

# Biochemistry Today

Alumni Newsletter

December 2014

University of Nebraska-Lincoln



## What's new?

Did you earn a promotion or are established in your health care career? Finished that Master's or PhD? Have you published recently? Let us know your updated information. We want to stay connected with you!

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## From the Department Chair

Greetings! You will be pleased to know that we continue to be one of the most accomplished research units at the University of Nebraska-Lincoln with 23 full time faculty, 340 undergraduate students, 31 graduate students, 21 postdoctoral fellows and research faculty, and highly dedicated staff.

This is the 20th anniversary of the George W. Beadle Center, which houses the department and continues to provide outstanding facilities advancing our educational and research missions. Our research programs address contemporary problems and are translational, which impact human and animal health, crop production, bioenergy, and the environment.



We are making seminal discoveries, resulting in a remarkable record of scholarly publications in top tier biochemistry journals, maintaining impressive levels of extramural funding, and shaping the direction of future research through our individual and collaborative research.

Our highly involved faculty provide an essential backdrop for the excellence in our undergraduate teaching mission, and we boast several Beckman Scholars, Fulbright and Goldwater Fellows, and National Science Foundation research program awardees.

It is indeed an honor to lead the Department of Biochemistry, which continues to be an outstanding academic unit on the basis of a rigorous and student-focused curriculum, the quality of research conducted, and the caliber of our graduates.

You are a part of our rich and successful history and we hope to hear from you regarding your current career endeavors. Please visit our new department website, [biochem.unl.edu](http://biochem.unl.edu) and send us an update.

- Dr. Paul Black

## Medical Innovation

**Jiri Adamec** is refining nationally recognized plasma-extraction technology to develop a cost-effective method to prescreen for diseases in parts of the world without ready access to blood testing.

One day, this technology could allow individuals to take their own blood sample with a mere finger prick and blot it onto a small card. There, the plasma would be separated from the whole blood onto a screen and the image uploaded via cell phone to a medical lab, where technicians could determine from the color the sample produces whether its sender could have a serious disease.

"This would be a pre-screening, not a diagnostic test," Adamec said.

Further testing of the patient would be necessary.

**Adamec's** UNL research builds on his previous collaboration with colleagues who developed the plasma separation technology while at Purdue University, which he and his colleagues commercialized through their private firm Novilytic, L.L.C. of West Lafayette, Ind.

The Noviplex Card, introduced earlier this year, is expected to be the first of a series of products and technologies to enable routine, rapid spectral analysis of biological samples with minimal human intervention. The discovery was recently named among R&D Magazine's 100 most technologically significant products introduced during the previous year. In addition, Novilytic received \$1.1 million in NIH Small Business Innovation Research funding for Phase I and Phase II research to develop Noviplex technology and associated applications involving detection of Vitamin D and other biomarkers.

**Adamec**, who came to UNL in 2010, said traditional blood tests, critical to modern health care, require a phlebotomist to draw a sample and a well-equipped lab for analysis; those are luxuries in many parts of the world. This new technology "will circumvent this age-old process, making it possible for a physician or individual to prepare their own sample anywhere by placing a drop of blood from a fingerstick on a small paper card that is mailed or transported to a laboratory."

This technology eliminates the need to travel to a lab before visiting a physician and requires no phlebotomy, special training, centrifugation, refrigeration or other laboratory processing. Blood samples can be mailed, samples are easily stored dry for future reference, and a very small volume of blood is required for plasma sample collection.

Here at UNL, **Adamec** is pursuing research to hone the Noviplex Card from a mere collection device to a pre-screening tool. The plasma blot could show by its color and intensity whether certain biomarkers are present that could indicate such ailments as cancer and liver disease or

exposure to certain bacteria and viruses.

**Adamec** emphasized that this would be a pre-screening only and its findings would require further testing to confirm, but it could serve as an initial, cost-effective indicator of potential disease to people in developing countries, or even in parts of the United States, far from health care.

"This is a very sensitive issue," **Adamec** acknowledged of the technology. Users of the card would not be able to determine for themselves what the colors and corresponding intensities mean; that would require analysis by a medical expert.

This technology is some years away from commercial use; FDA approval likely would take five years, and development of cell phone technology for transmission could take three.

"This is where we think medicine will go in the future," **Adamec** said. "This brings health care to the people with a very simple device."

- Dan Moser



## Graduate Training Program

A new graduate training program that spans seven departments across City and East campuses at UNL will launch this year with four student fellows conducting groundbreaking research while learning the skills needed for interdisciplinary research careers.

The Molecular Mechanisms of Disease Graduate Predoctoral Training Program is the brainchild of **Melanie Simpson**, professor of biochemistry. Simpson said she wanted to create a program that used interdisciplinary research to solve the puzzles of disease in humans, as well as provide a training ground for graduate students who want to pursue a career path of interdisciplinary research.

“As a training program, it’s intended to springboard students into what is becoming a more and more competitive research market, requiring complex multidisciplinary skills. The elements of the program really emphasize interdisciplinary training,” Simpson said.

With the assistance of program co-director **Paul Black**, professor and chair of the biochemistry department, Simpson submitted a funding proposal to the National Institutes of Health. While the program did not receive funding for the first year, **Simpson** and **Black** were encouraged by the high marks the proposal received and were advised by the institute to host the program as a pilot for one year and re-apply. That

prompted **Simpson** to seek funding from UNL, which was granted.

The program officially kicked off Aug. 20 in the East Campus Union with presentations by the four fellows chosen for the inaugural year, four short talks selected from submitted abstracts and a poster session.

Ronnie Green, Harlan Vice Chancellor for the Institute of Agriculture and Natural Resources, told those in attendance how important such programs are for future teaching and research funding.

“We’ve seen this really heavily in the funding agencies in the last four or five years and it’s going to be more the case in the next decade,” Green said. “They are requiring more systematic, interdisciplinary work that has problem-solving attached to it.”

The departments involved in the program are biochemistry, chemistry, biological sciences, chemical and biomolecular engineering, biological systems engineering and the Department of Food Science and Technology.

As funds become more scarce, Simpson said multidisciplinary programs will become more important to funding agencies.

“The NSF and NIH and other funding agencies are emphasizing that we need to prepare the whole student for a variety of opportunities and futures that each of you envision for your own career



path,” she said, adding that the new program is “intended to provide exposure to a variety of different skills needed, from presentation to proposal writing, as well as entrepreneurship, academic editing and grantmanship.”

With the success of the pilot program, **Simpson** and **Black** said they hope to receive funding from NIH for subsequent years. As they receive more funding, they will add to the number of fellows accepted into the program.

The first-year fellows are researching diseases such as fatty liver disease, diabetes and Parkinson's Disease.

The fellows selected for the 2013-2014 academic year are: **Nicole Milkovic**, advised by **Mark Wilson** in Biochemistry and Robert Powers in chemistry; **Annastasia Hyde**, advised by **Joseph Bar-ycki** in biochemistry and Jiantao Guo in chemistry; Catherine Muller, advised by Jens Walter in food science & technology and **Ed Harris** in biochemistry; and Ryan Matsuda, advised by David Hage and Eric Dodds in chemistry.

- Deann Gayman

## Study of mitochondria could help ALS

For more than a half-century, students across the United States have come to know mitochondria as the “powerhouse” of cells – a label rooted in their ability to generate energy.

Yet just as any worthwhile factory features a quality control center, so too do mitochondria.

With a new \$1.4 million grant from the National Institutes of Health, UNL researchers are leading efforts to better understand Oma1 – an enzyme critical in the maintenance of mitochondria that could prove key to combating ALS and other late-onset neurological diseases.

As part of this intramitochondrial quality control system, Oma1 helps eliminate damaged or excess proteins in the same way an inspector might remove defective products from circulation on a factory floor.

The UNL-led team aims to clarify the murky mechanisms behind the activation of Oma1, which previous research has suggested will lie dormant until it senses its cell is under siege by disease- or age-related stress.

“The concept of an (enzyme) that sits in the membrane and gets activated by stress is pretty novel,” said **Oleh Khalimonchuk**, assistant professor of biochemistry and faculty member in the Nebraska Center for Redox Biology, who heads the research. “You ask yourself, ‘Why in the world would nature preserve something over millions of years if it doesn’t do anything?’ We got intrigued by that, and we started to look at certain conditions where cells are under stress – conditions that are mimicking a disease state. Lo and behold, Oma1 becomes important.

“We don’t know many more details than that, and we want to figure out how this works.”

To dig deeper into the processes underlying Oma1’s response, **Khalimonchuk** and his colleagues are using analytic tools from genetics, cell biology and protein chemistry to analyze its behavior in yeast, mammalian cells and zebrafish.

The team is also examining the ge-



netic- and molecular-level interactions between Oma1 and recently identified “partner proteins” with which it works to maintain the healthy functioning of mitochondria.

“In essence, this is a highly interconnected network,” **Khalimonchuk** said. “That’s where yeast becomes a really useful model, because you can easily delete genes there to functionally dissect the components of that system. It also helps us to screen for other molecules that might take over when these proteins are absent. So

it should help us to define the quality control landscape of mitochondria.”

**Khalimonchuk** said recent studies have connected mutations in Oma1 with incidence of ALS, commonly known as Lou Gehrig’s disease. He said about 90 percent of ALS cases are not currently tied to a specific cause, potentially making Oma1 research a revelatory weapon in the fight against an affliction that’s currently without a cure.

“This is an exciting development, because we have essentially identified a novel genetic factor that potentially predisposes people to ALS,” **Khalimonchuk** said. “We have data (showing) that cells that are deficient in Oma1 ... cannot respire properly, meaning that even when it’s necessary to slow down a little bit, they won’t do that. When the cells age, this actually leads to progressive respiratory decline. We believe that this is actually one of the reasons for ALS, because ALS is a late-onset disease.”

If future research efforts can identify ways to stimulate Oma1 in such cases, **Khalimonchuk** said, they could enable therapeutic interventions capable of combating the neurodegenerative disease.

“We are witnessing a renaissance of mitochondrial research,” **Khalimonchuk** said. “People are understanding that many of these diseases that are seemingly incurable may have mitochondrial dysfunction behind them.”

The team’s research is funded by the National Institute of General Medical Sciences, part of the National Institutes of Health, under grant number R01GM108975.

- Scott Schrage

**Tomas Helikar's** research focus is three-fold: 1) better understand the dynamics of molecular and cellular mechanisms in complex networks in disease; 2) enable more efficient application of computational systems biology through the development of new technologies; and 3) improve Science-Technology-Engineering-Mathematics (STEM) education via the development and implementation of interactive technologies and computational modeling in the classroom.



He is the principal investigator on a four-year, **\$2,321,012 grant** from the National Science Foundation that will transform Life Sciences teaching. They are developing computer models and learning content for topics taught in both introductory and specialized biology courses.



**Rebecca Roston** studies the role of membrane modifying enzymes during freezing tolerance and the biogenesis of the thylakoid membranes. The focus of her group will be to understand the underlying molecular mechanisms in each process so that they can

be used as the basis for translational crop studies. She did her post-doctoral work at Michigan State University.

## NEW FACULTY

**Jing Zhang** teaches the biochemistry laboratory course and she is interested in the mechanisms of intracellular trafficking in eukaryotes. Jing was a postdoctoral research associate at the University of Nebraska Medical Center before she joined the department.



**Karin van Dijk** joins us from a faculty position at Creighton University. There are two research areas her group studies: one on host-pathogen interactions and the other on algae and their potential as biofuel feedstock through lipid production.



**Jonathan Markham** focuses on understanding the organization of (sphingo) lipid metabolism and how metabolic components of this pathway can influence critical cell-fate decisions.



## Department Highlights and News

- **Concetta DiRusso** Fellow of the American Association for the Advancement of Science
- **Concetta DiRusso** Jefferson Science and Technology Fellow
- **Donald Weeks** Fellow of the National Academy of Inventors
- **Donald Weeks** Outstanding Research and Creativity Award
- **Paul Black** Outstanding Senior Scientist, Sigma Xi
- **Donald Becker** Charles Bessey Professorship
- **Joseph Barycki** Holling Family Award for Teaching Excellence 2013
- **Ashley Hall** Holling Family Award for Teaching Excellence 2014
- **Jaekwon Lee** Susan J. Rosowski Professorship
- **Jaekwon Lee** Promoted to Full Professor
- **Charles Wood** Fellow of the American Association for the Advancement of Science
- **Melanie Simpson** Promoted to Full Professor
- **Britta Osborne** L.K. Crowe Outstanding Undergraduate Advisor Award 2012
- **Britta Osborne** Builder's Award for Outstanding Academic Advising 2013
- **Donald Weeks** and **Robert Spritzer** will be retiring on June 30, 2015

# STUDENT NEWS



## Biochemistry Club



Officers Pictured: **Katy Cornwell, Megan Gardner, Josh Floth, and Hannah Schumacher**

The most popular event this year was the *Science for Preschoolers* afternoon where several members helped 3-5 year olds complete basic density experiments at the UNL Children's Center.

Other popular events included the annual Beadle Lab Tours, Study Night, Husker Watch Party and The Big Event.

The Club was nominated for several categories during the 2014 CASNR Celebration Week, including Outstanding Organization, Service, Club Member (**Josh Floth and Megan Gardner**) and Officer (**Katy Cornwell**). The Biochemistry Club WON the Student Organization Service Award for their Science for Preschoolers and Science Olympiad service events.

### Highest Distinction Graduates

Congratulations to our undergraduates who earned a 3.92 GPA or higher and completed an honors thesis!

**2013: Daniel Agraz, Joshua Folchert, Lindsay Leikam, Dillon Lieber (Chancellor's Scholar 4.0 GPA), Michael Stewart, and Emily Zurbuchen**

**2014: Wei Wen Chong, Rachel Coburn, and Ashley Thelen**

### Scholarship and Award Winners 2013-2015

The Dr. Benjamin M. Sahagian Scholarship Award: **Rachel Coburn, Ashley Thelen, Katie Larkin, Katy Cornwell, and Brian Richard.**

The Roscoe C. Abbott Scholarship: **Katie Larkin, Boqiang Tu, Amanda Hare, and Jaileen Albers.**

The Donald P. Weeks Scholarship: **Anthony White and Jeffrey Wallman.**

The Milton E. Mohr Scholarship: **Sara Christianson, Rachel Coburn, Amanda Hare, Shelby Koenig, Ashley Thelen, Thao Trinh, and Boqiang Tu.**

Agricultural Research Division (ARD) Undergraduate Research Award: **Tyler Chonis, Cynthia Nguyen, Eric Shuman, and Ashley Thelen.**

Forty-nine biochemistry students earned Undergraduate Creative Activities & Research Experience (UCARE) Awards.

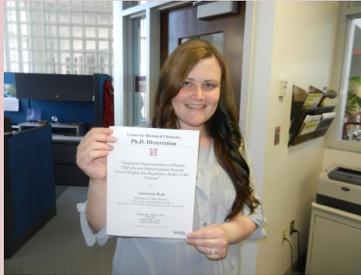
## 2012-2014 Graduate Degrees Awarded

M.S.: **Sabreena Larson** (Bailey), **Sandhya Lakshmi Gopalakrishnan** (Harris), and **Nick Eurek** (Hall)

Ph.D.: **Mike Moxley** (Becker), **Amy Knobbe** (Weeks), **Boon Hoe Lim** (Spreitzer), **Nikhilesh Sanyal** (Becker), **Alaattin Kaya** (Gladyshev and Fomenko), **Tom Plucinak** (Weeks), **Drew Brueggeman** (Weeks), **Ben Arentson** (Becker), **Caitlin O'Hare McAtee** (Simpson), **Annastasia Hyde** (Simpson and Barycki), **Maxim Gerashchenko** (Gladyshev and Fomenko), **Nathan Smith** (Lee), **Nicole Milkovic** (Wilson)



**Donald Becker** and **Nikhilesh Sanyal** after Ph.D. defense May 2013

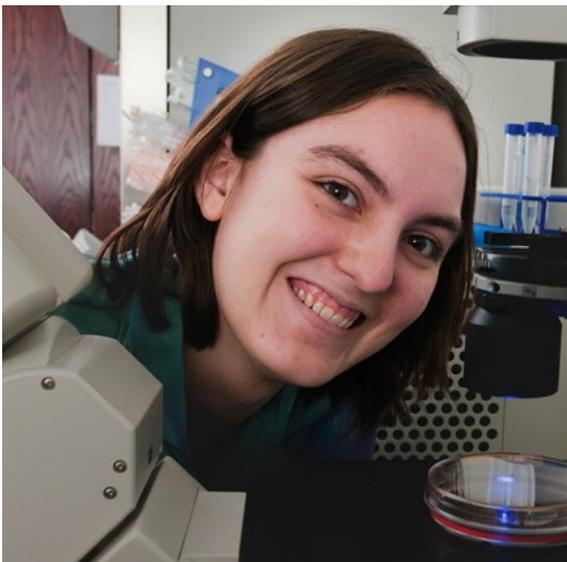


**Annastasia Hyde** May 2014



**Tom Plucinak** and **Don Weeks** after Ph.D. defense December 2013

The NSF Graduate Research Fellowship Program recognizes and supports outstanding graduate students in supported science, technology, engineering, and mathematics disciplines who are pursuing research-based doctoral degrees at accredited United States institutions. It pays a stipend of \$32,000 annually, as well as a \$12,000 cost-of-education allowance to the institution the student chooses to attend. More than 14,000 applications were received for the 2014 competition, but only 2,000 fellowships were awarded. UNL Biochemistry is proud of our two most recent recipients: **Abbey Berkebile** '12 and **Ashley Thelen** '14. Abbey is currently at the University of Iowa Carver College of Medicine studying Cystic fibrosis, while Ashley is at the University of California– Berkeley in the Molecular and Cell Biology division of Chemical Biology.





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