OSMOLYTES & STRESS

In an article that not only made the cover of Protein Science, but also is highlighted in that issue and accompanied by an online video, then graduate student Mohona Sarkar in the Pielak Group, now a postdoc at Notre Dame University, and Professor Gary Pielak, suggest the reason why small molecules, called osmolytes, are used to overcome the effects of environmental stress.

Osmolytes are ubiquitous in biology. Given that dehydration stress adds to the crowded nature of the cytoplasm, the team speculated that cells might use osmolytes to overcome the destabilization caused by the increased attractive interactions that accompany desiccation.

-Continued on Page 11

BATTERY REVOLUTION

In studying a material that prevents marine life from sticking to the bottom of ships, researchers led by Carolina Chemistry’s Joseph DeSimone, have identified a surprising replacement for the only inherently flammable component of today’s lithium-ion batteries: the electrolyte.

The work, published in the Proceedings of the National Academy of Sciences, paves the way for developing a new generation lithium-ion battery that does not spontaneously combust at high temperatures.

-Continued on Page 11

Nancy Allbritton on Convergence

It is hard to imagine that seven years have passed since my arrival in the UNC Department of Chemistry. At that time, I was drawn to Carolina by virtue of the great faculty in the Department, the quality of the University, and the exceptional opportunities to collaborate, both here on campus and with neighboring universities. To say my choice to relocate from California was a wise one would be an understatement.

My research program bridges chemistry with engineering and the biomedical sciences. Since our arrival, the laboratory has grown and established productive collaborative projects with faculty in the Chemistry Department, the School of Medicine and with laboratories at both NC State and Duke. Five years ago, I took on the mantle as Chair of the Joint UNC/NC State Department of Biomedical Engineering in addition to my responsibilities as Professor of Chemistry and this has only expanded the opportunities for such interdisciplinary collaborations.

-Continued on Page 11

Solar Fuels Research Center Continues

The UNC Energy Frontier Research Center, EFRC, Center for Solar Fuels, headquartered in the Chemistry Department at the University of North Carolina at Chapel Hill, was funded by the U.S. Department of Energy in 2009, and is one of 32 EFRCs that recently received new funding through 2018 in a highly competitive funding environment.

-Continued on page 12

Eastman Chemical Research Partnership

It would be an understatement to say that Carolina’s research faculty are highly innovative and productive given that total funding to the university was $792.7 million in the fiscal 2014. Over 72% of the funding was awarded by the federal government but only 6% from private industries. UNC-Chapel Hill is therefore pursuing effective ways to diversify funds and create stronger partnerships with industry. For example, in the spring of 2013, Carolina and Eastman Chemical Company entered into a six-year research partnership that covers issues such as confidentiality and publication while providing pre-negotiated IP and payment terms. This relationship allows Carolina faculty to engage in Eastman specific research in chemistry and materials science. In turn, Carolina and Eastman have reaped many primary and secondary benefits. To date, the company has sponsored 10 research projects worth several million dollars.

-Continued on page 12
Greetings from the Chair's office! I am excited, happy, and privileged to share this newsletter with you. Our Department is at the end of a very successful calendar year, during which faculty and students have been recognized with prestigious national and international awards.

We celebrated the election of Professor Joseph DeSimone into his third National Academy. Joe is one of only twenty people worldwide who hold the distinction of membership in the all three academies. We are also delighted with the election of Professor Mike Ramsey into the National Academy of Engineering, and that Professor Tom Meyer, another National Academy member, was selected by Israel’s Prime Minister Benjamin Netanyahu to share the 2014, $1M, Samson Prize for his research on alternative fuels. National recognition was also given to Professor Maurice Brookhart, who received the ACS Award for Creative Research in Catalysis. The ACS also recognized one of our outstanding graduate students, Caitlin McMahon from the Alexanian research group, by giving her an ACS Division of Organic Chemistry award. Additionally, three-year NSF research fellowships were awarded to five of Caitlin’s graduate student colleagues. Our young faculty also garnered significant recognition this year as Professor Jim Cahoon received the prestigious Packard Fellowship. He joins Professor Dave Nicewicz, another of our faculty members holding this prominent fellowship. Moreover, Professor Leslie Hicks received the Phytochemical Society of North America’s Young Investigator Award for her research in analytical chemistry. Finally, our faculty members continue to lead and serve at the university level. This year, Professor Joe Templeton received the Thomas Jefferson Award from the University, given to a single faculty member in recognition of a career of commitment to scholarship and service at UNC. What a year, and what a pleasure to work with such impressive students, faculty, and staff members.

This year, we celebrated the First Annual Pariser-Parr Lecture. The inaugural lecturer was Professor Weitao Yang from Duke University, one of Professor Parr’s students. The seminar honors the tremendous research contributions of the team of Dr. Rudy Pariser, Science Director of DuPont Central Research, retired, and Dr. Robert Parr, William R. Kenan, Jr. Professor of Theoretical Chemistry and Wassily Hoeffding Professor of Chemical Physics. The research led by Professor Parr and Dr. Pariser is still the most cited work in all of Chemistry with close to 60,000 citations. It was a delight celebrating their accomplishments and sharing this rich departmental history with present faculty and students; especially as the seminar was held on Professor Parr’s 93rd birthday.

I am also pleased with the arrival of two outstanding new faculty members, Dr. Thomas Freeman and Dr. Cheryl Moy, and look forward to their contributions.

We could not continue all of these outstanding efforts without your support. Thank you for your generosity to the department and particularly to the “Say Yes” fund. As I described in the last issue, this fund allows me as Chair to say yes to the requests of faculty and students for small amounts of support that make huge differences in their research and education. Thank you again for the support that you have always given to Chemistry in all forms, and we invite you to consider the “Say Yes” fund in the future. As always, we enjoy hearing from you and would love to see you when you are in Chapel Hill!

Warmest Regards and Holiday Greetings,

Valerie Sheares Ashby

Caitlin McMahon, a fourth year graduate student in the Alexanian Group, has been selected by the ACS Division of Organic Chemistry to receive a 2014-2015 Graduate Fellowship. Awardees for this highly competitive award are selected by an independent committee, and evidence of research accomplishments is an important factor in the selection process. Caitlin will travel to the 2015 National Organic Symposium to present a poster of her research.

Caitlin’s research focuses on the development of metal-catalyzed organic reactions, with the goal of discovering new ways to form carbon-carbon bonds and expanding the methodology available to synthesize organic building blocks. More specifically, she has developed a palladium-catalyzed, intermolecular Heck-type reaction using alkyl electrophiles - significantly expanding the scope of the widely-utilized Heck reaction. She is currently studying carbonylation metal-catalyzed reactions, building functionalized organic molecules by forming two carbon-carbon bonds in one step under mild conditions.
Templeton wins Jefferson Award

Francis Preston Venable Professor of Chemistry, Joseph Templeton, is the recipient of this year’s Thomas Jefferson award, which was presented to him by Chancellor Folt at a Faculty Council meeting. “I would just like to add from my own opportunity to work so closely with Professor Templeton the last year, how deserving and wonderful this award is,” said Chancellor Folt.

Templeton is a chemistry professor and a world-renowned inorganic chemist. He is also program director of the Chancellor's Science Scholars, a program that increases diversity among future scientists. Many students from the program crowded in the back of the room to watch Templeton receive his award. "When I looked in the back, and there were a half a dozen Chancellor Science Scholars, that was so nice," Templeton said. "I don't know how they found out, but they know I care about them." He is also involved in the summer reading selection committee, the Carolina Counts program and he has been Special Assistant to the Chancellor since 2009.

"Templeton has a way of leading people that makes one feel honored to be included," said colleague Professor Marcey Waters. "And although he is an exceptionally busy man who wears many hats, he always takes the time to stop and say hello, share pictures of his grandchildren, or have a laugh about something."

Brookhart ACS National Awardee

Carolina Chemistry Professor Maurice Brookhart has been selected to receive the 2015 Gabor A. Somorjai ACS National Award for Creative Research in Catalysis. The award recognizes outstanding theoretical, experimental, or developmental research resulting in the advancement of understanding or application of catalysis, and consists of a $5,000 cash prize along with a certificate and up to $2,500 for travel expenses to the meeting at which the award will be presented.

Professor Brookhart was recently highlighted by the National Science Foundation for his ground-breaking contributions to the improvement of the process used to create alternative fuels. He is part of a team of scientists who have invented and patented, and are bringing toward commercialization, catalysts that will convert light hydrocarbons into diesel fuel. The improved process can create diesel in a less expensive, cleaner way, whether it is diesel made from traditional sources, such as oil, or alternative sources, such as biomass.

Ramsey Member of NAE

Minnie N. Goldby Distinguished Professor of Chemistry, and Director, Center for Biomedical Microtechnologies, Michael Ramsey, has been elected a member of the National Academy of Engineering for his development of microfluidic technologies for analytical applications.

Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to "engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature," and to the "pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

Leslie Hicks Young Investigator Awardee

Assistant Professor Leslie Hicks has been awarded the Arthur C. Neish Young Investigator Award. These awards are given each year by the Phytochemical Society of North America to outstanding early career scientists. The young investigator chosen will present their research at the annual meeting as part of the Arthur C. Neish Young Investigator Mini-symposium.

Research in the Hicks lab focuses on development and implementation of mass spectrometric approaches for protein characterization including post-translational modifications, as well as the identification of bioactive peptides/proteins from plants.
Joseph DeSimone, Chancellor’s Eminent Professor of Chemistry, has been elected to the Institute of Medicine, one of the highest honors in the fields of health and medicine a U. S. scientist can receive.

DeSimone’s election to Institute of Medicine represents the third time he has been named a member of a U. S. National Academy. He was elected to the National Academy of Engineering in 2005 and the National Academy of Sciences in 2012. Fewer than 20 people in history have achieved election to all three U. S. National Academies, and DeSimone is the first professor in the state of North Carolina to achieve this honor.

“Dr. DeSimone is a renaissance scientist,” said Chancellor Carol L. Folt. “He was the first to successfully adapt manufacturing techniques from the computer industry to make advances in medicine, including next-generation approaches to cancer treatment and diagnosis. It’s a beautiful example of how transcending disciplines can revolutionize science and open up entirely new fields of study. We are very proud of what Dr. DeSimone and his students have accomplished. He is a gifted and talented teacher and amazing University citizen.”

“It is humbling to join such an elite group,” DeSimone said. “This is a tribute to my students at UNC-Chapel Hill and NC State whose research at the intersection of diverse fields enables us, as a team, to create significant impact in and beyond medicine.”

DeSimone, who is also the William R. Kenan, Jr. Distinguished Professor of Chemical Engineering at NC State and of Chemistry at UNC-Chapel Hill, is known for his ability to apply insights in materials science to create advances in medicine, as well as other fields. He has more than 300 publications and holds more than 180 patents, which have also led him to found multiple companies based on his work.

During his 24-year career at UNC-Chapel Hill and NC State, DeSimone has made multiple important contributions to the advancement of medicine. In the early 2000s, he developed breakthrough materials for a new, drug-eluting, bioabsorbable cardiac stent to treat heart failure which dissolves in the body once a previously clogged artery has healed and can function on its own. The stent is now being commercialized by Abbott Vascular and is available in over 60 countries.

In 2005, DeSimone and his students invented a new technology to create nano- and micro-particles called PRINT, Particle Replication In Non-wetting Templates. PRINT enables scientists to manufacture large batches of uniform particles with tailored shapes, sizes, flexibility and chemistries using tools reminiscent of the processes used to make transistors in the microelectronics industry. PRINT particles are currently being explored by DeSimone and his team for the development of next-generation vaccines including for dengue fever, influenza and certain forms of cancer.

Since PRINT particles can be loaded with active pharmaceutical agents, including chemotherapy drugs, DeSimone’s lab is also using PRINT to pursue novel cancer treatments, as well as inhalable therapeutics for multiple conditions. DeSimone founded Liquidia Technologies, Inc. in 2005 based on PRINT, and in 2012, the company announced a large, multi-year partnership with GlaxoSmithKline focused on using PRINT to develop vaccine and inhaled products for the prevention and treatment of serious health conditions.

Also in 2005, DeSimone’s team’s work led to the creation of the Carolina Center for Cancer Nanotechnology Excellence, a ten-year, almost $40 million initiative based at UNC’s Lineberger Comprehensive Cancer Center, funded by the National Cancer Institute.

Currently, DeSimone is on sabbatical leave to lead his new company, Carbon3D, in Silicon Valley. Carbon3D is developing a new 3D printing technology invented by DeSimone and colleagues, which can fabricate objects significantly faster than current state-of-the-art 3D printers.

Christopher Pinion, Javier Grajeda, Elizabeth Keenan, Michael Little, and Kelley Hammon, from left to right, are this year’s recipients of grants from the The National Science Foundation’s Graduate Research Fellowship Program, GRFP.

GRFP helps ensure the vitality of the human resource base of science and engineering in the United States and reinforces its diversity. The program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based master’s and doctoral degrees at accredited US institutions.
Professor Thomas Meyer

Thomas Meyer, Arey Distinguished Professor of Chemistry, and director of the Energy Frontier Research Center for Solar Fuels, has been honored as one of two recipients of a $1 million prize given by Israel for research on alternative fuels. Meyer and Michael Grätzel of the Ecole Polytechnique de Lausanne in Switzerland are the 2014 winners of the Eric and Sheila Samson Prime Minister’s Prize for Innovation in Alternative Fuels for Transportation, as announced by Prime Minister Benjamin Netanyahu.

“We are making a major multi-year effort so that we will not be dependent on fluctuations in the price of oil,” Netanyahu said. “This prize gives the researchers true appreciation for their efforts.”

Meyer and Grätzel are developing cheap and efficient processes based on solar cells that convert solar energy into electricity, which can be used for vehicle propulsion. The cells are able to split water into hydrogen and oxygen – a critical step in the generation of solar-based fuels, whose only emissions are water.

“Dr. Meyer is a superb example of the kind of innovators we have here at UNC,” said UNC Chancellor Carol L. Folt. “I join the entire Carolina community in congratulating him on this international honor. His team is bringing the world closer than ever to making solar energy a practical, reliable power source, and we are proud to have him as a member of our faculty here at UNC.”

A member of the National Academy of Sciences, Meyer works on solar energy conversion, artificial photosynthesis and the splitting of water into hydrogen and oxygen. His Energy Frontier Research Center recently received a renewal grant of $10.8 million over the next four years from the U.S. Department of Energy to advance emerging solar energy technologies and to turn these technologies into devices that can efficiently produce fuels.

“Receiving the Samson award is a remarkable honor and I am thrilled to receive it with Michael Grätzel. In fact, the award is a recognition of the research efforts of many students and colleagues over the years,” Meyer said. “I take special note of the UNC Energy Frontier Research Center on Solar Fuels funded by Basic Energy Sciences at DOE. It is through the efforts of this talented group of people that we have been able to pioneer what may be a breakthrough technology for providing a useful form of solar energy for future generations.”

Allbritton, Redinbo, & Thompson AAAS Fellows

Professors Nancy Allbritton, Matthew Redinbo, and Nancy Thompson are the department’s most recent inductees into the American Association for the Advancement of Science. AAAS is the world’s largest and most prestigious general scientific society, with over 125,000 individual and institutional members, and is the publisher of the well-known scientific journal Science.
We had the opportunity to sit down with Jennifer Finnegan McCafferty when she visited campus recently. Jennifer received her Ph.D. from the Wightman group in 1995, and after working for Merck for almost eleven years, has now been with GlaxoSmithKline, GSK, since 2006. Jennifer is also a member of the Department of Chemistry’s External Advisory Board, and it was in this context that we talked to her about her engagement with the department.

Tell us about your experience at UNC and your career path since completing your PhD?
I had a great experience in Mark Wightman’s lab where I completed my Ph.D. research conducting electrochemical and fluorescent measurements on single biological cells. In my final year, I participated in the on-campus interviews organized by the UNC campus career center and accepted a role as a senior analytical chemist with Merck in the Philadelphia area. I worked with Merck for eleven years, taking roles of increasing responsibility in a variety of site and central roles across analytical, regulatory, quality operations and commercialization functions. For the past 8 years, I have worked with GSK in Research Triangle Park NC, most recently as Vice President leading a global improvement program for our Consumer Healthcare Supply Chain.

What is your current involvement with the Department of Chemistry?
Since moving back to Chapel Hill with my family - in 2006 my husband Dewey McCafferty was offered a great opportunity as a Full Professor with that University located on the other end of highway 15-501 - I have taken the opportunity to become more personally involved with the Chemistry Department. Initially in support of GSK-sponsored Analytical Seminar series and more recently participating in events with students such as career fairs and recognition dinners. In 2012, I accepted the invitation to join the Chemistry Department Advisory Board where we work closely with Department Chair Valerie Ashby on departmental strategy. Dewey and I have also been proud to support the work of the Department financially, with contributions during the Venable brick campaign, annual fund drives, and most recently the “Say Yes” fund.

What motivates you to give to the Department of Chemistry?
The UNC Chemistry Department has been an enduring pillar of excellence within the University and global scientific community. I am so proud to have had the opportunity to learn and benefit from the amazing legacy of Analytical Chemistry at UNC. I want to do my part in helping that distinction to carry on for decades and decades to come.

What would you like to share with fellow alumni about the importance of giving to the Department?
From my interaction with the other Board members and scientists in industry, I have come to realize and appreciate the uniquely special environment of excellence and collegiality that I was able to experience during my graduate education. I would like to encourage other alumni who have that same feeling of gratitude to help support the Department by paying it forward!

Dr. Jennifer Finnegan McCafferty

---

Why I Give to Carolina Chemistry

The “Say Yes” fund in Chemistry allows me as Department Chair to say “YES” to special and often urgent requests from faculty and students for small amounts of support, which contribute greatly to their research and education.

Even your smallest gift will make a tremendous difference in my ability to support our outstanding faculty and students.

Please use the enclosed gift envelope to help me say “YES!”

Your continued support is greatly appreciated.

Thank you!

To give online, go to: www.chem.unc.edu/giving
James F. Cahoon of Carolina Chemistry is one of eighteen nationwide recipients of a 2014 Packard Fellowship for Science and Engineering, awarded to highly creative researchers early in their careers. The award from the David and Lucile Packard Foundation is for $875,000 over five years.

UNC-Chapel Hill has had five Packard Fellows in the past. The 2014 announcement marks the third year in a row that a UNC-Chapel Hill faculty has won the prestigious award, underscoring Carolina’s position as a premiere research institution that attracts the countries brightest and most innovative young scientists and engineers.

“Jim Cahoon is a talented and innovative scientist and an excellent teacher and colleague,” said Valerie Ashby, professor and chair of the Chemistry Department. “His research on tunable semiconductor nanomaterials is deserving of this level of recognition, and the department is thrilled for him.”

The Packard Fellowships program invests in future leaders who have the freedom to take risks, explore new frontiers in their fields of study and follow uncharted paths that can lead to groundbreaking discoveries. It is among the nation’s largest nongovernmental fellowships.

James focuses his research on novel semiconductor nanomaterials. Semiconductors are used in a vast array of modern technologies, from solar cells that convert sunlight into electricity to microprocessors that drive computers. His work —using a multidisciplinary approach involving chemistry, physics, materials science and engineering — is expected to yield a new strategy for the design of electronics, optical circuits, solar energy devices and thermoelectric systems.

James received bachelor’s degrees in chemistry and philosophy from the College of William and Mary, and a Ph.D. in physical chemistry from the University of California, Berkeley. He did post-doctoral work at Harvard University before joining Chemistry at Carolina in 2011.

2014 Undergraduate Award Winners

Outstanding junior and senior chemistry majors were recognized at the 2014 Junior and Senior Awards Ceremony, held at the Carolina Club. Pictured above, front row are Alyssa Vassallo and Eleanor Brightbill. From left to right, top, are Daniel Martin, Alex Flores, Zijian Zhou, Alexander Gilligan, and Quoc Mac. Unable to participate when the photo was taken were Alexis Akeyson, Cathy Anderson, and Sarah McShane.
Holiday Greetings from Carolina!

The Carolina Chemistry Faculty

1 Todd Austell 16 Mark Schoenfisch 31 Erik Alexanian 46 Thomas Freeman
2 David Nicewicz 17 Mark Wightman 32 Paul Kropp 47 Lee Pedersen
3 Harold Kohn 18 Michael Ramsey 33 John Papanikolas 48 Gerald Meyer
4 Yosuke Kanai 19 Matthew Lockett 34 Scott Warren 49 Andrew Moran
5 Bo Li 20 Eric Brustad 35 Jeff Johnson 50 Nancy Thompson
6 Marcey Kanai 21 Michael Crimmins 36 Simon Meek 51 Kevin Weeks
7 Linda Spremulli 22 Dorothy Erie 37 Jillian Dempsey 52 Michel Gagne
8 David Lawrence 23 Malcolm Forbes 38 Cindy Schauer 53 Jennifer Krumper
9 Valerie Ashby 24 Alexander Miller 39 Gary Pielak 54 Steve Soper
10 Edward Samulski 25 James Cahoon 40 Gary Glish 55 Michael Rubinstein
11 Thomas Meyer 26 Maurice Brookhart 41 Maurice Bursey 12 Leslie Hicks
13 Domenic Tiani 27 Wei You 42 Tom Baer 14 Brian Hogan
15 Royce Murray 28 Nancy Allbritton 43 James Jorgensen 16 Mark Schoenfisch
29 Matthew Redinbo 30 Charles Johnson 44 Joseph DeSimone 31 Erik Alexanian
Carolina!

The Twelve Days of Chemistry

One Jefferson Awardee
Two ACS Winners
Three AAAS Fellows
Four Million Dollars of Eastman Grants
Five NSF Graduate Fellowships
Six Faculty in the National Academies
Seven Years in Caudill
Eight Hundred Seventy-Five Thousand Dollar Packard Fellowship
Nine Undergraduate Award Winners
Ten Energetic Assistant Professors
Eleven Million Dollar EFRC Renewal
Twelve “Say Yes” Recipients
And a World Class Chemistry Department!

Happy Holidays!!
As a first year graduate student, being called on to solve a chemistry problem at group meeting was nerve-wracking. Walking up to the whiteboard, questions rushed through my mind. What if it went terribly? Would my advisor and lab mates still respect me? Did they even think I could do this? Could I do this?

Though I survived the exercise, the questions never quite went away. After research discussions with my male colleagues, I was left with a vague feeling of weariness. My energy was spent making sure my explanations were articulate and accurate. Yet I noticed that speaking about science with other women did not drain my energy; I felt like I had to prove my intellect before receiving the same level of respect afforded to my male peers. While I made respectful and cautious suggestions, my male colleagues confidently argued and proposed highly experimental ideas. This confidence seemed instilled from a young age, bred by a society that encouraged men to share their opinions and rewarded their confidence. The same society had taught me that I should always appear polite and humble. When none of my research was working, I hid my frustrations, thinking that showing emotion would be written off as female weakness, a far cry from the image of an objective scientist. These thoughts slowly formed my awareness of a gender-based divide of expectations and stereotypes.

I doubt seeped in as I replayed my decision to drop my physics major in college, instead pursuing chemistry. I was making mostly B’s and a couple of C’s but as one of only two women in all of my classes, I felt an intense pressure to excel. Did I really leave because I liked chemistry better, or because physics was too stressful? Would I make it through the chemistry graduate program?

I wanted to understand how these attitudes towards women in science were formed, in myself and others. For months I read and shared with friends every article that mentioned unequal treatment of women in science in the headline. Around this time I met a post-doctoral researcher who was very informed on these issues named Ginny Hench. She was toying with the idea of starting a women in science group on campus but decided against it because of her work schedule. As I was lamenting this loss to my roommate Jazz, an analytical chemistry graduate student, over dinner, she casually said to me, “Why don’t we do it?” The seed was planted. We recruited a small group of women graduate students to help us shape this new group and named it UNC Women in Science and Engineering, WISE.

I wanted to create a safe space to sort through our own understanding of implicit and explicit bias against women in science and together find a way to move forward. We decided this space would take the form of monthly meetings, based around a peer-reviewed study or popular article. We felt that grounding our discussions in concrete data would not only provide structure but be useful in conversations outside of the group. Jazz came up with the idea to also share the life and scientific work of a woman scientist at each meeting. We felt it was important to value the contributions of the women who came before us and always end on a positive note. As famed astronomer Maria Mitchell put it, “the more we see, the more we are capable of seeing.”

Our first meeting covered current statistics relevant to women in science, led by Valerie Schmidt, an organic chemistry graduate student. She presented a myriad of national statistics from amount of PhDs awarded to women to percentage of women faculty to salary comparisons by sex. Many of us present had heard the claim from our male colleagues that being female gave us an advantage in applying for awards. But we learned that women PhD’s and professors actually received less scholarly awards than expected based on the proportion of women in the field.

This simple statistic sparked multiple calls for more data and carefully designed studies. We wanted to know whether women were equally aware as men of award opportunities, how many women were actually applying for awards and if they were not, why? While every meeting was unique, it was a recurring theme for us to critically analyze and question the data from multiple angles.

Over the months we discussed balancing work and family life, unconscious bias, mentorship, female tendencies to undervalue their contribution and many others. I led a meeting on stereotype threat, finally able to define my anxiety in situations where I might fulfill a negative stereotype about my group. Each discussion was guided by a member on a volunteer basis. The discussion leader brought their own personality and gained affirmation from the group’s thoughtful engagement while members grew confident in articulating their opinions.

Member participation was key to our success and we were very deliberate in providing opportunities to lead special projects. The goal was not only to encourage active investment from members, but to help them develop leadership and organization skills outside of laboratory research. This way we could promote women in science in tangible ways and not just through rhetoric.

We have also been involved in two large science outreach events in the community, both organized by motivated student members. We demonstrated science experiments for kids and families, sharing our passion for science and physically representing the idea that anyone can be a scientist.

In December, we elected new leadership and as graduating members, Jazz and I passed the reins of the group onto amazingly dedicated younger members. Over the past 18 months, WISE has become more than just a meeting ground for discussions. It has become community of trusted allies. They are women and men who are learning how to speak up for themselves and for others. Leading this group, I have finally able to define my anxiety in situations where I might fulfill a negative stereotype about my group. Each discussion was guided by a member on a volunteer basis. The discussion leader brought their own personality and gained affirmation from the group’s thoughtful engagement while members grew confident in articulating their opinions.

Tien Nguyen is now a Communications Specialist with the Department of Chemistry at Princeton University.

For more information on the UNC WISE organization, go to: http://uncwise.wordpress.com/
The team used NMR-detected amide proton exchange experiments to measure the stability of the test protein chymotrypsin inhibitor 2 under physiologically crowded conditions in the presence and absence of the osmolyte glycine betaine. The osmolyte overcame the destabilizing effect of the cytosol, a result that provides a physiologically relevant explanation for the accumulation of osmolytes by dehydration-stressed cells.

DeSimone and Wong then asked Nitash Balsara, faculty senior scientist at Lawrence Berkeley National Laboratory and professor of chemical and biomolecular engineering at the University of California, Berkeley, and his team to collaborate. They started studying lithium-ion transport within the electrolyte and found compatible electrodes to assemble a battery.

Going forward, the team will focus on optimizing electrolyte conductivity and improving battery cycling characteristics, which are necessary before the new material can be scaled up for use in commercial batteries, explains Wong. If successful, a commercial battery can also be used in extremely cold environments, such as for aerospace and deep sea naval operations.
Solar Fuels EFRC Continued

The UNC EFRC has built a world-class research effort in renewable energy, and has created a new paradigm for successful academic and translational research at UNC and partner institutions. Built around a cadre of faculty from multiple disciplines and institutions, skilled researchers, and state-of-the-art capabilities, integrated and led by effective communication and continuous review, the UNC EFRC provides a strategic “full service” research environment in which rapid and transformative research progress occurs.

The Center is led by Thomas J. Meyer, Arey distinguished professor of chemistry at UNC, member of the National Academy of Sciences, and recently co-awarded the 2014 Sampson prize, the world’s largest award in renewable energy. The UNC EFRC has successfully pioneered the concept of the Dye Sensitized Photoelectrosynthesis Cell, DSPEC, for solar fuels production, and achieved key scientific breakthroughs in solar water splitting chemistry. At the heart of the DSPEC architecture are custom engineered, light-harvesting molecular assemblies immobilized on transparent semiconductor electrodes. In a modular approach, multidisciplinary research teams collaborate to develop and optimize individual components which are integrated into working devices. With prototypes in place, the process of iterating toward lower cost solutions and achieving higher efficiencies and long term stability regionally, nationally and internationally in solar and related energy research through scientific conferences and workshops, presentations to political and industry leaders, and community outreach activities. It has had a significant educational impact in contributing to the energy workforce of the future with 70 postdoctoral fellows, 100 graduate students, and 30 undergraduates trained or in training, 50 graduate degrees awarded, many prestigious fellowships earned, and more than 120 alumni with careers in industry, academia, government, policy, and the public sector. Through its research discoveries, educational and outreach activities, and research and technology partnerships, the UNC EFRC Center for Solar Fuels is poised to leave its mark in advancing the world’s energy future.

For more information: www.efrc.unc.edu

Eastman Chemical Research Partnership

Continued from front page

At the infrastructure level, this relationship is supported through allocated office spaces in Kenan Labs for Joon Cho, the UNC Relationship Manager, and for partners from the Eastman Innovation Center (EIC), located on NC State University’s Centennial Campus. At the project level, collaborative research efforts are initiated by Eastman posting Requests for Proposals (RFPs), which define a particular company technical challenge and provide guidance for project success criteria. Once a project is funded, the agreement allows for a variety of collaboration such as site visits and capability sharing. Across the country, this high amount of interpersonal relationship building is being discussed as the “high-touch model” and touted as a successful example of University-Industry partnership. Given the promising start, Carolina is utilizing this model in other departments outside of Chemistry including Physics and Astronomy, Applied Physical Sciences, and Biomedical Engineering.

In addition to funded projects, this high-touch model has allowed for secondary benefits such as a higher rate of engagement between Carolina students and Eastman recruiters. For example, one Carolina graduate student spent a week at her collaborator’s lab at Eastman’s headquarters in Kingsport, Tennessee. This led to her better understanding of invention and patent applications. The Center has provided leadership nationally and internationally in solar and related energy research through scientific conferences and workshops, pre- sentations to political and industry leaders, and community outreach activities. It has had a significant educational impact in contributing to the energy workforce of the future with 70 postdoctoral fellows, 100 graduate students, and 30 undergraduates trained or in training, 50 graduate degrees awarded, many prestigious fellowships earned, and more than 120 alumni with careers in industry, academia, government, policy, and the public sector. Through its research discoveries, educational and outreach activities, and research and technology partnerships, the UNC EFRC Center for Solar Fuels is poised to leave its mark in advancing the world’s energy future.

For more information: www.efrc.unc.edu

Eastman Visiting Scientists then organize a technical workshop to match the RFP needs with the research interests of Carolina. These workshops have been vital to the success of the partnership as face-to-face interactions between Eastman subject matter experts and UNC faculty members are critical to establishing high value research projects. In fact, in the past 18 months, nearly 30 Eastman scientists and engineers have visited Carolina from across the nation. Such meetings have contributed to the strength of written proposals from Carolina, which generated the aforementioned millions of dollars in research funding.

Once a project is funded, the agreement allows for a variety of collaboration such as site visits and capability sharing. Across the country, this high amount of interpersonal relationship building is being discussed as the “high-touch model” and touted as a successful example of University-Industry partnership. Given the promising start, Carolina is utilizing this model in other departments outside of Chemistry including Physics and Astronomy, Applied Physical Sciences, and Biomedical Engineering.

In addition to funded projects, this high-touch model has allowed for secondary benefits such as a higher rate of engagement between Carolina students and Eastman recruiters. For example, one Carolina graduate student spent a week at her collaborator’s lab at Eastman’s headquarters in Kingsport, Tennessee. This led to her better understanding of invention and patent applications. The Center has provided leadership nationally and internationally in solar and related energy research through scientific conferences and workshops, presentations to political and industry leaders, and community outreach activities. It has had a significant educational impact in contributing to the energy workforce of the future with 70 postdoctoral fellows, 100 graduate students, and 30 undergraduates trained or in training, 50 graduate degrees awarded, many prestigious fellowships earned, and more than 120 alumni with careers in industry, academia, government, policy, and the public sector. Through its research discoveries, educational and outreach activities, and research and technology partnerships, the UNC EFRC Center for Solar Fuels is poised to leave its mark in advancing the world’s energy future.

For more information: www.efrc.unc.edu

Wei You, Maurice Brookhart, David Norman, Cindy Schauer, Joon Chu, Alex Miller, David Nicewicz, Michel Gagne, and Damon Billodeaux
After seventeen and fifteen years on the Chemistry faculty, respectively, Kenan Distinguished Professors Kevin Weeks and Matt Redinbo were each able to realize the dream of sabbatical research leaves at two of the world’s greatest universities. Kevin decamped his family to Cambridge University, where he was a Visiting Fellow at Clare Hall, and spent his days immersed in the world-renowned MRC Laboratory of Molecular Biology and his evenings philosophizing “in college.” Dissociated from his car, he cycled to and from work, and spent off hours exploring Cambridge, the UK and continental Europe.

Matt moved his family to Oxford University for the year, and shared his professional time between the Structural Genomics Consortium at the Nuffield Department of Clinical Medicine, and Magdalen College, where he was Visiting Fellow. Matt’s two sons matriculated in English schools, but only one affected the proper British accent. The family took too many side trips from tiny London airports to mention.

Matt and Kevin are shown here at the annual Wayflete dinner at Magdalen College, Oxford.

Where are they Now? Travis Falconer and Stephanie Urbin

Stephanie Urbin and Travis Falconer first met at Carolina in the summer of 2004, where their competitive spirits clashed during a heated pick-up soccer game—literally! Despite this inauspicious start, the two Chemistry graduate students soon developed an ionic-like bond; and they made sure to play on the same side in subsequent soccer matches. Stephanie completed her PhD with Professor Brookhart in 2009, studying the mechanism of olefin and 1,3-diene polymerizations by cationic (n-allyl)palladium(II) complexes. Travis began his graduate research with Prof. Roger Miller and completed his PhD with Prof. Glish in 2008, studying the formation of ultra-small ion-neutral complexes in superfluid helium nanodroplets. He then enjoyed a two-year post-doc with Professor Ramsey developing miniaturized ion trap mass spectrometers. The couple married in the summer of 2009 and relocated to Cincinnati, OH, where Procter & Gamble recruited Stephanie and Travis joined the U.S. Food & Drug Administration. Away from the lab, they remain avid soccer players and are sharing their love for sports and science with their daughter, Mackinley.

Stephanie is a Senior Scientist in the Fabric & Home Care Strategic Innovation & Technology organization at Procter & Gamble. Within P&G, Stephanie has leveraged her technical background in mechanistic understanding and problem solving to globally develop new & sustainable surfactants, Front End Innovation prototypes for liquid laundry detergents and fabric enhancers, and technical models to predict performance based on both physical and theoretical properties. Her experience as UNC ACGS President prepared her well to lead and contribute to organizational programs such as the Emerging Technology Program, Recruitment, and R&D Onboarding. In her five years at P&G, Stephanie has been recognized for her contributions, which include four granted patents, and by being awarded Recognition Shares and the Outstanding IP Contribution Award.

Travis is a chemist at the U.S. Food & Drug Administration’s Forensic Chemistry Center, which is responsible for testing of evidence used in prosecution of violations of the U.S. Food, Drug, & Cosmetic Act. This laboratory also rapidly develops methods and performs analyses in response to food and drug crises, such as those involving contaminated infant formula and dog food, and seafood testing related to the Deepwater Horizon oil spill. At the FDA, Travis uses the broad set of skills he acquired at UNC in a variety of agency activities, including forensic research, courtroom testimony, instrument troubleshooting and networking, and instructing mass spectrometry courses for fellow FDA chemists. Travis’s contributions to the agency have been recognized by several individual and group awards.

Stephanie and Travis believe that the quality of the faculty, facilities, staff, and students at UNC positioned them for success in their post-graduate careers. Even in fields outside of their graduate specialties, it was quickly apparent that they were well prepared to solve problems, tackle challenges, and immediately contribute in a meaningful way in their new roles. Stephanie and Travis attribute several professional opportunities to the widespread recognition of the university, the department, and the faculty, as well as the achievements of those graduates who preceeded them. Stephanie’s recruitment to P&G serves as an excellent example of this: P&G sent recruiters to UNC due to the aforementioned factors, and the presentations and interviews were conducted by a UNC alumnus. Indeed, the network of UNC chemists is extensive and can be a terrific resource. Stephanie and Travis continue to benefit from their outstanding classmates and labmates through collaborations, speaking invitations, curriculum advisement, etc.

While their lifestyles and surroundings have deviated from those in Chapel Hill, Stephanie and Travis are never too far away from UNC. They still enjoy cheering on the Tar Heels, whether from afar or in person, as they did last year in snowy South Bend when UNC’s men’s basketball team dominated Notre Dame. They also consider their friends from graduate school among their closest and still see several of them on an almost annual basis. Stephanie and Travis greatly look forward to returning to Chapel Hill in 2015 for a reunion of Roger Miller students and postdocs that is currently being planned. They are already debating which of their favorite restaurants to visit. Until then, go Tar Heels!
The Dempsey Group Solar Fuel Production

Motivation to harness the energy of the sun has never been greater than it is today. Concerns over the impact of CO₂ emissions on our climate, dwindling reserves of fossil fuel resources and political issues related to energy security are all driving research in solar energy capture and conversion. Figuring out how to capture sunlight efficiently is one challenge facing researchers but determining how to store solar energy is an even bigger task. The Dempsey group is tackling both these challenges by examining how light energy can be captured and used to drive energy-intensive, fuel-forming reactions.

The energy-intensive synthesis of chemical fuels like hydrogen and methanol from abundant resources such as water and carbon dioxide can be driven with solar energy in a process analogous to photosynthesis. Work in the Dempsey group has focused on exploring how these multi-electron, multi-proton reactions can be facilitated by molecular catalysts. For instance, the group is exploring coordination complexes based on earth-abundant metals which can mediate the reduction of water to hydrogen fuels. In related work, the group is exploring the pathways by which fuel-producing reactions, which involve proton-coupled electron transfer processes, can be driven directly with photo-excited species. By directly integrating light absorption with complex chemical transformations, efficiency of light-driven fuel production will be substantially improved.

In order to realize solar fuel production, individually optimized components—such as light absorbing materials and fuel-production catalysts—must be integrated into a single device. The Dempsey group is learning how to interface these individual pieces for efficient energy capture and conversion. For example, when sunlight is absorbed by light-harvesting semiconductor materials, electrons and holes are generated and these charge carriers must be separated over long distances, transferred across interfaces to fuel-producing catalysts, and used to drive fuel production. Assembling components in a manner that allows charge carriers to be conducted seamlessly across interfaces is a grand challenge.

In response, the group is focused on optimizing electron transfer reactions at the semiconductor interface to enable these new technologies.

The Dempsey group employs a wide array of physical inorganic methods in their research, including electrochemical analysis and laser flash-photolysis coupled with transient absorption spectroscopy. Graduate students and undergraduate researchers work side-by-side to develop new light absorbing materials and fuel-production catalysts and examine their reactivity and physical properties. The group is very passionate about their research and works hard to share their interests and accomplishments both with other scientists and the general public. As such, the group has also been actively involved in various science outreach activities. For example, group members have recently developed several interactive activities to help explain their research to community members at public events.

New Faculty Cheryl Moy and Thomas Freeman

Dr. Cheryl Moy received her B.A. in chemistry from Willamette University, cum laude and with department honors. She received her Ph.D. from the University of Michigan under the direction of Dr. Anne McNeil. After graduating from Michigan, Cheryl was in Washington, D.C. serving as a Science and Technology Policy Fellow at the National Academy of Sciences and NASA’s Science Mission Directorate. Prior to her appointment at UNC, Cheryl was a Visiting Assistant Professor at her alma mater, Willamette University.

Dr. Thomas Freeman received his B.S. in Biochemistry from Xavier University of Louisiana in 2003, and Ph.D. in Biochemistry under the direction of William Wimley at Tulane University in 2010. Prior to joining our faculty, Thomas was a SPIRE, Seeding Postdoctoral Innovators in Research and Education, Postdoctoral Scholar mentored by Dr. Leslie Parisé at UNC-Chapel Hill and served as an Adjunct Assistant Professor of Chemistry at Johnson C. Smith University in Charlotte, NC.
As the Chair of the Joint Department of Biomedical Engineering, the only Department that spans UNC-Chapel Hill, based in both the College of Arts and Sciences and the School of Medicine, and NC State University, collaboration, innovation, and translation defines my professional identity. The mission of the joint department itself speaks to this inherent spirit: unite engineering and medicine to improve lives. Even this rallying cry only starts to suggest the diverse nature of the ubiquitous collaborative research and development that goes on within Biomedical Engineering. Our collaborative projects extend far beyond the School of Medicine and the College of Engineering into NC State's College of Textiles and College of Veterinary Medicine as well as UNC's College of Arts and Sciences, School of Public Health, and School of Pharmacy. Biomedical Engineering is a prime example of what is coming to be known as convergence science; it constantly blurs and erases the lines between life sciences, physical sciences, and engineering to develop and deliver better solutions to biomedical problems.

As a microcosm, my own lab and research is a space that draws together expertise from a spectrum of disciplines in order to develop novel assays and technologies that are translated into biomedical applications. Research in my lab falls into three broad categories: analytical techniques for single-cell biochemical assays, microfabricated platforms for sorting and cloning cells, and microengineered systems for recapitulating organ level function. Some highly collaborative endeavors currently converging in my lab include a bio-assay project with Shawn Gomez of Biomedical Engineering, Qisheng Zhang in the School of Pharmacy, and Jen Jen Yeh in the Lineberger Cancer Center, to achieve single-cell measurements of lipid signaling in colorectal cancer, a microfabricated platform project with Paul Armistead of the Lineberger Cancer Center, to develop microwell based live-cell arrays to screen, select, and isolate T-cells that are cytotoxic against a patient’s own leukemia blasts, and a microengineered systems project with Mike Ramsey and Christopher Sims in the Department of Chemistry and Sai Chavala from Ophthalmology to produce a gene targeted human iPS cell library for macular degeneration. These three examples of transdisciplinary integration in my own research program represent well BME’s drive to collaborate in order to innovate to ultimately translate break-through biomedical technologies into the direct service of improving human health.

At the macro-scale the Joint Department of Biomedical Engineering, a partnership between North Carolina’s two flagship research universities, is designed to be an engine of collaboration and the partnership provides unique advantages. UNC-Chapel Hill contributes strengths in the health and physical sciences whereas NC State provides its pre-eminent engineering skills. These diverse knowledge sets provide synergistic opportunities for educating the future workforce, for understanding unmet needs in healthcare, and for both creating and then translating innovative technical solutions into practice.

Specifically, the Department offers a stimulating array of collaborative research and training opportunities in five loosely differentiated convergence areas. Regenerative Medicine links tissue engineering, molecular biology, scaffolds, and mechanobiology. Biomedical Microdevices encompasses biomedical microtechnologies, microfluidics, and bioanalytical devices. Pharmacoengineering interfaces engineering and pharmaceutical sciences to develop safer and more effective medicine and medical technologies. Imaging Engineering includes PET, ultrasound, MRI, and photonics. Rehabilitation Engineering combines biomechanics and assistive devices.

This structure serves well BME’s goal to combine medicine, science, and engineering to improve life. By creating a bridge for collaboration between UNC-Chapel Hill and NC State University BME expects to:

- Drive global innovation in medicine and biotechnology
- Offer students the best education to address global challenges and needs
- Promote seamless exchange between engineers, clinicians and scientists
- Create a ground-breaking inter-institutional model for faculty and students
- Foster a translational culture for bringing ideas to market
- Improve healthcare worldwide

By its nature Biomedical Engineering encourages and even demands a team science approach to solving problems. Like myself, many faculty members hold appointments in other departments due to distinctly transdisciplinary research foci. It is my sincere hope that BME researchers will be ambassadors to their collaborative departments demonstrating the power of diverse project teams to translate innovative research into improved health. When a critical mass of the research endeavor is prosecuted by transdisciplinary collaborations in the model being pursued by BME, I forecast a paradigm shift in the speed, efficiency, and positive impact of translating science and engineering research into products that enhance the quality of life.

Helen Huang and Nancy Allbritton in the biomedical engineering lab at NC State University

Nancy Allbritton with collaborator David Lawrence, who holds a joint appointment in Chemistry and the School of Pharmacy
In this issue:

Allbritton on Convergence
Eastman Chemical Partnership
Lithium Ion Battery Revolution
DeSimone in all National Academies
Energy Center Renewed