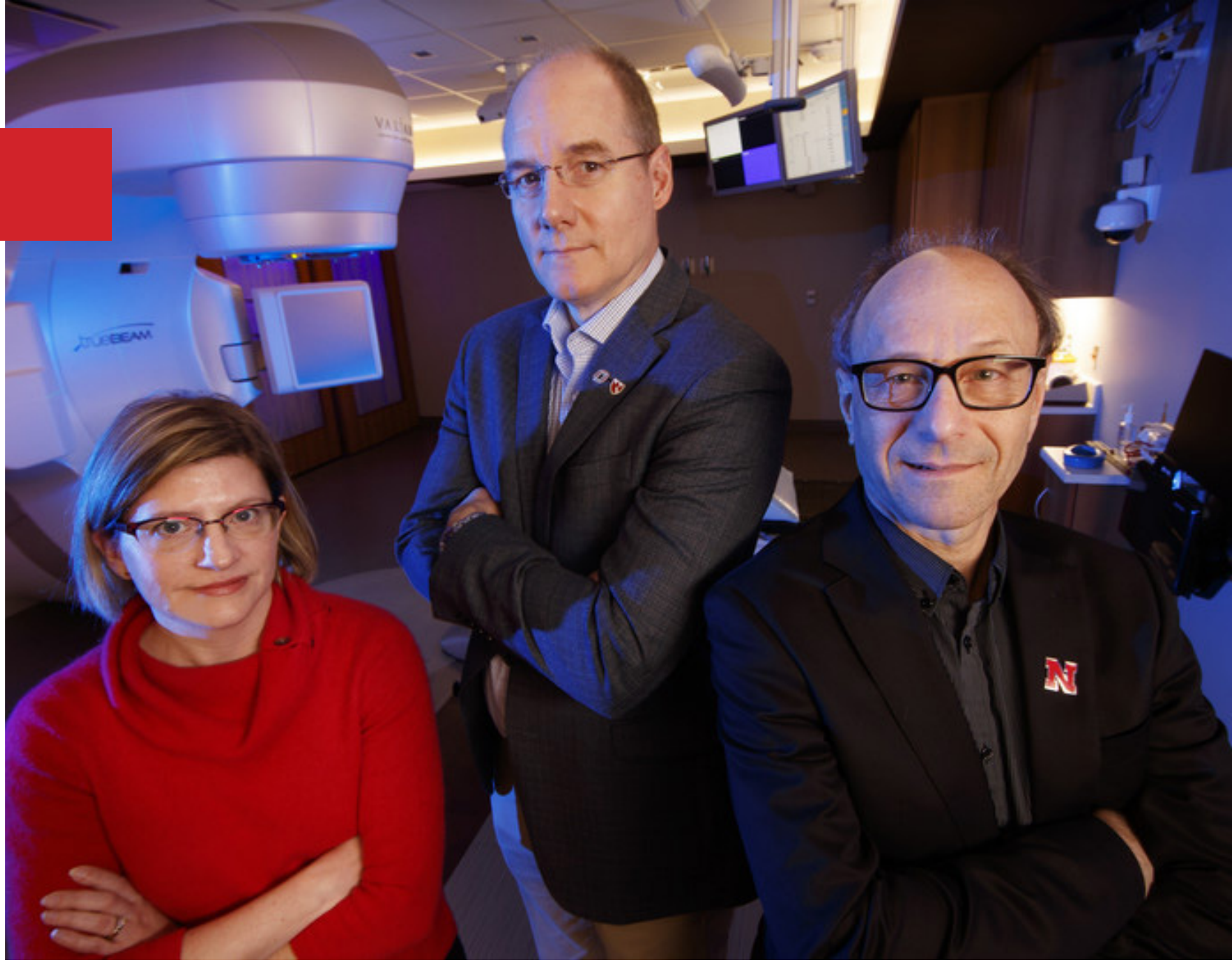
"We've pitched this concept to develop a virtual pharmaceutical company, a drug development pipeline that would coordinate the activities of all the expertise we have across all of our campuses and develop capabilities to move molecules forward for drug development," he said.

Handfuls of NU's top scientists will work on medicinal chemistry, metabolomics and bioinformatics in order to move potential drug candidates toward clinical trials. "We'll be coordinating all of these aspects like a pharmaceutical company does," Bayles said. "If we do it right, this pipeline concept is an opportunity to build the economy in Nebraska, build the pharmaceutical industry in Nebraska."

Berkowitz said the new multi-pronged, multi-campus team is complex, but, "it's working pretty well."

"We are extremely proud to be affiliated with this research and the impact it can have for the Department of Defense, Defense Health Agency and other agencies as well," Lt. Gen. Hinson said.
Consultants from pharmaceutical industry will advise Nebraska scientists on the drug development effort.

Collaborators include the following University of Nebraska scientists, who bring key expertise to the project to establish a drug development pipeline that could speed the process



Becky Deegan (UNMC), Kenneth Bayles (UNMC), and David Berkowitz *Craig Chandler | University Communication*

of developing new drugs at the Armed Forces Radiobiology Research Institute to counteract the effects of radiation exposure:

- Samuel Cohen, UNMC, toxicology
- Patrick Dussault, UNL, synthetic chemistry
- Babu Guda, UNMC, bioinformatics
- Tomas Helikar, UNL, computational systems biology
- DJ Murry, UNMC, pharmacokinetics and pharmacogentics
- Rebecca Oberley-Deegan, UNMC, radiation therapeutics
- Robert Powers, UNL, metabolomics

Additionally, multiple University of Nebraska alums, all doctoral scientists, with current or former experience in private pharma, also are involved. This experienced consultant team includes Eugene Cordes of Philadelphia (honorary degree, UNL, 2009), Norton Peet, Holland, Mich. (Ph.D., UNL, chemistry, 1970), Kevin Woller, Antioch, Ill. (Ph.D., UNL, chemistry , 1996), Chad Briscoe, Overland Park, Kan. (Ph.D., UNL, chemistry, 2009), Ryan Hartung, Tuscon, Ariz. (B.S., UNL, chemistry, 2000).

"They are appreciative of the opportunity to give back to their home institution," said Berkowitz. "They really like the idea of the Lincoln and Omaha campuses collaborating. They really like working for the DoD. There is a patriotic aspect of helping the country and protecting our troops using the tools of biomedical science.

"That's something that has made this project special for all of us."

Select external awards

Marilyne Stains, PI — NSF — $512,550 (02/28/2018 – 02/28/2021) "CAREER: The Winding Roads to Effective Teaching: Characterizing the Progressions in Instructional Knowledge and Practices of STEM Faculty"

Andrzej Rajca, PI — MIT (NIH Prime) — $379,560 (04/01/2018 – 03/31/2023) "Organic Nanoparticles for Dual MRI-Guided Therapeutic Selection and Ovarian Cancer Drug Delivery"

Mark Griep, PI — NSF — $355,181 (06/01/2018 – 05/31/2021) "REU Site: Research Experiences for Undergraduates in Chemical Assembly at the University of Nebraska"

Clifford Stains, PI — NIH — $125,000 (06/18/2018 – 06/17/2019) "Chemical Approacheds for Interrogating Fundamental Biomedical Processes (Supplement)"

Eric Dodds, PI — NIH Maximizing Investigators' Research Award (R35) — $1,843,480 (07/01/2018 – 06/30/2023) "REU Site: A Research Program on Advancing Biomedical Glycoproteomics"

Jiantao Guo, PI — NSF — $5,890 (07/15/2018 – 12/31/2018) "CAREER: Quadruplet Codon Decoding-Mechanistic Studies and Application in Cellular Genetic Code Expansion (Supplement)"

David Berkowitz, PI — NSF ENG CBET — $470,000 (08/01/2018 – 07/31/2021) " New Approaches to Catalyst Screening and Development"

Rebecca Lai, PI; Joselyn Bosley (University of Nebraska-Lincloln Department of Physics and Astronomy), Co-PL — NASA — $8,000 (10/01/2018 – 12/31/2019) "UNO-NASA Space Grant: UNL Conference for Undergraduate Women in Physical"

Rebecca Lai, PI — NSF EPSCoR — $5,000 (10/01/2018 – 12/31/2018) "Conference for Women in Physics"

David Berkowitz, PI; Patrick Dussault, Robert Powers, and Thomas Helikar (University of Nebraska-Lincloln Department of Biochemistry), Co-PL — National Strategic Research Institute — $6,346,771 (10/01/2018 – 9/30/2023) "Medical Countermeasure Drug Discovery and Development, phase 2"

Collaborations

Donald Becker, PI; Jiri Adamec, co-PI; Jim Alfano, co-PI; Oleh Khalimonchuk, co-PI; Jaekwon Lee, co-PI; Seung-Hyun, co-PI; Julie Stone; co-PI; Mark Wilson, co-PI; Limei Zhang (University of Nebraska–Lincoln Department of Biochemistry), co-PI; Rodrigo Franco Cruz (University of Nebraska–Lincoln School of Veterinary Medicine & Biomedical Sciences), co-PI; Liangcheng Du, co-PI — NSF — $98,663 (03/01/2018 – 02/28/2021) "REU Site: Training in Redox Biology"

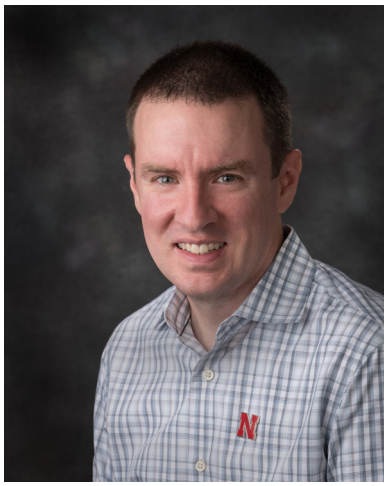
Sidy Ndao (University of Nebraska–Lincoln Department of Mechanical & Materials Engineering), PI; Nicholas Brozovic (University of Nebraska–Lincoln Department of Agricultural Economics),co-PL; Rober B. Daugherty (Water for Food Global Institute at the University of Nebraska), co-PI; Rebecca Lai, co-PI — IntelliFarm (Nebraska Department of Economic Development, Phase II Prime) — $201,657 (03/01/2017 – 02/28/2018) "Contaminant Sensing and Field Data Platform"

Wei Niu (University of Nebraska–Lincoln Department of Chemical & Biomoleular Engineering), PI; Mark Wilson (University of Nebraska–Lincoln Department of Biochemistry), co-PI; Jiantao Guo, co-PI — NSF — $335,516 (09/01/2018 – 08/31/2021) "Engineering Carboxylic Acid Reductase for the Biosyntheses of Industrial Chemicals"

Karrie Weber (University of Nebraska–Lincoln School of Biological Sciences), PI; Joshua Herr (University of Nebraska–Lincoln Department of Plant Pathology), co-PI; Rebecca Lai, co-PI — NSF — $335,516 (09/01/2018 – 08/31/2021) "Engineering Carboxylic Acid Reductase for the Biosyntheses of Industrial Chemicals"

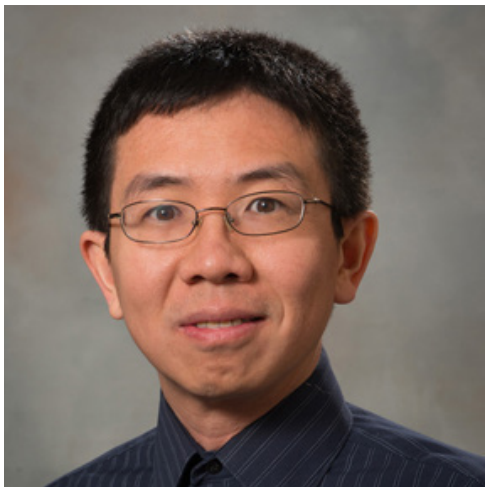
Faculty promotions and awards

Congratulations to our faculty who received promotions and awards from the university and the College of Arts & Sciences over the past academic term!



Cliff Stains

Promoted to Associate Professor & Granted Tenure



Jiantao Guo

College of Arts & Sciences' Outstanding Research and Creativity Activity Award

David Hage

University of Nebraska Outstanding Research and Creativity Activity Award

Moon joins Nebraska Chemistry

Dr. Alena Moon joined the Department of Chemistry in August of 2018. Moon an Assistant Professor specializing in chemical education research recieved her B.S. degree from John Brown University (Arkansas). She continued her education in the Marcy Towns group as she recieved her Ph.D. from Purdue university. And prior to arriving in Lincoln Dr. Moon was a postdoctoral fellow with Professor Ginger Schultz at the University of Michigan.

Over the academic year, Moon's research group has grown, adding postdoctoral fellow Morgan Balabanoff, graduate student Katie Patterson and several undergraduate students assisting in research.

The group's research centers around one core concept–light-matter interactions–and one key scientific practice–engaging in argument from evidence.The group is investigating students' understanding of core concepts within light and matter interactions. Students encounter light-matter interactions throughout their entire degree, so we are working to develop a learning progression, which is a potential trajectory students may progress through as they move towards a sophisticated understanding.

For more information on the Moon Research Group visit: *chemweb.unl.edu/moon*

Industrial Adv

[L to R]: Teresa Urlacher, David L. Pugmire, Norton P. Peet (IAB
Woller, Paul Ries, Jody Redepenning (Chemistry Interim Chair),

dvisory Board

AB Chair), Peggy Ruhn , Michael Grace, James E. Lohr, Kevin R.
), Larry A. Middendorf, Marijean Eggen, Christian A. Sandstedt

Students showcase research at 2018 Summer Poster Session

The 2018 Summer Poster Session was held on August 7. Over 40 high school, undergraduate, graduate, and post doc participants highlighted their research at the two-hour long event. It was another great showing of how our students are contributing to the department's overall research endeavor. Congratulations to this year's winners!

Post Doc Division

1st Place – *Novel Bright Phosphinate-Based Near-Infrared Fluorophores and Their Biological Applicaiton*; **Yuan Fang**, Xinqi Zhou, Cliff Stains*

Honorable Mention – *Improved the anti-MRSA antibiotics WAP-8294A production of Lysobacter enzymogenes by nutritional manipulation*; **Xusheng Cheng**, Lingjun Yu, Liangcheng Du*

Senior Graduate Division

1st Place – *Where is this CAHB going?*; **Suman Chakrabarty** and James Takacs*

2nd Place – *Slow Recovery of Longitudinal Polarization in the Gas-phase NMR Spectra of Matrix-isolated Molecules*; **Seth Blackwell** and Gerard Harbison*

3rd Place – *Characterization of Phenazine O-Methyltransferase LaPhzM from Lysobacter antibioticus*; **Jiasong Jiang**, Daisy Guiza Beltran, Andrew Schacht, Stephen Wright, Limei Zhang, and Liangcheng Du*

3rd Place – *Energy-Resolved Collision-Induced Dissociation of Protonated O-Linked Glycopeptides*; **Maia Kelly** and Eric Dodds*

3rd Place – *Discrimination of Metal Adducted Isomeric Carbohydrates by Ion Mobility Spectrometry, (a) (b) (c) LST-b LST-c 2, 4A3/Y2α 1,3A3/Y2α 562 LST-b LST-c LST-b LST-c Electron Transfer, and Vibrational Activation*; **Anna Diepenbrock**, Katherine Schumacher, and Eric Dodds*

Honorable Mention – *Improving quadruplet codon decoding efficiency through fine-tuning biomolecular interactions*; **Erome Hankore**, Linyi Zhang, Yan Chen, and Jiantao Guo*

Junior Graduate Division

1st Place – *Structural Determinants of Ion-Neutral Collision Cross Section in Carbohydrate Isomers as Group I Metal Adducts*; **Jessica Minnick** and Eric Dodds*

2nd Place – *Method Development for Matrix-Assisted Laser Desorption/Ionization Mass Spectrometry Imaging*; **Alana Riser**, Andrea McCain, Jennifer Wood, and Eric Dodds*

3rd Place – *Rapid Screening of Drug-Protein Interactions by High-Performance Affinity Chromatography*; **Ashly Woolfork**, Pingyang Tao, Zuchen Sun, and David Hage*

Undergraduate Division

1st Place – *Measuring Analyte-Protein Binding AFfinities Using Ultra-Thin Layer Affinity Chromatography*; **Brandon Hacha**, Allegra Pekarek, Elliot Rodriguez, and David Hage*

2nd Place –*Physiological Role of the Conversion of Modified Phenazines in Lysobacter Antibioticus* OH_{13}; **Ronald Woodruff**, Jiasong Jiang, Liangcheng Du*

3rd Place – *Phosphinate-Based Rhodol and Fluorescein Derivatives and their Applications as Bioprobes*; **Gillian Good**, Yuan Fang, and Cliff Stains*

Honorable Mention – *New Small, Rigid Nitroxide for Site-Directed Spin Labeling of Proteins*; **Nicole Richards**, Zhimin Yang, Suchada Rajca, and Andrzej Rajca*

High School Division

1st Place – *Use of Serine- and Phosphoserine- containing Peptides in the Design and Fabrication of Electrochemical Uranium Sensor*; **Sarah Melton**, Emily Schaefer, Channing Thompson, and Rebecca Lai*

Honorable Mention –*Hand-Operable Elastomeric Devices*; **Gabriel Pribil**, Abhiteja Konda, Madi Schwenka, Karla Perez-Toralla, Jay Taylor, and Stephen Morin*

2018 scholarship and award winners

The department would like to congratulate the 2018 student award and scholarship winners!

Award Winners

Pill-Soon Song Graduate Research Assistant Award
Jie Zhong
Advised by Xiao Cheng Zeng

Charles A. Kingsbury Graduate Research Assistant Award
Xinqi Zhou
Advised by Cliff Stains

Craig Eckhardt Graduate Research Assistant Award
Hamid R. Lotfi Zadeh Zhad
Advised by Rebecca Lai

Graduate Research Assistant Honorable Mention
Abhiteja Konda
Advised by Stephen Morin

Cromwell Graduate Research Assistant Award
Suman Chakrabarty
Advised by James Takacs

Fuerniss Fellowship Award
Moriah Locklear
Advised by Patrick Dussault

Edward P. Rack Graduate Teaching Assistant Award
Seema Pande
Advised by Xiao Cheng Zeng

James Looker Graduate Teaching Assistant Award
Moriah Locklear
Advised by Patrick Dussault

T. Adrian George Graduate Teaching Assistant Award
Anna Diepenbrock
Advised by Eric Dodds

Henry Holtzclaw Graduate Teaching Assistant Award
Jay Taylor
Advised by Stephen Morin

Graduate Teaching Assistant Honorable Mention
Maia Kelly
Advised by Eric Dodds

James D. Carr First Year Graduate Teaching Assistant Award
Rukshani Wickrama–Arachchi
Advised by James Takacs

First Year Graduate Teaching Assistant Honorable Mention
Andrew Hartman
Advised by Alexander Sinitskii

George Sturgeon Undergraduate Teaching Award
Matthew Ballweg

Scholarship Winners

University of Nebraska–Lincoln Chemistry Scholarship
Joshua Cuddy
Maddison Han

Ervin F. Wilson Chemistry Scholarship
Noah Free
Marcus Judah
Payton Knutzen–Young

Marjorie Dewey & Catherine Kelly Scholarship
Bailee Flemming
Emma Hastings
Dung Lee
Dayton Schumacher
Connor Van Orman

Viola C. Jelinek Scholarship in Chemistry
Nora Breen
Kaleb Jones
Kyle McMillan

Lester C. & Joan M. Krogh Scholarship in Chemistry
Jiayuan Cui
Mason McCormick
Sean McDermott
Megan McKay
Carly Moran
Jane Speire

Sandoz Foundation Chemistry Scholarship
Jared Fletcher
Shae Lott
Britton Lyon
Madison Schlachter
Colton Webster

Maxine Wertman Fund Scholarship
Alexander Batelaan
Ngoc–Tran Bui
Miranda Johs
Haylee Lafrentz
Emily Meade
Jacob Moore
Henry O'Callaghan
Benjamin Steffensmeier

Dr. B. Clifford Hendricks Memorial Fund Scholarship
Matthew Gromowsky

Clyde & Elva Weyenberg Scholarship
Lauren Lesiak

Ralph F. Nielsen Scholarship
Matthew Ballweg

Alumni Spotlight: Henry Hughes '70

I, Henry Hughes, a University of Nebraska Ph.D. graduate, am taking this opportunity to reminisce about my past, including my wonderful years at the University of Nebraska–Lincoln.

I was born in Germany and came to this country in 1948, not speaking a word of English. I spent my first year at a country one-room school, first through eighth grades. That's were I learned to speak English, just by attending school and playing with my friends.

I was the only one in my family that eventually went to college, attending Quincy University, where I majored in Chemistry, then applied and was accepted at the University of Nebraska in the Chemistry department. I graduated in 1970 with my Ph.D. in Organic Chemistry.

My first and only employer was Motorola, in Phoenix, Arizona where I was fortunate to have my own lab, and eventually obtained the rank of Senior Member of the Technical Staff. I was employed at Motorola for 33 years, retiring in 2003.
My years at Motorola were very most interesting, I loved every minute of my job (95% of the time), and I spent my entire career doing research in the Semiconductor Research Laboratories.

My research investigations including problem solving for manufacturing, semiconductor process improvements, modifying new photographic polymers and organic dielectrics, semiconductor wafer bonding, photoresist process improvements, synthesis of new spin-on dielectrics (spin-on glasses), silicone polymer chemistries, and eventually exploring opportunities in chemical and micro-electromechanical systems (MEMS).

I retired with several accomplishments, including 25 patents, 35+ publications, and several personal awards through the years.
When I first came to Motorola, an electronic company, I had no idea that this was as much a chemical world as it was electrical. The electronic industry is, even today, an opportunity for many university chemistry departments to explore and form partnerships.

When I was close to graduating, I did not know just what direction I should go in my career. I was fortunate to have a Professor that had come from the chemical industry before entering into the teaching field. His industrial experience really gave me a first had introduction of what opportunities were open to me, especially with an advanced degree in chemistry.

After applying to several universities, I had several offers, most of which were in the East. I had also applied for a TA available at the University of Nebraska, which had a strong chemistry department. I subsequently, accepted at Nebraska, as I had no desire to fight the oldness, traffic congestion, and cost of living in the East.

My choice for the University of Nebraska was undeniably the best! The atmosphere, open spaces of Lincoln, and the camaraderie, friendliness, interactions within the chemistry department were unbeatable. Doctor James Looker (my research director), and other professors with which I had interactions, including Drs. H.Baumgarten, J. Holtzclaw, C. Michjeda, J. Demuth, and N. Cromwell, just to name a few, were always cordial, easily approachable, and open to listening and giving advice. They all taught me well.

The one thing that I found perhaps that could have been somewhat more helpful and an asset to a university, was to have had a professor that had come from industry, in particular the semiconductor industry, as that industry at the time was especially open to the needs of chemists. I feel it was rather unknown to many undergraduates and graduate chemistry professors.

My research project under Dr. Looker, was related to cancer applications, but as it ends up, the materials I synthesized had photochemical behaviors, and that is what caught the attention of the Motorola laboratories in Phoenix, AZ. Hence, I was invited to come for an interview at Motorola and subsequently received a job offer. (I do have to say that the colored, lighted palm trees, western motif, and vastness of land on my trip to Phoenix in November had something to do with making my decision over offers I had received from several companies back East.)

My days in Lincoln, Nebraska were some of the best years of my life. Though it required lots of studies and nights in the laboratory, there was plenty of time to enjoy the camaraderie of friends. And of course, who can forget the Go Big Red football days! Never being a football fan before coming to Lincoln, one soon got caught up in its festivities, and going to the games in a sea of red was an unbelievable experience. Parking was a big hassle game days, but I got around that by riding a modped and parking at Avery Hall, which was almost adjacent to Memorial Stadium. A few hours on weekends were reserved to have a little fun. In some of my circle of chemistry friends, we took turns brewing a few spirits. Tom Barrett was the beer brewer using his bathtub! I took my turn fermenting wine in gallon jugs, using a blown glass air lock specially designed for poor grad students by the glass shop. Heinz Krönberger, a fellow grad student and others used to go to the (at that time famous restaurant), Der Loaf and Stein, to have a few beers. Though Heinz and I were both from Germany, Heinz use to say, "Henry, I am ashamed of you...only two beers and you're from Bavaria." (Two beers were my limit, as any more than that, I'd fall asleep.)

The friendliness of the Nebraska people also was so pleasing. I got married to Carolyn Gualtieri after my first year in Lincoln, and we rented a house on West A street for $85/mon! Our landlords were both employed by UNL. Next door neighbors were another young couple, and we'd take off on many weekends just to see the country, i.e. the Black Hills, Yankton Dam, Omaha, Lake Okoboji, just to name a few. Great times and friends in Lincoln!

The education I received at UNL opened up several job opportunities in several areas in the chemical industry, and unexpectedly, my chemical education at UNL enabled me to follow my career in the electronic industry.

For those entering the engineering and chemical field, the opportunities are there. It just takes perseverance, a "where there is a will, there is a way" attitude, interactions with your fellow classmates and professors, and a passion for your endeavor. Take the initiative on your own to set what you want to accomplish, set your goals (i.e. set your own realistic goal when you want to graduate), and work AND play hard. I had that opportunity at the University of Nebraska. So can you!

Don't forget to contribute a little to your University. UNL gives one the fundamentals to succeed, and it is a good feeling to be able to pay back a little for the accomplishments one has achieved.

Left to Right: Katherine Schumacher, Maia Kelly, Abby Gelb, Eli Riekeberg, Richard Zare, Fatema Bhinderwala, Tessa Andrews, Anna Diepenbrock, Jay Taylor

Robert Vencil | Nebraska Chemistry

Zare wins 2018 Phi Lambda Upsilon – Rho Chapter Award Lecture

Professor Richard N. Zare of Stanford University was awarded the Phi Lambda Upsilon – Rho Chapter Lecture Award on March 9, 2018.

The Zare group is developing new ambient ionization mass spectrometric techniques for high resolution mass spectrometric imaging. They call these new methods desorption/ionization droplet delivery mass spectrometry (LDIDD MS) and nanoambient ionization mass spectrometry (NAIMS). The LDIDD MS utilizes a pulsed laser for desorption and ionization of molecules on a substrate; liquid droplets directly sprayed onto the focused laser irradiation spot carries the desorbed ions to a mass spectrometer. The distribution of different molecules in mouse pancreas tissue, presumably the islets of Langerhans, was successfully imaged. LDIDD MS is also capable of direct real-time analysis of samples in the liquid phase. They are currently seeking the application of LDIDD MS to spatially resolved metabolomic profiling as well as the spatiotemporally resolved secretomic profiling at the single-cell level.

Zare is the Marguerite Blake Wilbur Professor in Natural Science at Stanford University. At Harvard University, Zare earned a B.A. in Chemistry and Physics in 1961. He also completed his PhD in Chemical Physics from Harvard in 1964. He moved to Stanford in 1977and was named Chair of the Department of Chemistry in 2005. In 2006 He was named a Howard Hughes Medical Institute Professor. From 1997-2000 he served as the Chair of the President's National Medal of Science Selection Committee. Currently, he was appointed chair of the Committee on Science, Engineering, and Public Policy of three academies. He currently holds honorary degrees from 12 universities and is a member of NAS and AAAS. He has authored over 900 publications, 50 patents, and 4 books.

Recent Honors & Awards

- Othmer Gold Medal - Chemical Heriate Foundation, 2017
- King Faisal International Prize in Science, 2011
- RB Bernstein Award in Stereodynamics, 2010
- ACS Priestley Medal, 2010
- FA Cotton Medal for Excellence in Chemical Research, 2009
- H. Julian Allen Award, NASA Ames Research Center, 2007
- Wolf Prize in Chemistry, 2005
- ACS Charles Lathrop Parsons Award, 2001
- Royal Society of Chemistry Faraday Lecture, 2001
- ACS Nobel Laureate Signature Award for Graduate Education, 2000
- APS Arthur L. Schawlow Prize in Laser Science, 2000
- Welch Award in Chemistry, 1999
- ACS E. Bright Wilson Award in Spectroscopy, 1999
- California Scientist of the Year Award, 1997
- NASA Exceptional Scientific Achievement Award, 1997
- ACS Award in Chemical Instrumentation, 1995

Hammes-Schiffer honored with 2018 Nebraska Cluster for Computational Chemistry Award Lectureship

Sharon Hammes-Schiffer & Jody Redepenning *Dihua Xue | Nebraska Chemistry*

Professor Sharon Hammes-Schiffer of Yale University was awarded the Nebraska Cluster of Computational Chemistry Award Lectureship on March 30, 2018.

Sharon Hammes-Schiffer received her B.A. in Chemistry from Princeton University in 1988 and her Ph.D. in Chemistry from Stanford University in 1993, followed by two years at AT&T Bell Laboratories. She was the Clare Boothe Luce Assistant Professor at the University of Notre Dame from 1995-2000 and spent the next twelve years at Pennsylvania State University as the Eberly Professor of Biotechnology. In 2012, she became the Swanlund Professor and Chair of Chemistry at the University of Illinois Urbana–Champaign, and in 2018, she became the John Gamble Kirkwood Professor of Chemistry at Yale University.

Her research centers on the investigation of charge transfer reactions, dynamics, and quantum mechanical effects in chemical, biological, and interfacial processes. Her work encompasses the development of analytical theories and computational methods, as well as applications to a wide range of experimentally relevant systems.

She is a Fellow of the American Physical Society, American Chemical Society, American Association for the Advancement of Science, and Biophysical Society. She is a member of the American Academy of Arts and Sciences, the National Academy of Sciences, the International Academy of Quantum Molecular Science, and the Basic Energy Sciences Advisory Committee. She was the Deputy Editor of The Journal of Physical Chemistry B and is currently the Editor-in-Chief of Chemical Reviews. She is on the Board of Reviewing Editors for Science and has served as Chair of the Physical Division and the Theoretical Subdivision of the American Chemical Society. She has over 230 publications, is co-author of a textbook entitled Physical Chemistry for the Biological Sciences, and has given more than 345 invited talks.

Honors & Awards

- G.M. Kosolapoff Award from Auburn University, 2019
- Center for Advanced Study Professor, University of Illinois Urbana–Champaign, 2017
- Senior Fellow, Canadian Institute for Advanced Research (CIFAR), 2016–Present
- Fellow, Biophysical Society, 2015
- Blue Waters Professor, 2014–2018
- Member, International Academy of Quantum Molecular Science, 2014

Abigail Doyle
Dihua Xue | Nebraska Chemistry

Organic Reactions Award presented to Doyle

The inagural Organic Reactions Award was presented to Professor Abigail G. Doyle of Princeton University on April 6, 2018. The award was sponsored Organic Reactions, Inc.

Abigail Doyle is the A. Barton Hepburn Professor of Chemistry at Princeton. Abigail Doyle received her B.A. and M.A. from Harvard University and then spent a year at Stanford University conducting research with Prof. Justin Du Bois. Doyle returned to Harvard for her Ph.D. studies, working with Prof. Eric Jacobsen in the area of asymmetric catalysis. She joined the faculty at Princeton University in 2008. Her group's research interests center on the invention of new approaches to chemical synthesis that harness unique properties of transition metal catalysts.

Dating back to the 1970s and Kochi's seminal mechanistic studies, Ni catalysts have been identified as capable of radical generation from organic halides and their subsequent functionalization. A subtle but profound distinction is whether it is possible to separate the two roles of Ni to use Ni-catalyzed cross coupling to functionalize radicals generated by alternate means. This idea and its recent realization has inspired major advances in the fields of Ni-catalyzed cross coupling and radical chemistry. Numerous classical and modern methods are available for radical generation from abundant, inexpensive and stable feedstocks. These substrate classes are often not, in their own right, accessible to Ni-catalyzed cross coupling. In the award lecture, Doyle described how combining photoredox and Ni catalysis delivers a strategic alternative to C(sp3)–H functionalization that uses Ni rather than precious metal catalysts, precludes the need for traditional metal-coordinating directing group on the C–H partner, and features exceptionally mild reaction conditions. She also discussed mechanistic studies that offer new insights into recently reported Ni/photoredox transformations and implicate Ni as an underexplored alternative to precious metal photocatalysts.

Stuart Schreiber

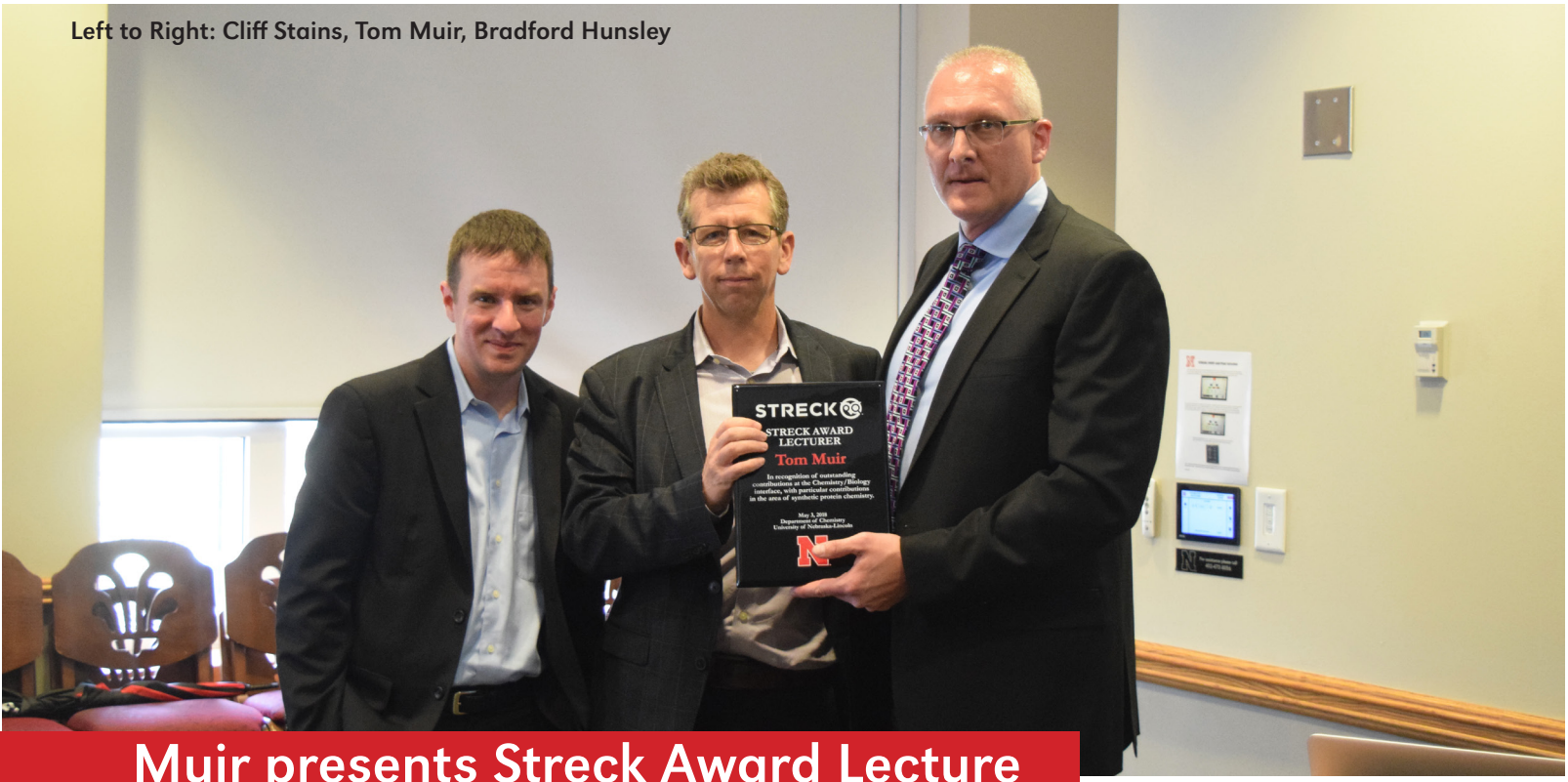
Schreiber delivers 2018 Marjorie Dewey and Kay Kelly Award Lecture

Professor Stuart L. Schreiber of Harvard University delivered the Marjorie Dewey and Kay Kelly Award Lecture on April 20, 2018.

Schreiber received his B.A. in Chemistry from the University of Virginia in 1977. He pursued graduate studies at Harvard University withProfessors R.B. Woodward and Y. Kishi, and received his Ph.D. degree in Organic Chemistry in 1981. Professor Schreiber began his independent academic career at Yale University in 1981 and was promoted to Associate Professor in 1984 and Professor in 1986. In 1988, he joined the faculty at Harvard University where he is currently the Morris Loeb Professor of Chemistry and Chemical Biology. He is also a co-Founder of the Broad Institute, a Howard Hughes Medical Institute Investigator, and has been a member of the National Academy of Sciences since 1995.

Schreiber's research integrates chemical biology and human biology to advance our understanding of chemistry and biology, and the science of therapeutics. He is known for his use of small molecules to systematically explore biology, especially disease biology, and for his role in the development of the field of chemical biology. His lab made numerous landmark contributions through uncovering principles that underlie information transfer and storage in cells. Key advances include: (1) co-discovered mTOR (simultaneously with Sabatini) and illuminated the nutrient-response signaling network; (2) discovered histone deacetylase (HDAC) and the role of chromatin marks in gene expression; (3) mapped the first membrane-to-nucleus signaling pathway (with Crabtree); (4) uncovered small-molecule dimerizers that activate cellular processes by enforced proximity; and (5) made the first demonstration that drugs can result from the targeting of protein kinases and protein phosphatases. His work has also contributed to diversity-oriented synthesis (DOS) and discovery-based small-molecule screening in an open data-sharing environment, and it resulted in the development of the first public small-molecule screening database named ChemBank. Professor Schreiber's research has been reported in over 600 publications (H index = 138), presented in more than 500 honorary lectureships, and recognized with over 50 prestigious awards, such as the ACS Award in Pure Chemistry (1989), the ACS Eli Lilly Award in Biological Chemistry (1993), the ACS Award for Creative Work in Synthetic Chemistry (1994), the Warren Triennial Prize (with Leland Hartwell, 1995), the Tetrahedron Prize for Creativity in Organic Chemistry (1997), the ACS Alfred Bader Award in Bioorganic and Bioinorganic Chemistry (2000), the Charles Butcher Award in Genomics and Biotechnology (2007), the AACR Award for Outstanding Achievement in Chemistry in Cancer Research (2010), the ACS Arthur C. Cope Award (2014), the Nagoya Gold Medal Award of Organic Chemistry (2016), and the Wolf Prize in Chemistry (with K.C. Nicolaou, 2016).

Schreiber has been involved in the founding of numerous biopharmaceutical companies whose research relies on chemical biology, such as Vertex Pharmaceuticals and Ariad Pharmaceuticals. These companies have produced new therapeutics in several disease areas, including cystic fibrosis and cancer. Four new anti-cancer drugs that target proteins discovered in the Schreiber lab have been approved by the U.S. FDA. Furthermore, Schreiber has also served the scientific community by the founding of the first chemical biology journal Chemistry & Biology. He has served on the editorial boards or as advisory editors of many scientific journals, such as *PNAS*, *Nature*, *Chemical Biology*, *ACS Chemical Biology*, *Scientific Reports (NPG)*, *ChemBioChem*, *Bioorganic and Medicinal Chemistry Letters*, etc.



Left to Right: Cliff Stains, Tom Muir, Bradford Hunsley

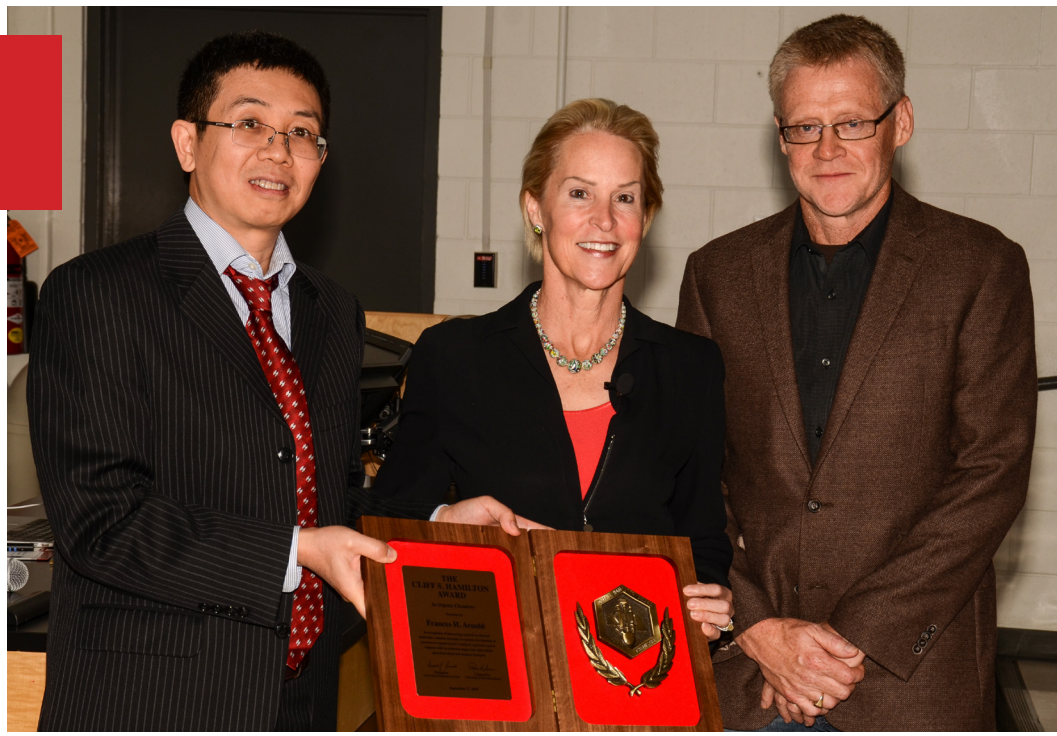
Muir presents Streck Award Lecture

Professor Tom W. Muir was awarded the 2018 Streck Award on May 3, 2018. Streck's Director of Research & Development, Bradford Hunsley, was on hand for the presentation.

Muir is currently the Van Zandt Williams Jr. Class of 1965 Professor of Chemistry and serves as the Chair of the Department of Chemistry at Princeton University. He is also an Affiliate of the Lewis-Sigler Institute for Integrated Genomics. Professor Muir obtained a Ph.D. in Chemistry from the University of Edinburgh with Professor Robert Ramage. From there, he went on to conduct postdoctoral work at the Scripps Research Institute with Professor Stephen B. H. Kent. He began his independent research career in 1996 at Rockefeller University in New York City and joined Princeton University in 2011. He has published over 180 papers in area of chemical biology and has received numerous awards including the Burroughs-Wellcome Fund New Investigator Award, the Pew Award in the Biomedical Sciences, the Alfred P. Sloan Research Fellow Award, the Leonidas Zervas Award from the European Peptide Society, the Irving Sigal Award from the Protein Society, the Vincent du Vigneaud Award in Peptide Chemistry, the Blavatnik Award from the New York Academy of Sciences, the Jeremy Knowles Award from the Royal Society of Chemistry, the Arthur C. Cope Scholar Award from the American Chemical Society, the Breslow Award in Biomimetic Chemistry from the American Chemical Society, and the E.T. Kaiser Award in Protein Chemistry from the Protein Society. Professor Muir is a Fellow of American Association for the Advancement of Science (2007), the Royal Society of Chemistry (2012), and the Royal Society of Edinburgh (2013).

Professor Muir investigates the physiochemical basis of protein function in complex systems of biomedical interest. The Muir lab studies protein function by integrating the tools of synthetic organic and physical chemistry with those of molecular genetics. Driven by a series of biological questions, the Muir lab has developed general chemical biology approaches that allow the covalent structure of proteins to be manipulated with a similar level of control to that possible with smaller organic molecules. These technologies, which can be applied both in vitro and in vivo, allow the insertion of unnatural amino acids, posttranslational modifications, and isotopic probes sitespecifically anywhere into proteins. The chemistry-driven approaches pioneered by the Muir lab are now widely used by chemical biologists around the world. Professor Muir's current interests lie in the area of epigenetics, where he tries to illuminate how chemical changes to chromatin are linked to different cellular phenotypes.

Arnold named Cliff S. Hamilton Awardee



[L to R]: Jiantao Guo, Frances Arnold, Jody Redepenning

Professor Frances H. Arnold is the Linus Pauling Professor of Chemical Engineering, Bioengineering, and Biochemistry, and the director of Donna and Benjamin M. Rosen Bioengineering Center at the California Institute of Technology. Professor Arnold received her B.S. in mechanical and aerospace engineering from Princeton University in 1979. She pursued graduate studies at the University of California, Berkeley with Professor Harvey Blanch, obtaining her Ph.D. in chemical engineering in 1985. She then carried out postdoctoral research in physical chemistry with Professor Ignacio Tinoco at UC-Berkeley prior to embarking upon her own independent academic career at Caltech in 1987, where she rapidly rose through the ranks.

Professor Arnold's research focuses on protein engineering by directed evolution, with broad potential applications in synthesis, process chemistry, biorenewable energy and agricultural applications, clinical diagnostics and medicine. She is one of the key pioneers in 'directed evolution,' with an eye toward artificially engineering enzymes for unnatural substrates and catalytic activities of value to the chemist. She has explored and developed a wide range of protein evolution techniques that are widely used in academic and industrial laboratories to create proteins with desirable properties.

Professor Arnold's laboratory has successfully expanded the toolkit of genetically encoded chemistry permitting access areas of chemical space that heretofore had not been in the domain of enzymatic catalysis. More specifically, recent research has focused upon greatly expanding the catalytic repertoire of native metalloenzymes from activating oxygen to insert into C-H bonds to activating abiological carbenoid and nitrenoid organic functionalities in modified active sites. These successes have benefited from improved protein engineering methods that utilize machine learning. Her laboratory has used engineered enzymes to accomplish and, in some cases, outpace synthetic transformations routinely carried out using conventional chemical methods. Her recent achievements include an enzymatic synthesis of highly strained carbocycles using a reaction not previously known in biology, a genetically programmed asymmetric organoborane synthesis that marks the first synthesis of boron–carbon bond-containing compounds by bacteria, a biocatalytic alkene oxidation that provides high anti-Markovnikov selectivity, and a route to the selective formation of carbon-silicon bonds that proceeds with high efficiency.

An author of over 200 publications and over 50 patents, Francis Arnold has achieved a rare trifecta in science, having been honored by membership in the US National Academies of Science, Medicine, and Engineering. Beyond this, Dr. Arnold has been elected into the prestigious American Academy of Arts and Sciences, American Philosophical Society, and National Inventors Hall of Fame. Dr. Arnold is the first woman to receive the Millennium Technology Prize from the Technology Academy of Finland (2016) and the first woman to receive the Charles Stark Draper Prize from the National Academy of Engineering (2011). Her work has also been recognized by several other major awards, including the US National Medal of Technology and Innovation (2011), the National Academy of Sciences' Sackler Prize in Convergence Research (2017), and the Margaret H Rousseau Pioneer Award from AIChE (2017). She has received honorary doctorates from Stockholm University, University of Chicago, Dartmouth College, and the Swiss Federal Institute of Technology (ETH Zurich). Professor Arnold also chairs the Advisory Panel of the David and Lucile Packard Foundation Fellowships in Science and Engineering and is a Trustee of the Gordon Research Conferences. She is a Board of Director at Illumina and co-founded Gevo, Inc. to make fuels and chemicals from renewable resources and Provivi, Inc. in 2014 to develop non-toxic modes of agricultural pest control.

Just three days after addressing Nebraska Chemistry, Arnold was awarded the Nobel Prize in Chemistry. In doing so, Arnold became only the fifth woman to be awarded the prize.

2018 M.L. Gross Award Lecture presented to Lebrilla

Carlito Lebrilla

Carlito B. Lebrilla is a Distinguished Professor at the University of California Davis in the Department of Chemistry and in the School of Medicine, Department of Biochemistry and Molecular Medicine. He received his B.S. degree in chemistry from the University of California Irvine, and his Ph.D. degree in chemistry from the University of California Berkeley. As an Alexander von Humboldt Fellow and an NSF-NATO Fellow, he carried out postdoctoral research at the Technical University of Berlin with Professor Helmut Schwarz. He later returned to Irvine as a University of California President's Fellow and performed further postdoctoral work with Professor Robert T. McIver. Professor Lebrilla was appointed to the faculty of UC Davis in 1989 and has focused his research program on applications of bioanalytical mass spectrometry to clinical glycomics (including the development of mass spectrometry based tools for early detection of the glycomic signatures of cancer) and biofunctional food (including the functional examination of human milk as the model of a "perfect food" through determination of its bioactive components).

Professor Lebrilla has authored over 390 scientific articles, which have collectively garnered him over 14,100 citations and an h-index of 65. His record of service includes his current position as Co-Chief Editor of Mass Spectrometry Reviews (since 2002); service on the editorial advisory boards of the European Journal of Mass Spectrometry (1995-2017), Mass Spectrometry Reviews (since 1998), International Journal of Mass Spectrometry (2000 – 2016), and Molecular and Cellular Proteomics (since 2014); his election to the Board of Directors of the American Society for Mass Spectrometry (2007-2009); and a term as Chair of the UC Davis Department of Chemistry (2008-2011). He was awarded the UC Davis Academic Senate Distinguished Research Award in 2018.

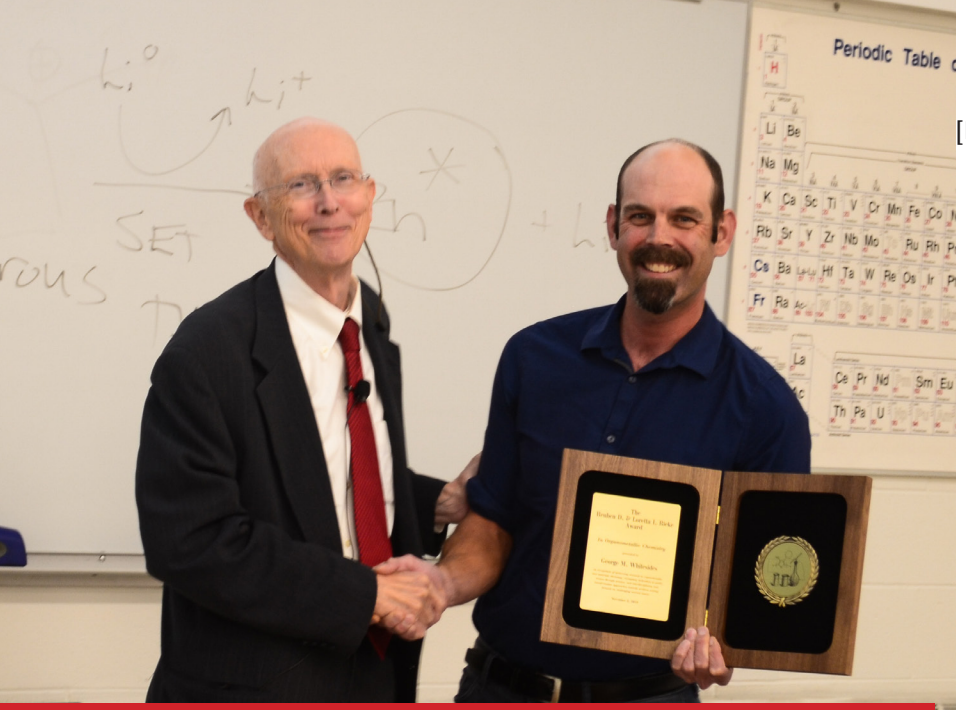
John Seinfeld

2018 Washburn Award Lecture

John H. Seinfeld was presented with the Nebraska Chemistry Washburn. Seinfeld is the Louis E. Nohl Professor of Chemical Engineering at the California Institute of Technology. He received a B.S. from the University of Rochester and a Ph.D. from Princeton University. Both degrees are in Chemical Engineering. He has spent his entire professional career at Caltech. From 1990-2000 he served as Chair of Caltech's Division of Engineering and Applied Science.

Seinfeld is one of the world's leading authorities on atmospheric chemistry and airborne particles. Shortly after joining Caltech, he initiated a research program on urban air pollution. Seinfeld and his Ph.D. students developed the first computational models of urban air pollution and worked out both the chemistry of ozone formation and the elaborate thermodynamic equilibria that govern atmospheric gas-particle distributions. He established a major program aimed at understanding the origin and chemistry of organic airborne particles that are produced from the atmospheric oxidation of volatile organic compounds. This class of airborne material, which comprises as much as 80% of the mass of airborne aerosols worldwide, became known as "secondary organic aerosol". Together with Professor Richard Flagan at Caltech, he established the first transparent outdoor smog chamber as a means to simulate atmospheric chemistry and aerosol formation under controlled conditions. Dozens of such chambers (no longer outdoors) now exist worldwide. As of the end of 2017, SciFinder identifies 1363 journal articles with "secondary organic aerosol" in the title.

Seinfeld has mentored 93 PhDs and 45 postdoctoral fellows, about half of whom occupy faculty positions worldwide. He is the author of almost 800 papers and 7 books. His book co-authored with Spyros Pandis, Atmospheric Chemistry and Physics, now in its 3rd edition, is considered the definitive text on the subject.



[L to R] George Whitesides with Stephen Morin

Inaugural Rieke Award Lecture

The inaugural Reuben D. and Loretta I. Rieke Award Lecture in Organometallic Chemistry was presented to Professor George M. Whitesides of Harvard University.

Whitesides received an A.B. degree from Harvard University in 1960 and a Ph.D. from the California Institute of Technology (with J.D. Roberts) in 1964. He was a member of the faculty of the Massachusetts Institute of Technology from 1963 to 1982. He joined the Department of Chemistry of Harvard University in 1982, and was Department Chairman 1986-89, and Mallinckrodt Professor of Chemistry from 1982-2004. He is now the Woodford L. and Ann A. Flowers University Professor.

Professor Whitesides began his independent career at MIT in 1963 working primarily in the fields of NMR spectroscopy and organometallic chemistry. In 1982, Prof. Whitesides moved back to the Department of Chemistry at Harvard University, his alma mater, taking his laboratory with him. The primary objective of the Whitesides Research Group is "to fundamentally change the paradigms of science." Current and recent research interests are broad and include: adaptive materials, composites, and polymers, bioanlysis, biophysics, density as a tool for chemistry and biology, dissipative systems, flames complexity and emergence, low cost diagnostics and tools for global health, microfluidics, molecular electronics, paper as a material, soft lithography and unconventional fabrication, soft robotics, and the chemical origin of life.

An author of over 1,400 publications, Professor Whitesides has the highest h-index (212) of any chemist. He is a member of the American Academy of Arts and Sciences, National Academy of Sciences, National Academy of Engineering, National Academy of Inventors, and the American Philosophical Society, and a fellow of the American Association for the Advancement of Science, Institute of Physics, American Physical Society, New York Academy of Sciences, World Technology Network, and American Chemical Society. Prof. Whitesides serves on the Board of Directors for Biopharma, Nano-Terra, Arsenal Vascular, 480 Biomedical, Diagnostics for All (501-c-3), and Soft Robotics. He serves on the EditorialBoards for Angewandte Chemie, Small, Lab on a Chip, and Soft Robotics. He was awarded the U.S. National Medal of Science in 1998 and the Priestley Medal, the highest honor bestowed by the American Chemical Society, in 2007.

Dr. Reuben D. and Loretta I. Rieke

Dr. Reuben D. and Loretta I. Rieke have dedicated their professional lives to helping advance scientific research.

Reuben Rieke grew up in Fairfax, Minnesota. He received a Bachelor of Chemistry from the University of Minnesota-Minneapolis, conducting his undergraduate research with Professor Wayland E. Nolan. He received a PhD from the University of Wisconsin-Madison under the direction of Professor Howard E. Zimmerman, and carried out his postdoctoral research with Professor Saul Winstein at UCLA. A strong proponent of education, Dr. Rieke taught at the University of North Carolina at Chapel Hill (1966-76), at North Dakota State University in Fargo (1976-1977) and at the University of Nebraska-Lincoln (1977-2004). Dr. Rieke served as Department Chair for UNL Chemistry for 4 years.

Loretta Rieke was born and raised in New York City. She earned a Bachelor of Science from Queens College in New York City and pursued graduate studies at the University of Wisconsin-Madison.

From the day the Riekes met at the entrance examination for the chemistry graduate program at the University of Wisconsin-Madison in September 1961, they have been a team. From their early days at North Carolina at Chapel Hill, Loretta worked side by side with Reuben carrying out research with his group. In 1991, Reuben and Loretta Rieke founded Rieke Metals, Inc. with the goal of developing highly reactive metals and novel reagents for the advancement of scientific research. Loretta served as Vice President and Business Manager for their company, in addition to being the cornerstone of all business and research travel. Another major force in the efforts of Rieke Metals, Inc., was daughter Elizabeth, who started working part time in the family company, and rose to the position of CEO before the company was sold in July 2014. Equally important, son Dennis was a constant supporter of company efforts and an excellent sounding board for ideas.

The Riekes are proud of their contribution to the scientific community and the many "firsts" they have achieved. Rieke Metals, Inc. was the first company to:

- Develop proprietary highly reactive Rieke® Zinc and Rieke® Magnesium
- Manufacture and sell hundreds of unique organozinc and specialty Grignard reagents
- Offer thousands of highly functionalized fine chemicals
- Offer P3Ht, Poly(3-hexylthiophene-2,5-diyl), as well as many functionalized thiophene polymers and monomers

Reuben has been awarded 23 patents, has published more than 220 articles and is an esteemed lecturer on the subject of organometallic chemistry, presenting more than 150 seminars across the US and around the world. He has received accolades from both the chemical science industry and the business community at large, being elected to the rank of Fellow of the American Association for the Advancement of Science (1996), named Chemist of the Year (1997) by the Midwest Section of the American Chemical Society, and receiving the 2003 Walter Scott Entrepreneurial Business Award, among many other honors.

Now, the Riekes' passion for science and their legacy will be carried forward in the Rueben D. and Loretta I. Rieke Lectureship in Organometallic Chemistry at the University of Nebraska-Lincoln.

Mass Spectrometry Symposium

In October of 2018, Nebraska Chemistry hosted the Cutting Edge Mass Spectrometry: Omics to Imaging symposium. This two day event welcomed multiple leaders in the field to speak to the University of Nebraska-Lincoln community. The guest speakers and their talk titles are below:

- **Alan G. Marshall**- Florida State University
  Life at the Frontier: 21 Tesla Fourier Transform Ion Cyclotron Resonance Mass Spectrometry

- **Jeffrey Spraggins**- Vanderbilt University
  MALDI Imaging Mass Spectrometry: Next Generation Molecular Histology

- **Joseph A. Loo**- UCLA
  Native Top-Down Fourier Transform Mass Spectrometry of Protein Complexes as a Tool for Structural Biolo gy & Drug Development

- **I. Jonathan Amster**- University of Georgia
  FTMS Solutions to the Analysis of Glycosaminolycans

- **Ying Ge**- University of Wisconsin-Madison
  Novel Strategies in Top-Down Proteomics Enabled by Ultra-High Resolution Mass Spectrometry

- **Michael L. Gross**- Washington University
  Mass Spectrometry & Structural Proteomics: Problem Solving in Biochemistry & Biophysics

The symposium is part of the department's dedication to mass spectrometry research. This commitment also shows in the growth of the facilities that allow research to be conducted at the highest level.

In the fall of 2017, the department received a Fourier transform ion cyclotron resonance mass spectrometer (FTICR-MS) equiped with a 15 Tesla (T) superconducting magnet in November. The FTICR-MS is the most powerful commercially available mass spectrometer.

The equiptment has unique capabilities that will be leveraged to study (1) intact proteins, including their intricate patterns of chemical modifications that dictate biological function ("top-down proteomics"), and (2)metabolites in complex mixtures of thousands of unknown components ("global metabolomics").

Periago and Wang win Applause Awards

Jessica Periago and Jun Wang each recieved recognition through the Applause Award in 2018. The award is presented monthly honoring College of Arts and Sciences staff members who perform their jobs extraordinarily well.The Applause program recognizes innovative ideas, consistently outsanding performance, or service above and beyond the call of duty.

Jessica Periago

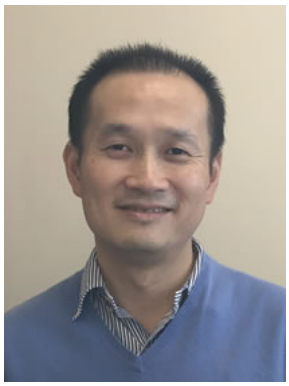
Periago, the Lab Manager, recieved the monthly recognition in May 2018. She was also recognized with an Annual Applause reward for her tremendous work in the Department of Chemistry. Her nominators said:

"Jessica's dedication shows in all aspects of her work. She has reorganized and streamlined the labs to run more efficiently. She is responsible for managing and assisting TA's, ensuring safety in the undergraduate labs and prepping for Chemistry Day. She is always willing to help where needed. Jessica is very deserving of the Applause award!"

"Jessica has taken on the job of lab manager while she is finishing her degree in Chemistry from UNL. She has shown a high degree of organization in her position. She has arranged equipment in teaching labs to create effective use of material and equipment by teaching assistants and students. She has demonstrated an energy level that is almost contagious as she leads her staff in rearranging how things are done. She is, when necessary, a disciplinarian, enforcing regulations on wayward students' poor conduct (cheating) or lab hygiene and practices. She demonstrates concern for staff feelings over her changes and for their understanding of their importance within the chemistry department. She gives direction and allows staff to operate within those guidelines without undue supervision. She listens to staff explain past operations or opinions about current and future trends and supports good ideas from them. She deserves recognition for her efforts and spirit on behalf of the department and university!"

"Jessica is a team player. She is very fun to be around, and is very task/work oriented. She is high energy and gets the job done. She has the labs working at high capacity, and is very conscious of what needs to be done, cleaned up, reorganized, and safe. She seems to have fit into this busy work environment by diving in and has a very good knowledge of the job. What she needed to learn, she has. I think she is very deserving of this nomination and deserves to be awarded the Applause Award!"

"Jessica has single-handedly revamped the Lab Manager position, raising standards for TA performance while also providing them with all the support they need. She excelled at navigating the intricacies of dealing with unhappy students, TAs, and parents. She has taken the lead on enhancing the general chemistry lab curriculum by refining lab activities, developing slides to standardize the information students are provided across sections, refining lab practicals, and holding weekly meeting with all TAs to ensure that problems are addressed quickly. She also brings a lot of fun to the position: yesterday (Halloween) she dressed up as the witch from the Wizard of Oz and performed a fun pumpkin demonstration in all the general chemistry lectures! Students loved it!"



Jun Wang

Wang recieved his Applause Award in October 2018 for his excellent work as the department's IT Spercialist. His nominators said:

"Jun is always willing to drop what he is doing and come to personally visit a faculty or staff member to troubleshoot a computer problem, reconfigure a machine, clone a machine or offer advice on a new purchase. On several occasions, Jun has personally designed a custom computer for our research group to meet the computational needs for our research. He usually suggests purchasing computer cards, and external RAM from third party vendors, to save money, and allow us to build more powerful CPUs than the vendor would normally market. He has set up a number of secure portals for the group so that all can remotely access key machines. Jun is very professional; he always tries to make himself available as quickly as possible when an issue arises and he will work to resolve a software or hardware issue for hours on end until it is resolved. I applaud him for being a dedicated, helpful IT expert in the Department, day in and day out, for many years now. His ability to answer the bell, regularly, professionally and successfully is much appreciated!"

"Jun is a great IT guy. He has been filling in and helping update our website and doing a great job at it. If I have any computer problems he is quick to respond and fix the situation. Jun is very knowledgeable, works hard and is dedicated to making sure all runs smoothly."
"Jun is a helpful colleague and fantastic resource for all things computer-related. If you have a question about computers or software, Jun is likely to know the answer. Jun has a fun and enthusiastic demeanor–he is always willing to provide assistance when asked. He has helped me with a number of computer-related tasks ranging from software installs to troubleshooting problems with an unfamiliar operating system. Overall, Jun is an important member of the department of chemistry team. Let's give him an Applause! "

"Jun is a highly accountable IT support staff. He always gave 100% effort to finish the tasks we request in a timely and professional manner. We are fortunate to have someone like Jun in our department to solve various IT problems. Jun is truly a team member!"

"Jun's doing an excellent job in helping us dealing with the daily IT-related issues in our group. He's very nice and super professional. Whenever we encounter a problem, Jun's always there, and can quickly get the job done, things just go on much more smoother. Thanks to Jun's outstanding service, we have a well-maintained environment to work with, which saved us a lot of time and workload."
"Jun plays an integral role in our daily IT needs. Recently, in conjunction with the Dean's office IT and the University Webpage IT, Jun was able to get our Webpage audit score up. This involved a lot of intricate views at the behind the scenes code of our Webpage in order to get it to the level it needed to be. Jun was able to do this and then some. On a private note, we were hoping to get up to at least 75% but Jun went above and beyond and got us up to a 95%. Woot woot! Jun deserves an Applause Award for his efforts!"

Hofmaier acknowledged with the Ovation Award

The Ovation Award is awarded monthly in the College of Arts and Sciences in recognition of a student worker who plays an integral role in assisting staff and faculty.

Nick Hofmaier, a student worker in the Chemistry Resource Center recieved the Ovation Award in February 2018. His nominators said:

"Nick is an outstanding student worker, he has done everything we have asked of him without hesitation. He handles many tasks for us, including setting up the Signup Genius program for TAs to signup for office hours, then downloading the data and putting it in a readable format. He worked at setting up Chemistry Day and worked all day, helping with whatever needed to be done that day, then processed the participant evaluations. He answers questions at the front desk, makes copies, helps with lab clean up, helps with Clean up jobs in the Resource Center and helps us to stay organized, helps to prepare for the Chemistry Evening Exams for 2500. He also does double duty as he is also a Chemistry TA, having taught Chem 109 once and 110 twice. He is very deserving of an Ovation award for going way above average for the department!"

"Nick is a student worker in our Resource Center. If you are aware of the Resource Center you know it is a hub of activity with over a 1,000 people going through the Fall semester. It is a hopping and happening place. Just the place that needs someone like Nick. Nick is very easy to work with, extremely reliable and in general an all-around great person. He was tasked with washing copious amounts of glassware, not necessarily a glamorous job, but one he did with ease and responsibility. He was even able to joke about it which made him that much more endearing. Nick is a fantastic student worker and thus it would be my honor to nominate him for an Ovation award! "

Thank you to our generous donors

We want to thank our generous donors for their gracious support of the University of Nebraska–Lincoln Department of Chemistry and its mission!

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Editorial Correspondence

Parker Robinson
Recruiting & Communications Coordinator
University of Nebraska–Lincoln
Department of Chemistry
515A Hamilton Hall
P.O. Box 880304
Lincoln, NE 68588-0304

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Department of Chemistry
552 Hamilton Hall
P.O. Box 880304
Lincoln, NE 68588-0304