

New Frontiers

RESEARCH AND CREATIVE ACTIVITY AT THE UNIVERSITY OF NEBRASKA AT KEARNEY

A woman with dark hair, wearing a teal cardigan over a white top, is smiling and working on a server rack. She is holding a blue cable. The server rack is filled with various equipment and a large number of red and orange cables. The background is slightly blurred, showing more of the server room.

Technology, Teaching, Teamwork
ANGELA HOLLMAN



**CELEBRATING 10 YEARS OF RESEARCH
AND CREATIVE EXCELLENCE**



From the Chancellor

Ten years.

When we launched this magazine a decade ago our objectives were simple: To increase the prominence of research and creative activity at the University of Nebraska at Kearney, and to demonstrate the excellence of the academy, collectively, through individual stories about faculty.

Over time this publication has become a signature piece that collects and documents a body of work that is both significant to Nebraska, our nation, and our world – and also, that connects that work to UNK’s mission of teaching our students and serving our community.

As we deliberated and prepared our new strategic plan recently, we came together to talk about who we are as an institution, what Nebraska needs from us, and how we can look to the future to strategically position ourselves for continued success. We are challenged every day to be more and do more for our constituents while reacting to – and anticipating – challenges that lie ahead.

At the core of our strategic plan is learning. Our faculty are directly responsible for the learning that takes place in their

classrooms, labs, on stages, and as we focus on experiences and hands-on activities that happen outside our academic buildings.

The faculty you read about in these pages are selected because of their excellence – both in their scholarly activities, and for using their research and other activities to lead and inspire their students to do more. They demonstrate that “UNK Difference.”

I’m proud of the achievements of the faculty featured in this magazine as well as those featured in previous issues. Throughout the decade, telling stories of their work has elevated the importance and visibility of UNK scholarly activity and enhanced UNK’s reputation along the way. Thank you, faculty.

As you read the pages that follow, I hope you are, like me, inspired to do your best. And to continue to look ahead at

how UNK is positioned to make a difference in the lives of our students, in solving problems and creating beauty and excellence, and in leading Nebraska.



Douglas Kristensen

DOUGLAS A. KRISTENSEN, J.D.
Chancellor

Welcome to New Frontiers 2017

This issue of New Frontiers marks the magazine's 10th anniversary – a time to look back and look ahead at the university's research and creative activities that impact our students, communities and the world.

Over the past decade, New Frontiers magazine has provided the University of Nebraska at Kearney with a platform to showcase faculty who excel in both teaching and research. In this anniversary issue, we revisit four researchers from past issues and introduce four more who are helping shape the next decade of research productivity at UNK.

As we reflect on the work of returning scholars in New Frontiers, it is clear why their research continues to ignite a spark within their students.

Christopher Exstrom's collaborative solar cell film research and Greg Brown's groundbreaking studies in strength training and supplements continue to bring firsthand research experiences to students.

International award-winning printmaker Victoria Goro-Rapoport has made strides in teaching art, scientifically, to understand and share how the world works. Frank Tenkorang's commitment to researching the economic effects of ethanol have informed policy makers and communities for the future of biofuels.



New faces in New Frontiers include Angela Hollman, Bryan Drew, Dick Meyer and Denys Van Renen. Their research is helping keep UNK at the forefront in topics such as cyber security in business, plant pollination, school improvement processes, and science in literature.

The work of these eight faculty members exemplifies the innovative and interdisciplinary spirit of research and experiential learning in their fields. UNK has built a foundation on recruiting and retaining faculty who actively progress in research endeavors – one reason why grant awards to UNK faculty are at an all-time high this year. Their passion for research paves the way for future scholars.

There would be no New Frontiers without faculty who are willing to share their research and apply it to the classroom. I continue to be inspired by every new issue of New Frontiers, and I hope you will join me in celebrating its milestone anniversary.

KENYA S. TAYLOR, Ed.D.
*Associate Vice Chancellor for Academic and Student Affairs
Dean for Graduate Studies and Research*

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VOLUME X

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EDUCATING EDUCATORS

Focused on relationships, Meyer zeroes in on bullying, online learning

By TODD GOTTULA

Deshler, Nebraska.

It is where Dick Meyer grew up. In a house on Hebron Avenue, across from St. Peter Lutheran school.

It is the town here he developed a love for math and science, and respect for his teachers – who put an emphasis on personal relationships and teamwork.

“I had great relationships with my teachers,” said Meyer. “I emulated them, and I grew up wanting to be like them.”

Deshler is tucked away south of Highway 136 in southeast Nebraska, just west of Hebron.

It is where Meyer’s dad, Clarence, worked for the local dairy, picking up milk, eggs and cream from farmers and delivering to area stores. Where his mom, Lucille, worked as a secretary for Holle Insurance Agency.

And it is where church and education lined up side by side in his youth.

“I grew up thinking everybody was Lutheran,” joked Meyer, noting his hometown had four Lutheran elementary schools.

“I always loved school. My mom worked, so after school we went to the neighbor’s house and played school. I just always liked being in school.

I liked the environment. I liked learning.”

Meyer, associate professor and chair of educational administration at UNK, gained an early interest in education, which has led to a 42-year career as a teacher and administrator.

“I still remember all those lessons growing up, in and out of the classroom,” he said. “I grew up in a terrific environment in Deshler, and that has always stuck with me.”

TRANSITION TO HIGHER ED

Meyer’s career path includes 27 years as a middle school and high school principal at schools in Holdrege, Columbus, Humphrey and Wolbach.

Much of his research focuses on curriculum assessment, school improvement processes and using data to improve student learning. His research also examines formative assessment leadership and professional development for teachers.

As a UNK faculty, Meyer teaches educational administration courses such as: Social Foundation of Education, Assessment Leadership, Supervision of Instruction, Technology Tools for Teachers and Intro to

Educational Research.

“I could always relate to students, and I think that remains a strength of mine today. One of the things I always tried to do as a principal was be visible and out among the kids. I would stand in the hallways, shake kids’ hands and greet them each morning.”

Meyer was 26 years old when he got his first job as principal, at Wolbach Public Schools. He also served as athletic director, coached football and taught geometry there.

“I knew being young that I’d have to work at being a leader because in most cases my faculty members were older than me. Building relationships and earning respect was a real challenge early in my career, but I always liked that interaction with students, teachers and other administrators.”

Following 38 years working in public schools, Meyer decided to enter the world of higher education. He had worked at UNK as an adjunct, and he said it was a natural move to join UNK fulltime in 2013. He worked the previous seven years as curriculum, instruction and assessment director with Kearney Public Schools.

“I always thought I would enjoy working with graduate students and help educate principals,” he said. “I saw teaching at UNK as an extension of what I was doing at KPS.

“It was a little scary not knowing how everything operates in higher ed, but I knew I could learn it. I had the administrative skills and that strong base in education needed to be successful in this environment.”

Meyer said his past relationships with administrators benefit his research and work in UNK classrooms.

“Relationships are extremely important. I talk a lot with our faculty and students about being connected to K-12, visible and talking frequently with school leaders. Staying involved and having those relationships with principals and superintendents is so important in terms of recruiting students to our programs.

“I still have those relationships and bring those connections to everything I do.”

BULLYING, ANTI-SOCIAL BEHAVIORS

Bullying. It affects the social, emotional and academic success of students.

In extreme cases, it leads to suicide and is a contributing factor in young peoples’ decisions to end their own lives.

Meyer’s research on anti-social behaviors, their connection to bullying and impact on students confirms that anti-bullying programs are needed in schools to address these behaviors.

His 2016 article “Perceived Connections Between Anti-Social Gateway Behaviors and School Bullying and Culture” found that bullying is prevalent in schools and leads to mental health conditions such as depression and anxiety among young people.

Meyer examined and compared opinions of 8th- and 9th-grade teachers and students at a suburban middle school and high school in the Midwest. He found that four out of five students and teachers involved in his study believe that anti-social behaviors occur in their classrooms.

His research shows that 82 percent of students - and 100 percent of teachers – witnessed or were involved in bullying or anti-social behaviors. Seventy-six percent of students and 90 percent of teachers believed that a school-wide program would lessen extreme forms of bullying and improve the overall culture and school climate.

“Students are asking for our help,” said Meyer. “It’s our responsibility, as professionals, to put into place programs and systems that deal with the negative impact of bullying and also are educational and preventative.

“It’s time we start having more discussions about bullying, what it looks like and what we can do to help kids in our schools.”

Bullying remains hard to define, which often makes it even harder to address, said Meyer, whose research shows that bullying today is often psychological and does not involve physical contact.

“Whether you call it bullying or not, we all know what is acceptable behavior and what is not,” he said.

Outward physical bullying – or what Meyer’s research called “typical bullying behaviors of playgrounds of the past” – is less prevalent than harassment that occurs through social media and other settings.

These anti-social behaviors are termed “gateway” behaviors and include actions such as eye-rolling, whispering about someone and talking behind their back, or ceasing to talk when he/she is around, giggling, pointing or isolation. They are seen every day in classrooms and hallways, said Meyer.

They have been an almost accepted part of adolescent behavior through media presentation, reality television, and our own permissive response to such behaviors.

“While not as overt as some signs of bullying, these behaviors impact the culture of a school and can have negative impacts on the emotional health of a child, his/her ability to learn, and can lead to more distressing behaviors later,” Meyer said.

Anti-social behaviors often are linked to either suicide ideation or attempts in young people, Meyer said.

“This is something that we must turn our attention to in a purposeful and deliberate way. Our schools and classrooms must remain under our watchful eye.

“It is imperative that we address this. Sometimes it’s easier to pretend it doesn’t exist, ignore it and say ‘We don’t have that here in our school.’ When you look at our research, not every teacher sees this as an issue,” added Meyer. “That’s proof that we have room for improvement. The reality is this is an issue in every school.”

The Nebraska Department of Education has purchased online suicide prevention training for all Nebraska schools. That’s a positive start, Meyer said, but administrators and school personnel need some guidance in how to handle the emotional and relational health of students in their buildings.

Meyer hopes his study points educators in a new direction with regard to how to address the issue of bullying in schools and attitudes in their buildings.



“It’s time we start having more discussions about bullying, what it looks like and what we can do to help kids in our schools.”

Teacher intervention is crucial in addressing and reducing bullying behaviors, Meyer said, but some educators are unconvinced of the need for a formal program to address bullying. Meyer said some of the resistance stems from teachers’ lack of confidence in addressing bullying.

“We are seeing some strong efforts, but I hope schools have discussions on top of that. We need to make sure we’re paying attention and not just reacting when something terrible happens, when something extreme occurs. If our teachers, principals, superintendents ignore things, it is just going to build.”

ONLINE LEARNING MODELS

Online learning is expanding rapidly. In fact, online enrollment at many universities is growing faster than traditional enrollment.

Meyer’s 2016 article “Models of Administration for Online Learning Programs in the U.S Higher Education Institutions” examined two online learning models in 85 higher ed institutions and universities across the United States.

Working with staff and administrators of distance

learning programs, his research focused on Centralized Administration and Decentralized Administration models. The centralized model has one office or department in charge of everything related to online learning. The decentralized model has many online learning departments or offices within its colleges, and is more common at large universities.

Meyer’s research indicates online learning programs under the Centralized model are more common, and stronger.

“The centralized model is a more streamlined approach, which expedites decision making and implementation of programs. People in institutions using a centralized model tended to be more satisfied with their online learning program than those using the decentralized model,” the research said.

The centralized model provides more consistency.

“Under this model, college administrators and leaders who have knowledge of programs offered and needs of their online students provide input to the decision makers,” Meyer said.

“It is more consistent when one office oversees things as opposed to a bunch of people just doing their own thing. If you get too many pockets all disseminated out, a program becomes strong on one side and weak on the other.”

Meyer’s research also showed that staff and administrators involved in online learning programs were most concerned about high-level administrative support, specifically in areas of funding, guidance and oversight. Administrative leadership significantly affects the quality of an online learning program, said Meyer.

“Colleges and universities need to plan and devote appropriate resources in order to develop quality

“Colleges and universities need to plan and devote appropriate resources in order to develop quality online programs where students are able to demonstrate success.”

online programs where students are able to demonstrate success,” he said. “This will not happen without administrators who provide leadership and vision for the institutional direction regarding the role of online learning at the institutional level.”

Course design, technology, faculty development and faculty competence all affect success of distance education, Meyer said.

Developing and articulating an institutional strategy is key to that success, he stressed.

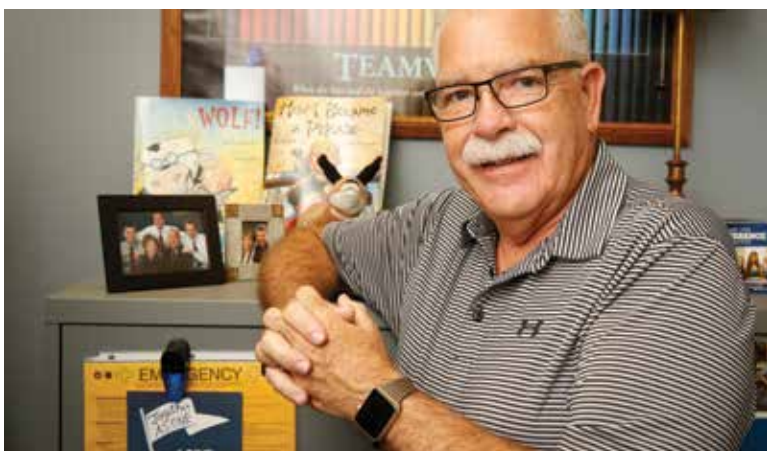
“You have to be clear on your mission, vision and what you want to accomplish. And then you have to communicate it to everyone,” Meyer explained. “You can’t just hope it happens. You can’t just tell your faculty the vision. You have to have continual discussion and have involvement. The message has to be consistent and shared over and over.”

RESEARCH NOT EASY

Research is a challenge, said Meyer, and he is matter-of-fact when asked about the difficulty in getting published.

“Publication of research is not a priority in K-12, so research is very difficult for me because I spent so many years in that environment,” he explained. “The shift to





DICK MEYER

Title: Associate Professor and Chair, Educational Administration

College: Education

Education: Education Doctorate, University of Nebraska-Lincoln, 2008; Master of Education, University of Nebraska-Lincoln, 1978; Bachelor of Science, University of Nebraska-Lincoln, 1975.

Years at UNK: 4

Career: Curriculum, Instruction and Assessment Director, Kearney Public Schools, 2006-13. Middle School and High School Principal, Holdrege Public Schools, 1995-2006. Middle School Principal, Columbus Public Schools, 1991-95. Middle School Principal, Holdrege Public Schools, 1984-91. K-12 Principal, Humphrey Public Schools, 1981-84. Grades 7-12 Principal, Wolbach Public Schools, 1979-81. Math Teacher, Culler Junior High, Lincoln Public Schools, 1975-79.

Family: Wife, Sheila; Sons: Aaron, 33; Lane, 31; Cole, 31; and Quentin, deceased. Grandchildren: Jaxon, Leo, Ellis and Nixon.

Hobbies/Interests: Watching college sports, watching professional baseball, traveling, golf, visiting wineries and breweries.

Honors/Awards: Al Kilgore Award of Excellence, Nebraska Association of Supervision and Curriculum Development, 2014. Nebraska High School Principal of the Year, Nebraska Council of School Administrators, 2002. Region IV High School Principal of the Year, Nebraska Council of School Administrators, 2000. Region IV Distinguished Elementary Principal of the Year, Nebraska Council of School Administrators, 1998.

Areas of research/specialization: Continuous school improvement, Using data to improve learning, Formative assessment, Professional development, Improvement of instruction.

Courses taught: Educational Administration courses: Social Foundation of Education, Assessment Leadership, Supervision of Instruction, Technology Tools for Teachers, Intro to Educational Research, Endorsement Internship, Independent Reading, Field Study, Internship.

Recent Published Articles:

- "Improving Teaching and Learning Using the Keeping Learning on Track Professional Development Program and Strategies," *Journal for Leadership and Instruction*, 2017.
- "Perceived Connections between Anti-Social Gateway Behaviors and School Bullying and Culture," *Higher Education Studies*, 2016.
- "Models of Administration for Online Learning Programs in the U.S Higher Education Institutions," *Journal of Applied Educational and Policy Research*, 2016.
- "Help at 3 AM! Providing 24/7 Timely Support to Online Students via a Virtual Assistant," *Online Journal of Distance Learning Administration*, 2016.
- "Rating User Interface and Universal Design in MOOC Course Design," *International Journal of Technologies in Higher Education*, 2015.

publishing manuscripts has been a steep learning curve.

"When I was in K-12, I collected data but didn't really publish. The academic writing piece didn't occur. Research has been a new challenge. It has forced me to get off autopilot and out of my comfort zone."

The biggest thing he learned about research is being clear on what his question is going in.

"That's not as easy as it sounds, but having clarity and defining what it is you're after is key," Meyer said. "Once you have that question, figuring out what you need to find the answers is easier."

"I'm very detailed and organized, so I need to know how everything relates to each other and supports each other. For me, that all needs to line up."

Meyer said working with UNK faculty Phu Vu, Martonia Gaskill and Matthew Bice has shaped his research knowledge.

"Finding others to mentor and collaborate with has been extremely important and helpful in my ability to get manuscripts published. I developed a connection right away with them. I know I can always go to them and ask for help with a piece of writing."

Seeing his work get published remains exciting for Meyer.

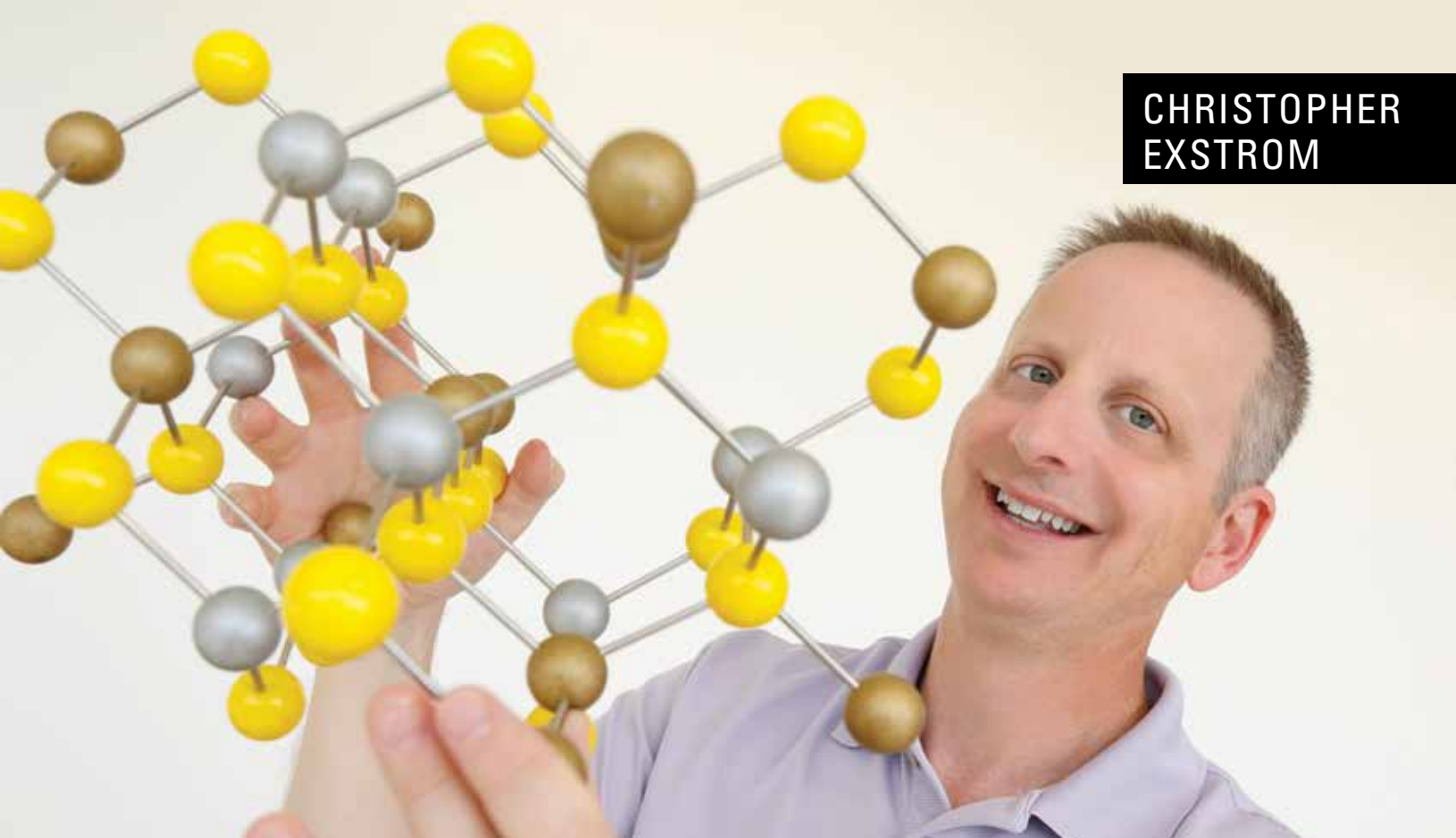
"I really like messing with numbers, running the stats and analyzing it all because I'm a quantitative guy. That is what I really enjoy about research. I also really enjoy getting published. That's still a thrill for me, and I think it always will be."

When asked what he wants people to take away from his research, Meyer steps away from the details.

Ultimately, the success of former students and people he's worked with is what drives him.

"I want to improve education by helping people achieve their goals, particularly on the administrative side. I like helping students get where they want to go in their lives and careers. I get frustrated when people in higher education lose sight of that."

"I try to have conversations and create relationships with students that help them become successful. People, student success and relationships has always been my driving force." ■



CAREER IN CHEMISTRY

Exstrom builds up students, UNK's research reputation

By JAN TREFFER THOMPSON

Inside a University of Nebraska at Kearney laboratory, two chemical elements have just become tungsten selenide. Argon that surrounded the reaction has just been purged from the container. It's time for a heat treatment.

Later, scientists will check the compound's composition in a Raman spectrometer and use an x-ray diffractometer to test its crystalline structure. If all the crystals are oriented in the same direction, the compound's electrons could efficiently convert light into electricity.

In the next room, a new dryer is being tested that uses heated carbon dioxide to clean the pores of low-density solids called aerogels.

While the work is part of significant chemistry research, what's truly unusual are the six scientists who staff this lab. These aren't doctoral candidates, or even graduate students. They're undergraduates, doing professional research that will

"... We've been able to acquire equipment that you rarely see in chemistry departments that don't have graduate programs."

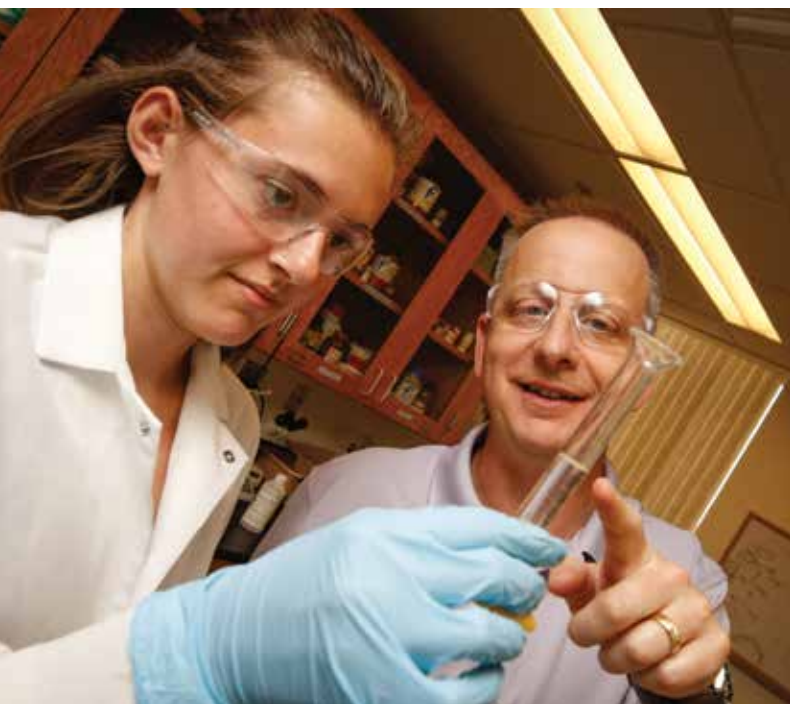
yield career-building conference presentations, publications, or even patents.

Students participate in 99 percent of the research done in UNK's chemistry department, said Professor of Chemistry Christopher Exstrom, which is unusual at a school without a graduate chemistry program.

What the chemistry undergraduates are able to do, and the advanced equipment they're able to work with, has come to UNK through Exstrom's research and related grants; the greatest investment can be credited to his two decades of research on solar cell films.

Since coming to UNK in 1996, Exstrom has published 25 journal articles and received \$3.79 million in grants. He has applied for seven patents, receiving four so far. He and UNK Chemistry Department Chair Scott Darveau began analyzing solar cell films in 2002; the research has yielded around 20 of his journal publications and three of his patent applications.

Exstrom's work earned him the university's Leland Holdt/Security Mutual Life Insurance Company Distinguished Faculty Award in 2010, and the Ron & Carol Cope Professorship in 2016. He was also named Undergraduate Research Faculty Mentor of the Year for natural science and received UNK's Pratt-Heins Award for Excellence in Research



and Scholarship in 2006.

But Exstrom said the greatest effect of his projects has been on the department and its students.

“Thanks to our grants and collaborations, we’ve been able to acquire equipment that you rarely see in chemistry departments that don’t have graduate programs. A nice feature about that is we also work these techniques into many of the upper level classes we teach. So when I teach materials chemistry, we take some field trips to the lab and students get some hands-on experience with these techniques,” he said.

RESEARCH MENTALITY

Bringing students into the research process wasn’t always an accepted practice. When Exstrom was hired, he said, “there was still a lot of faculty division campus wide about how much research one should be doing, or even if faculty should be doing research. At the time, there was a big camp that thought we should be just teaching our classes – if we didn’t spend all our time teaching our classes, then we’d end up like University of Nebraska-Lincoln, where research is the emphasis.”

In fact, each faculty office in the department used to have a lab bench, “with the idea that if faculty were going to do research they could just do it right there in their office.”

But Exstrom had been trained differently. At Illinois Wesleyan University, where he received his bachelor’s degree, he’d participated in the school’s first student research event. He’d been hired at UNK by James Roark, who encouraged not only faculty research, but student involvement as well.

“Scott (Darveau) and I, we’re the two remaining faculty of a group of five who were hired within two years of each other. And the plan from the get-go was for us to start an undergraduate research program. At the time, we wanted to

catch up to what the private schools were doing,” Exstrom said.

“A lot of faculty brought in during the ‘90s had a lot of private school experience, and at the time the private schools were leading the way in incorporating research into the education. In chemistry, the goal with our hirings was to get this started.”

As chair of the department from 2000-06, Exstrom helped spread that research mentality. He said he took the research apprentice program idea from UNK’s honors program, advertising to all freshman and sophomore chemistry majors. The department has eight to 15 apprentices each year, taking on as many as faculty feel they can effectively mentor.

He was also able to help change the building itself.

While the chemistry department had been converting teaching space into research laboratories throughout the 1990s, by the next decade a new layout was needed. As department chair, Exstrom and then-biology department Chair Charlie Bicak moved faculty offices. They put biochemists and molecular biologists together, since those specialties share equipment and interests. Dedicated undergraduate research laboratories were created as part of renovations in 2004 and 2009.

Exstrom and Darveau have run one of the research groups since they began working with solar cells.

SOLAR CELL FILMS

Before 1997, Exstrom’s research had focused on vapochromic chemicals, which change color in the presence of certain vapors. The work addressed concerns about buried hazardous waste, which sometimes leaches into soil when the barrels in which it’s housed corrode. Toxic vapors can then make their way into the atmosphere, and companies were interested in developing monitors that could sense the presence of those vapors.

“The grand plan was to make a device that they called an electronic nose,” he said.

While the project yielded five journal articles and four patents, that work dissipated when UNL electrical engineers Rod Soukup and Natale Ianno approached the UNK administration. They had developed a new way of making thin films to coat solar cells, and they were looking for chemists who could analyze those films.

At that time, Exstrom said, “(Scientists) were waist-deep in the second generation photovoltaic solar cell research.” The first generation had been silicon-based materials, developed in the 1970s and applied since the 1980s in products such as solar-powered irrigation pumps.

“There are some problems with silicon. Just as silicon can produce electricity from sunlight, it degrades in sunlight. Then too, you had to achieve a certain thickness of the silicon that limited its potential applications. At the time, the military was interested in making foldable solar cell panels to put on tents or backpacks or whatever,” Exstrom explained. “So we needed thinner materials and materials that were just naturally more efficient.”

That’s what the Lincoln engineers had produced.

UNK students and faculty experimented with processes to



make solar cell films, then analyzed the films for composition, phase and purity. The film then went to the UNL engineers, who put it on solar cells.

The project was initially funded by a grant from the Nebraska Research Initiative, a University of Nebraska program. It was the first multi-campus NRI grant, Exstrom said, that represented a 50/50 partnership between Kearney and Lincoln faculty.

Early developments led to funding from U.S. Department of Energy in 2006-11. Currently, the work is funded by the University of Nebraska Foundation.

One result of the project has been more laboratory equipment for UNK. One of the first major additions was a Raman spectrometer, which uses a laser to vibrate the crystal structure of samples. A graph of the frequencies at which the crystals vibrate lets scientists know exactly what's in their samples.

Across the room is an electron microscope – a low voltage model, Exstrom explains, small enough to sit on a counter and significantly less expensive than graduate students would use at research universities, but far more than undergraduates typically get to work with. In an adjacent room is the x-ray diffractometer, which bombards samples with x-rays, measures and graphs the angles at which the rays are diffracted.

While the group's solar cell research is focused on tungsten and selenium compounds now, scientists have worked with a

variety of materials over the years. Exstrom said they've done the most work with mixtures of copper, indium, gallium and selenide (CIGS).

CIGS research yielded Exstrom's most cited article related to solar cell films, published in 2010. In it, he reports the development of an open air process for creating the material. The finding was significant, he explained, because most reactions have to occur in containers filled with argon or nitrogen. CIGS compounds are typically made using common solvents, which must be heated far beyond their boiling points.

"So (scientists) would have to use these pressure chambers, and that's inconvenient – you can't check on the reaction, you have to run it and see what you get," he said.

Exstrom's research group decided to use a solvent that boiled at a much higher temperature. It was heated to an even higher temperature than scientists usually used in making CIGS, but because the solvent could go to that temperature, they didn't need a pressure chamber.

"It's much simpler to be able to prepare a pot and sit it on the lab bench," Exstrom said. They were the first group in the world to use such a method in preparing CIGS nanocrystals.

UNDERGRAD RECOGNITION

Three undergraduates are among the authors of the open-air reaction article; students are also typically named on patent applications that have resulted from research, which



Exstrom said is unusual because the standard for participation is high. “You really have to prove they contributed to the originality of the idea,” he said, but with the level of student involvement at UNK that routinely happens.

CIGS is a second-generation solar cell material that’s now commonly used at large solar farms; it gives the greatest efficiency from sunlight to electricity, and can be made into very thin films. But these compounds also have disadvantages, including the shortages of elements such as indium.

Scientists have moved on to a third generation, and so has UNK.

The first third-generation material Exstrom’s group studied was iron pyrite, which is very stable except for a few molecules’ thickness at the particle surfaces. The phases that form there are not semiconductors, so Exstrom said the group has focused on another Earth-abundant semiconductor instead, tungsten selenide.

“It’s fairly easy to produce or process from ores, and the interesting thing about it is that it forms a layered material. It just naturally forms these layered sheets at a molecular level, and it turns out that helps conduction. So if you make a high enough quality sample, it’s just naturally designed to conduct electricity well,” Exstrom said.

The naturally formed sheets can be just one formula unit thick – one layer of tungsten and two layers of selenium – making it useful for molecular electronics.

“What I envision is that there is a middle ground that can combine the best aspects of both teaching and research, and bring them together.”

“We actually need something thicker for the solar cell applications. So to make a thicker film and keep all these sheets parallel to one another is one of the challenges,” Exstrom said. Another challenge is the temperature required to process it, around 1,000 degrees Fahrenheit.

Exstrom’s group has made progress on that second hurdle, developing a low-temperature process for creating tungsten selenide that’s outlined in a 2016 journal article. Though the two-step process still requires heating to 550 degrees, it’s a much lower temperature than traditional methods.

AEROGEL PROJECT

Since 2014, Exstrom has made time away from solar cell research to collaborate with engineers Dennis Alexander and George Gogos of UNL. The project has been financed by a grant from the National Aeronautics and Space Administration.

The collaboration began when the Lincoln engineers developed a femtosecond laser treatment for metals.

“They can make all these contoured micro and nanostructures in a controlled fashion, and it has different effects on heat transfer in the material,” Exstrom said. NASA’s application goal is for equipment such as satellite components.

“You take a metal and treat it with a pulsed laser, carefully time the pulses and the power, and they can create these micro and nanostructural contours and features. They can make pyramids, mounds, spheres; they can make mounds that rise above the surface, mounds that are in holes below the surface. But what they didn’t have a good grasp on was the chemical analysis of the surface environment on these. Because it’s very possible to oxidize it and create these different compounds on the surface.”

UNK’s role was first to simply analyze metal samples that had been given this laser treatment, checking the samples’ composition and crystal structures. As the project developed,



CHRISTOPHER EXSTROM

Title: Ron and Carol Cope Professor, Chemistry

College: Natural and Social Sciences

Education: Ph.D., Chemistry (Inorganic/Analytical/Physical), University of Minnesota, 1995; Bachelor of Arts, Chemistry, Illinois Wesleyan University, 1990.

Years at UNK: 21

Career: Visiting Assistant Professor of Chemistry, Kenyon College, 1995-96; Assistant Professor of Chemistry, University of Nebraska at Kearney, 1996-2000; Associate Professor of Chemistry, UNK, 2000-06; Chair, UNK Dept. of Chemistry, 2000-06; Professor of Chemistry, UNK, 2006-16; Ron & Carol Cope Professor of Chemistry, 2016-present; Director of Science/Math Education, UNK Master of Science in Education program, 2012-present.

Family: Wife, Suzanne, office associate UNK Social Work Dept.; Sons: Geoff, 17, and Robbie, 14.

Hobbies/Interests: Golf, bowling, wine tasting, science fiction, film

Honors/Awards: Ron & Carol Cope Professorship, 2016; Leland Holdt/Security Mutual Life Insurance Co. Distinguished Faculty Award, 2010; Pratt-Heins Award for Excellence in Research and Scholarship, 2006; Undergraduate Research Faculty Mentor of the Year, Natural Sciences, 2006.

Areas of research/specialization: Semiconductor nanoparticle synthesis and characterization for solar cell and sensor applications, Material film characterization for various electronics and structural applications.

Courses taught: Undergrad courses in introductory, general, inorganic, analytical, environmental and materials chemistry. Graduate courses in inorganic and environmental chemistry, and chemical management and safety.

Recent Published Articles:

- "A Low-temperature Fabrication Method for WSe₂ Films Grown from Nanocrystalline Precursors," MRS Advances, 2016.
- "Properties of CuIn_{1-x}GaxSe₂ Films Prepared by the Rapid Thermal Annealing of Spray-deposited CuIn_{1-x}GaxS₂ and Se," Materials Research Society Symposium Proceedings, 2011.
- "Thermoelectric Properties of p-type CuInSe₂ Chalcopyrites Enhanced by Introduction of Manganese," Physical Review B, 2011.
- "Air Stable, Photosensitive, Phase Pure Iron Pyrite Nanocrystal Thin Films for Photovoltaic Application," Nano Letters, 2011.
- "A Non-vacuum Process for Preparing Nanocrystalline CuIn_{1-x}GaxSe₂ Materials Involving an Open-air Solvothermal Reaction," Solar Energy Materials and Solar Cells, 2010.

though, the scientists discovered that the treated surfaces were very porous. The UNK group began trying to imbed aerogels into the pores. Solid materials that have extremely low density, aerogels make good insulation.

"There are some direct applications if treating the metal surfaces on satellite components makes a difference in the thermal conductivity of the electronics, or can improve their function," Exstrom said. "Faster heating and cooling can help the satellite adapt to microenvironments it passes through in orbit."

The research group had to learn how to make aerogels, then find ways to embed them onto the metals. While no publications have come from the project yet, Exstrom said he's excited about the originality of their work.

"We can't find any other examples of this phenomena where you've been able to take another material and actually penetrate it into the surface of these treated samples," he said.

The aerogel project is an example of the many opportunities now coming to the department because of the group's previous solar cell work.

"With our reputation we've gained from our solar cell work, and people know we're experienced with nanoparticles, we've had collaboration requests on some very different projects, like the aerogel project," Exstrom said. What pleases him most about those requests is the experience they offer students for real, relevant research.

All six students working in the laboratory will end their summer by developing poster presentations, which they'll take to regional or national conferences in the fall. That point is usually when students realize what they've accomplished.

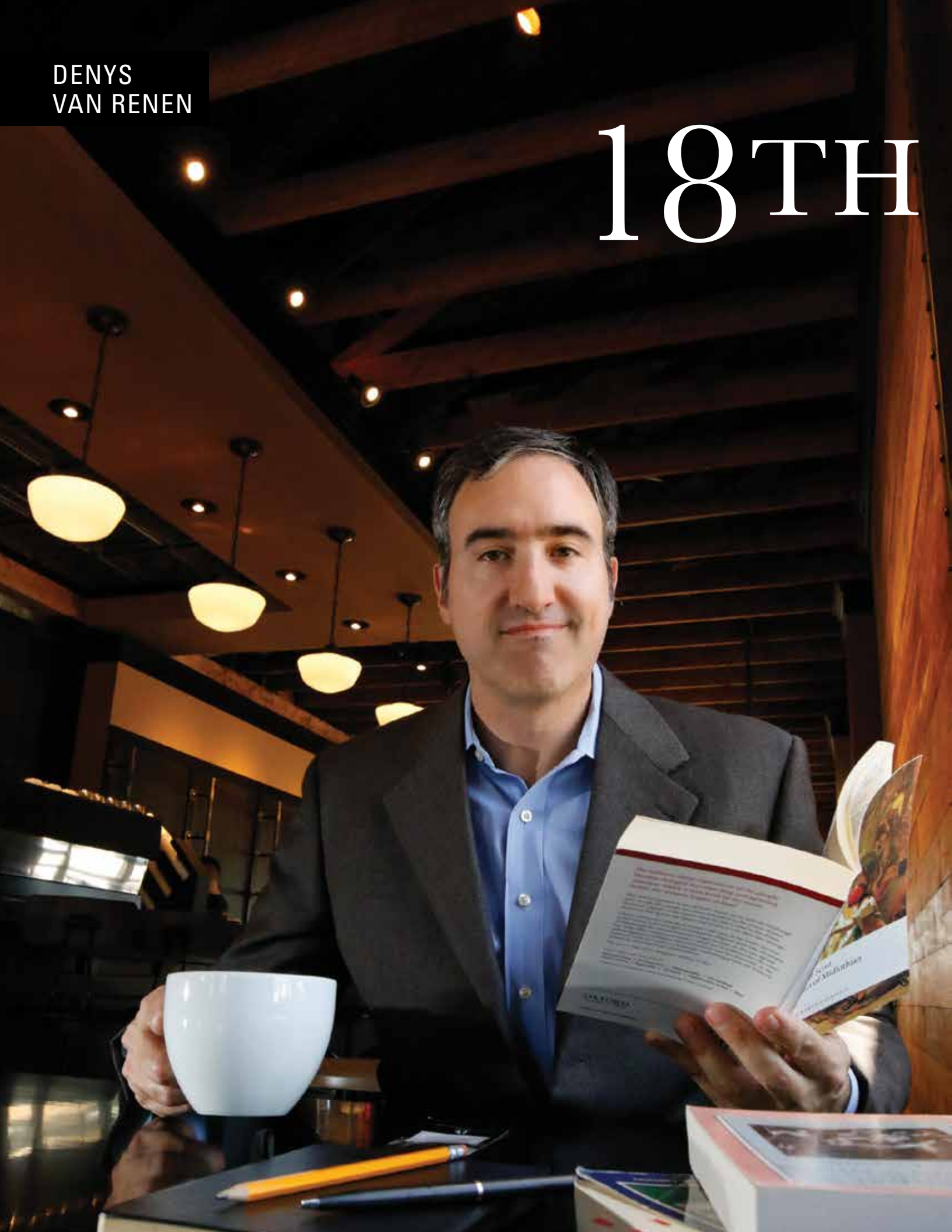
"It's when they put their posters together that they see all the pieces of the puzzle at one time, instead of just being so focused on trying to remember how to run a Raman spectrum," Exstrom said.

That moment represents the balance he wants to strike – the point where teaching and research connect.

"What I envision is that there is a middle ground that can combine the best aspects of both teaching and research, and bring them together. That's what I've tried to stand for during my career. The more I can integrate with teaching research and service, I think those are the things that have had the most traction." ■

DENYS
VAN RENEN

18TH



CENTURY

appeal

Van Renen integrates his passions:
environment, land uses, written word

By SARA GIBONEY

Following in the footsteps of the distinguished 18th-century writer, Samuel Johnson, Denys Van Renen has taken his research to Scotland and Wales.

Inspired by Johnson's "A Journey to the Western Islands of Scotland," Van Renen set off on two separate journeys to study Scottish and Welsh representations of the environment in texts from the 18th Century.

An associate professor of English at the University of Nebraska at Kearney, Van Renen's research integrates his two passions – the environment and the written word.

After spending much of his childhood living abroad near Cairo, Egypt, and in other parts of the world, this New Jersey native's family finally resettled in Boulder, Colo. It was there that he began to develop a deep interest in the environment and climate.

"Growing up in Boulder, seeing how beautiful it is and thinking about how that beauty emerged from forward-thinking efforts to preserve open space ... that was mainly what spurred my interest in the environment," he said.

As a college student, he studied aerospace engineering and computer science at the University of Colorado while working for the Laboratory for Atmospheric Space Physics, where faculty and students were sampling the chemical composition in the atmosphere.

He went on to earn a master's degree in aerospace engineering from Stanford University. At Stanford, he worked at Gravity Probe B, a program that tests Einstein's theory of relativity by orbiting gyroscopes, and he began teaching classes.

After his experience at Stanford, Van Renen decided to pursue his interest in British literature and earned his Ph.D. in English from the University of Illinois at

*"I love the energy
that comes from
the classroom
when you have
twenty minds
thinking through
the material."*



Urbana-Champaign.

"Teaching had always been of interest to me. The curiosity that comes with learning, and then wanting to share what you pick up with different generations of students appealed to me," he said.

"I love the energy that comes from the classroom when you have 20 minds thinking through the material."

Van Renen joined the English faculty at UNK in 2012.



“The contributions of women and the underclass to English society still go unrecognized.”

IMPACT OF THE ENLIGHTENMENT

The 18th century, a period tied to the emergence of the Enlightenment, democracy, capitalism, technological innovation and the rise of the individual, and therefore firmly connected to the modern era, has always appealed to Van Renen.

Widespread and irrevocable changes to British life took place between the years 1630 to 1820, Van Renen said.

There was expansive growth of London and its suburbs; viable colonies in the Americas were established, the “new science” was created and the first global war, the War of the Spanish Succession, was fought. British people traveled to Africa and the Far East. The period also witnessed the emergence of sensitivity to animals and the environment, and more.

“It’s a very exciting period,” he said, “especially to think about the decisions that were made and the pathways that led England to develop into a world power.”

Van Renen initially explored the plight of the laboring classes throughout the 18th century. His interest in the subject came from a class he taught on women and the laboring classes in the 17th and 18th century, where students read Daniel Defoe’s “A Journal of the Plague Year,” Eliza Haywood’s “Fantomina” and Addison and Steele’s “Spectator and Tatler.”

“The contributions of women and the underclass to

English society still go unrecognized,” he said.

“More land was consolidated for bigger and bigger estates, which took away land from farmers. Land was being used for elite purposes or large-scale agricultural purposes. All of my research has this underlying component of thinking about earlier forms of environmental usages and what we’ve lost during the industrial revolution, especially before the Romantic poets shaped a limiting sense of ‘nature’ as a space apart.”

In 2017, Van Renen published a book “The Other Exchange: Women, Servants, and the Urban Underclass in Early Modern English Literature,” which was based on his research.

“This was an example of teaching and research reinforcing one another,” he said. “Teaching ‘A Jovial Crew or the Merry Beggars,’ a 1642 play by Richard Brome, became a springboard for research, and sometimes it’s the other way around.”

Van Renen’s current research focuses on representations of the environment in the 18th Century, making comparisons between the environments in England, Scotland and Wales.

“My research revolves ... comparing England to other parts of the United Kingdom and even farther – settlements in British colonial settlements in Asia, the Americas and elsewhere,” Van Renen said. “Thinking about the environment allowed the British to rethink

what they were doing abroad and at home.”

Five years ago, Van Renen traveled to Scotland to study 18th-century texts that feature representations of the environment in literature. He spent time reviewing materials in the National Archives in Edinburgh, Scotland.

“That was a major development in my career. It allowed me to develop an expertise in 18th-century Scottish studies,” he said.

Van Renen published articles such as “Decomposing the Picturesque and Re-collecting Nature in Dorothy Wordsworth’s Scotland” in the *Journal of Narrative Theory*. During the summer of 2017, Van Renen traveled to Wales for a similar research project studying the environment of Wales through literature from the 18th century.

“I’m centering on what travelers to Wales and the Welsh wrote in the 18th century,” he said. “Depictions of Welsh surroundings as both separate from and a part of the United Kingdom provide useful commentary on land usage.”

The idea for his research trips came from Van Renen’s interest in the prolific 18th-century writer, Samuel Johnson. Johnson traveled to Scotland and Wales and wrote extensively about his trips. People still refer to the 18th century as “the Age of Johnson.”

The research Van Renen gathered during both trips will also serve as content for a future book about Celtic representations of the environment in literature.

IN THE CLASSROOM

Van Renen’s passion for the sciences and literature arises from the classroom, specifically in his English general studies courses.

“I tell them specifically on the first day that this is an interdisciplinary course. Science, business, political science majors ... we want their expertise and input as we’re looking at these texts, especially 18th-century texts,” he said.

“We study representative texts from all different disciplines, whether we are reading John Locke, Isaac Newton or Jonathan Swift. If students think they have an entry point, when authors are talking about business, political science, agriculture, we want them to speak up, contribute and participate.”

While teaching general studies courses allows Van Renen to help students make connections to their own areas of interest, teaching classes in the English major encourages students to think more critically, learn about a specific era and gain new perspectives.

“Curiosity drives the classroom dynamic. I think that’s why research and teaching go so well together – each involves a process of discovery. If there’s a new sub-discipline that develops in English, I learn about it and I teach it,” he said.

“We may be studying the past, but we’re not just reading the same old texts in the same old ways. I’m learning and I’m curious, and I’m teaching those sub-disciplines to students. They’re relevant to students in the 21st-century world. That’s why we can teach classes each semester that are new and exciting.” ■



DENYS VAN RENEN

Title: Associate Professor, English

College: Fine Arts and Humanities

Education: Bachelor of Arts and Bachelor of Science, University of Colorado; Master of Science, Stanford University; Master of Arts, University of Illinois; Doctor of Philosophy, University of Illinois.

Years at UNK: 5

Career: Research Assistant, Laboratory for Atmospheric and Space Physics; Research Assistant, Gravity Probe B, Stanford University; Instructor, University of Illinois.

Affiliations: Modern Language Association, American Society for 18th-Century Studies, Defoe Society, Eighteenth-Century Scottish Studies Society

Hobbies/Interests: Traveling, baseball, hiking and café culture (coffee, politics, art)

Honors/Awards: Faculty Mentor Award, 2015.

Areas of research/specialization: Eighteenth-century British literature, Cultural studies, Environmental studies, John Milton, Scottish Studies, Ecocriticism, Native Studies

Courses taught: Academic Writing and Research, British Literature, Representations of Animals, The Gothic Novel, Scottish Travel Literature

Recent Published Books:

- “Globalizing the American Revolution,” University of Virginia Press, 2018.
- “The Other Exchange: Women, Servants and The Urban Underclass in Early Modern English Literature,” University of Nebraska Press, 2017.

Recent Published Articles:

- “A Hollow Moan: The Contours of the Nonhuman World in James Thomson’s *The Seasons*,” *Animals and Humans: Sensibility and Representation*, 2017.
- “The Air We Breathe: Warfare in Farquhar’s *The Recruiting Officer*,” *College Literature*, 2016.
- “Decomposing the Picturesque and Re-collecting Nature in Dorothy Wordsworth’s *Scotland*,” *Journal of Narrative Theory*, 2015.

VICTORIA
GORO-RAPOPORT

printmaking



“My art focuses mostly on figures and their relationship to space. I am very interested in architecture as created by man as well as the idea of architecture as a life force.”

By KIM HACHIYA

Like many artists, Victoria Goro-Rapoport’s world is wrapped up in journey, process and discovery.

This printmaker has experimented with a number of ways to make prints, with each method containing technical limitations that ultimately proved unsatisfying as a medium. But as she has experimented and refined techniques, she may have landed, through serendipity, on a new printmaking method that combines technology and materials in different and fulfilling ways.

Goro-Rapoport’s story starts in the former Soviet Union, where she was born.

In addition to regular school, she attended a special arts school for an additional four hours, three days a week. She kept this demanding schedule for eight years through primary and secondary school. She graduated from Moscow Art College in 1985. She was 24 in 1990, and the Soviet Union was disintegrating. She took advantage of her Jewish heritage and emigrated to Israel, where she opened a frame shop and took classes in printmaking.

teamwork required in the theater. But she found great joy in drawing and imaging the designs themselves, and she also enjoyed the intersection of architecture to humans on the set – the relationship to people and surroundings. That interest is still evident in her choice of subject matter for her prints, which often depict structures, people, fantastical animals and nature.

“My art focuses mostly on figures and their relationship to space. I am very interested in architecture as created by man as well as the idea of architecture as a life force.” By that she means the symmetry and architecture of animals, plants, people and the forms of nature. Think of the mathematical relationship of the 3:5:8 ratio to the Fibonacci curve. That gentle unfolding sequence is found in all of nature – from the sequence of the unfolding petals of a rose, to the shape of a conch shell.

“Architecture like that is imbued in all life forms and can be seen in arches, scrolls and the symmetry of our bodies,” she said.

perfection

Goro-Rapoport experiments, refines techniques in demanding medium

Four years later, she immigrated to Salt Lake City, where her parents were living. There, she took a master’s degree in theatrical set design. That, she said, was a mismatch. A bad fit. And as soon as she graduated from the University of Utah, she entered the University of Illinois, and earned another graduate degree, this time in printmaking. She joined the University of Nebraska at Kearney faculty in 2004 as a professor of printmaking and drawing.

While she enjoyed theatrical set design, she found the impermanence of theater sets to be limiting. She also wasn’t enamored of the amount of collaboration and

ETCHING, MEZZOTINT, PHOTOPLATES

Goro-Rapoport abandoned theater work and moved into printmaking and drawing. And she started her quest for the “perfect” printmaking technique that would best showcase her aesthetic.

Her early work centered on a tried and true medium – etching. This demanding process involves using a needle-like tool to scratch (etch) her drawings onto a copper plate coated with an acid-resistant material called ground. The scratching removes the ground and the plate is dropped into acid, which etches a groove into the



plate where the ground was scraped off. When the etches are complete, the plate is cleaned of ground and ink is applied. The ink settles into the grooves and once the plate is pressed onto paper, the print is revealed.

“This is a very harsh process,” Goro-Rapoport said. “The initial attraction was the thin, crisp precise lines it creates. It allows much control. But it only creates those harsh, sharp lines. Not soft lines like one sees with a pencil.”

And she was searching for a way to replicate the

pencil’s softness.

She moved on to mezzotint. In this process, a half-mooned shaped tool is rocked across the surface of the plate, making a rough surface that then is smoothed in ways that create varied tones of light and dark on the print. Mezzotint is a “dry process” in which all variations in tone are created by tools. Rough areas of a plate hold more ink, so rough areas print darker than smoother areas.

“It’s a very laborious process,” she said. “It’s very physical



could she take her drawings, which often took months to finish, to the plates in less labor-intensive ways?

She moved on to photoplates, which allowed versatility but lacked precise values – they were neither as crisp as originals, nor as soft. “I never got to a level I found completely satisfying.”

STEAM PUNK VIBE

Goro-Rapoport said she puts so much emotional investment into the drawings that to be unable to realize the final steps was grueling and disappointing.

Would scanning and replicating via photocopies an option? Combining digital processes with etching was, she said, “horrible.”

“Etching has a hand-made charm, but when combined with the digital they negate each other. It is too big of a clash. It looks cheap. Horrible.”

And then, a breakthrough.

“Accidentally, almost by chance, I learned you can do digital printouts on wood. That adds a depth to the piece that is almost organic. The wood gives it a luminous quality.

“I’m kind of excited about this because it’s not really a print anymore. It becomes more of an object.”

This also seems to coalesce with a bit of a change in the content of her images and

how she is manipulating them. She now uses a computer to expand and blow up shapes, such as traditional Archimedean solids reinterpreted into forms previously unknown. “We perceive our world in five senses, but there is a world that is invisible to us,” she said. The computer can reveal this world, simultaneously depicting the inside and outside of a shape in fantastical ways.

Some of her pieces contain images of children or angels playing with objects of violence. She also depicts things like birds or fish (she finds mammals and furry things artistically boring) that morph and evolve so the bird’s wing might end in a human hand.

There are machines and other mechanical devices such as floating air ships. Often the works have a steam punk vibe, a sort of retro-futuristic look that incorporates 19th century industrial technologies and aesthetics with fantasy or apocalyptic worlds. For example, one of her award-winning etchings, “Sinking of the Empire,” features what appears to be a man’s head atop the Empire State Building, with laboring men and a ship all bound up in ropes and wires.

That may come from her Soviet upbringing, she said.

Embedded in the Soviet psyche is the concept of “boys draw war,” she said.

“As children, we would draw tanks and war items because they were so much the part of our culture

work for the printmaker.” Mezzotint plates are fragile and they wear quickly, yielding few prints. And often they do not print correctly after all the preparatory work.

“Mezzotints really wore me down,” she said.

Goro-Rapoport was still searching for a way to incorporate smooth, soft surfaces with etching. Her subjects, often human bodies, are soft and vulnerable, she noted, while architecture is sharp, precise and hard. How to combine the two into a satisfactory medium? How

*“Accidentally, almost
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“Etching has a hand-made charm, but when combined with the digital they negate each other. It is too big of a clash. It looks cheap. Horrible.”



since World War II. We wanted to be the heroes of our context as players on the world stage. I think for me, as a civilization we are smart and technology driven, but we are in the infancy of technology. It only started about 150 years ago, but homo sapiens are 200,000 years old. We are only just now learning how to harness some parts of technology. So we are in the infancy stages of something with tremendous potential for creativity but also tremendously dangerous. We have made discoveries as part of the war machine and adapted them to civilian use. We need to harness our emotions on how to use that technology. So thus the children images, to me, represent innocence and vulnerability as we live in the wider universe.”

RELIGIOUS SOCIETY

Goro-Rapoport’s art has resonance and has won numerous awards in more than 300 juried and invited art exhibitions worldwide.

Her most current work involves creating triptychs, traditionally three pieces of art often associated with religious altar pieces in early Christian churches. The subjects, however, are not the Madonna and Child images, but portraits of scientists Galileo, Isaac Newton and Albert Einstein. She depicts them wearing each other’s hair or clothing and comingles them with pieces of architecture, their own art and animals.

“I guess I am trying to say ‘has science become a religion?’” she says of the works. “It’s a little bit subversive. I came from a society that was violently atheistic – there were no believers. Now, I find myself in a very religious society here in America. It was a sort of an intriguing culture shock for me and an interesting way for me to play with the architectural shapes I love and finding points of connection between human shapes and evolution.”

Goro-Rapoport collects her inspiration from the works of artists from the Northern Renaissance – artists such as Rogier van der Weyen, who worked in Belgium in the early half of the 15th century, or Hugo van der Goes, a late 15th century Flemish painter. These artists often painted on wood, and their works have a luminosity not found in works on canvas. So her ability to print on wood has a straight-line connection to those artists.

She has another connection to those Dutch painters: she has created for herself a pair of wooden clogs that she wears in her studio. Crafted from chunks of 2x4s with leather straps, the clogs add several inches of height to the diminutive artist as she works at a tabletop about 5-feet high. The bi-level clogs show off her creativity and resourcefulness, and they protect her feet.

Printmaking is a technically demanding medium. It’s hard to correct errors. It’s dirty and physically hard; it involves dangerous chemicals. But while there is just one painting or drawing, a printmaker may be able to pull 30 to 50 quality prints from a plate until it degrades, she said. The art form has fewer practitioners than in the past, and yet it’s timeless, she notes. While she loves



VICTORIA GORO-RAPOPORT

Title: Professor, Drawing and Printmaking

College: Fine Arts and Humanities

Education: Master of Fine Arts, Printmaking, University of Illinois, 2002; Master of Fine Arts, Set Design, University of Utah, 1998; Bachelor of Fine Arts, Set Design, Moscow Art College, 1985.

Years at UNK: 13

Career: Visiting Assistant Professor, University of Illinois, 2002-04.

Hobbies/Interests: Recreational math, travel

Areas of research/specialization: Drawing, printmaking, etching

Courses taught: All levels of drawing and printmaking

Recent Juried Exhibitions and Awards:

- Second Place, Olympic Peninsula Fine Art Association Juried Show, Port Angeles (Wash.) Fine Arts Center, 2016.
- Best in Show, Fifth Annual Art and Earth National Juried Exhibition, Martinsburg, W.V., 2015.
- Juror’s Choice Award, National Juried Art Exhibition, Academy of Fine Arts, Lynchburg, V.A., 2015.
- Best in Show Shock Print, Juried National Print Exhibition, Ulrich Museum of Art - Wichita State University, Wichita, Kan., 2015.
- Best in Show, 24th Parkside National Small Print Exhibition, UW-Parkside Galleries, Kenosha, Wis., 2015.
- Best in Show, 92nd Annual All-Media National Juried Exhibition, Ann Arbor Arts Center, Ann Arbor, Mich., 2014.

drawing, she felt her drawings were unfinished as fragile works of art until they were advanced to printmaking. There, she said, the works gained permanence and felt finished.

She doubts she will ever stop experimenting with printmaking. But now she feels less deadline pressure and free to continue the journey, the process and the discovery of art making. ■

ANGELA
HOLLMAN



Technology, Teaching, Teamwork

Hollman helping protect businesses from cyber attacks

By SARA GIBONEY

Today, technology plays an important role in every discipline and industry.

Technology allows businesses to work more effectively and efficiently, but communication often creates challenges for businesses and organizations.

Angela Hollman is determined to find solutions for improving the communication processes between information technology departments and business executives, especially with the emerging need to protect against cyber attacks.

Her fascination with technology began when she was just 11 years old.

“My parents may have been a little unique in that we always had a computer around ever since I can remember,” said Hollman, assistant professor of industrial technology in the Department of Information, Networking and Telecommunications at the University of Nebraska at Kearney. “I remember when we had dial-up Internet. It was before we had a browser and you just typed things on the text line.

“I was using dial up and going on bulletin boards and playing different games with people who were all over the world. It was fascinating to me.”

While enrolling for classes at UNK, she was unsure what she should study. But when an adviser suggested technology, she went for it.

Hollman majored in computer programming and had a minor in networking and systems.

“I really liked technology, and I was fascinated by programming and how applications were made,” she said. “How you could type in code and make something for the user that looked totally different.”

During an exchange program at Utah State University, Hollman’s husband, Travis, suggested that they start a web applications business together. With his growing expertise in advertising and her knowledge of computer programming, they grew the business as they finished college.

“There came a point after graduation that I thought it would be better if he continued to grow the business, and I got a full-time job somewhere else,” she said.

PASSION FOR TEACHING

In 2004, Hollman began working as a network analyst in Information Technology Services at UNK. She was soon promoted to assistant director of networking and earned her master’s degree in education with a concentration in instructional technology at UNK.

“After I got my master’s I thought I might like to try teaching,” she said. “That was a turning point for me.”

She taught a capstone course for the networking systems major at UNK as a lecturer and quickly fell in love with teaching.

“I thought the sharing of knowledge to students wouldn’t be so much like teaching, but more like sharing my experiences,” she said. “That’s how I approached the class, and the students really appreciated that.”

“There’s a big assumption by middle and high school teachers and counselors that students just know how to use technology and are more savvy than teachers.”

Hollman was eventually offered a full-time assistant professor position, and she began working on her Ph.D. in educational studies with a specialization in educational leadership and higher education from the University of Nebraska-Lincoln.

“I liked bringing real world experiences to the classroom because I found it was really important to students,” Hollman said. “During the lecture/discussion, I brought in current events and talked about how technology related to students’ careers. It offered a deeper understanding of the theory and the technology combined together. I liked making that connection for them, and I liked that they were like, ‘Oh, I get it.’”

In the classroom, Hollman uses discussion to help students learn theory, and she uses hands-on work in the data center laboratory. Students learn to troubleshoot and problem solve in the lab, which also helps cultivate teamwork and communication skills.

“I find that even though this generation is considered one of the most technologically advanced, they still don’t understand what having a career in technology means and all of the vast opportunities available,” Hollman said. “I like to show them these opportunities and open their eyes

to the possibilities through the hands-on labs.”

Her passion for helping students understand how they can pursue careers in technology was the catalyst for a project to help expose middle school students to information technology.

Hollman and her husband received a \$125,000 grant from the State of Nebraska to develop and implement curriculum into middle schools.

“We realized that there’s a big assumption by middle and high school teachers and counselors that students just know how to use technology and are more savvy than teachers, but they don’t have an understanding of how it works and the careers that are possible,” Hollman said.

BUSINESS, IT COMMUNICATION

Helping build a technology company gave Hollman a special interest in how businesses use technology and how technology can be used to protect against cyber attacks.

“I find it valuable to talk about how technology works within business – the communication process between the IT director and other business people – sometimes it’s ineffective and doesn’t work well,” she said.

“Cyber security isn’t just an IT problem. When a company gets hit and its service gets taken down, it affects the well being of the whole company.”

In her paper published in the Journal of Cases on Information Technology in 2017, “Cyber InSecurity: A Post-Mortem Attempt to Assess Cyber Problems from IT and Business Management Perspectives,” Hollman explores how businesses and IT work together.

“My interest came from my background in our small company and some of the things I saw working in IT at the university, and how I thought we could do things differently (that) might be better,” she said. “If business was talking to IT differently, or IT was talking to business differently, things may work better.”

In her paper “Communication Processes of Information Technology Executives in Higher Education,” Hollman takes a unique look at a common phishing cyber





“Cyber security isn’t just an IT problem. When a company gets hit and its service gets taken down, it affects the well being of the whole company.”

attack that uses ransomware.

Her study seeks to explain key variables of internal communication processes of information technology executives, specifically chief information officers at higher education institutions.

The research is presented through the eyes of Jane, a veteran accounting employee at Sachem Manufacturing. The problem starts simply with Jane noting the slowness of the system, but soon escalates as a manager from information technology begins to investigate. He panics when he discovers that company assets have been compromised.

“Although the importance of technical security is emphasized within the case, organizational management and communication processes also play a significant role in defending an organization against cyber attacks,” Hollman said. “The research details what happens when upper-level management fails to perceive the risk to the organization’s

assets and denies the funding of important IT projects.”

In the end, Sachem’s top executives resort to finger pointing, name-calling and head shaking as they discover that their managerial, technical and political shortcomings are more ubiquitous than they care to admit. The CEO blames IT for not preventing the situation and for not communicating effectively with management in understandable terms. IT blames the CEO for limiting necessary technical resources.

“This case is geared toward two different types of courses: technical students in a leadership, business, law or security policy course; and business students taking a management, leadership or business class to learn how to manage technical people,” Hollman said.

“This study has practical implications to guide any executive within an organization such as a university dealing with communicating and intertwining technology within the higher mission.”



LOCALIZING FOOD SYSTEMS

In addition to her research on technology and business, Hollman explores how technology is used in other disciplines in her collaborative research projects.

During the 2016-17 academic year, she was part of a team of faculty awarded a grant for community gardens from the University of Nebraska Food for Health Collaboration Initiative. Hollman participated in promoting health through localizing food systems with technology and gardens.

“It’s important to me to stay current. I’m always changing my classes, always updating, always incorporating the latest information.”

In the upcoming academic year, a team of faculty will help rural middle school science teachers create and integrate aquaponics systems into their classrooms and curriculum.

The project is funded by the Nebraska Coordinating Commission for Postsecondary Education. Hollman

developed a curriculum for a technology systems workshop for middle school teachers, taught the workshop, and co-developed curriculum within the workshop with the teachers.

Aquaponics is a modern agricultural practice that marries aquaculture – which is the farming of fish and other aquatic organisms – and hydroponics, which is growing plants without soil.

Along with Hollman, the team working on this project consists of Matt Bice, assistant professor in the Physical Activity and Wellness Laboratory; Nate Bickford, assistant professor of biology; Sonja Bickford, assistant professor of industrial technology; Dustin Ranglack, assistant professor of biology; and Dick Meyer, associate professor and chair of educational administration.

Hollman also mentors students exploring undergraduate research projects in multiple disciplines. Some of the student

ANGELA K. HOLLMAN

Title: Assistant Professor, Industrial Technology, Information Networking & Telecommunications

College: Business and Technology

Education: Doctor of Philosophy, Educational Studies, University of Nebraska-Lincoln, 2014; Master of Science, Education, University of Nebraska at Kearney, 2009; Bachelor of Science, Computer Information Systems with minor in Telecommunications, UNK, 2001.

Years at UNK: 13

Career: Assistant Professor, ITEC Department and INT program, University of Nebraska at Kearney, 2014-present; Lecturer, ITEC Department, UNK, 2011-14; Assistant Director of Networking, ITS Department, UNK, 2008-11; Network Analyst, ITS Department, UNK, 2004-08; Hollman Media, co-founder and co-owner, 2000-present.

Family: Husband, Travis; Children: Sterling, 9, and Ayla, 5.

Hobbies/Interests: Hiking and vacationing with family, Reading fiction.

Honors/Awards: UNK Distinguished Young Alumni Award, 2014; University of Nebraska KUDOS Award, 2010.

Grants: Aquaponics in the Middle School Classroom, Nebraska Coordinating Commission for Postsecondary Education, \$65,000, 2017-18; Community Gardens, University of Nebraska Food for Health, \$20,000, 2016-17; Nebraska Developing Youth Talent, State of Nebraska, \$125,000, 2015-16

Areas of research/specialization: Information technology systems and security

Courses taught: Internetworking Literacy; Society & Technology; The Influence of Technology on Democracy; Network Architecture & Telecom I; Network Architecture & Telecom II; Internetworking Design; Global Internetworking; Information Networking Seminar.

Recent Published Articles:

- “Communication Processes of Information Technology Executives in Higher Education,” *Journal of Organizational and End User Computing*, 2018 (in press).
- “Cyber InSecurity: A Post-Mortem Attempt to Assess Cyber Problems from IT and Business Management Perspectives,” *Journal of Cases on Information Technology*, 2017.
- “Math Skills That Don’t Add Up: A Comparison Between Eighth Grade and College Students,” *The Professional Constructor*, 2017.
- “Kinesiology in 360 degrees,” *International Journal of Kinesiology in Higher Education*, 2017.
- “Assessment of Project Website Sustainability: Case of the Arctic EIA project,” *Informing Science: The International Journal of an Emerging Transdiscipline*, 2016.

research projects have included researching health care and cyber security, and researching sensors and the interaction of sensors in gardening.

Through her research, Hollman is able to stay current on how technology is being used in industries today.

“It’s important to me to stay current. I’m always changing my classes, always updating, always incorporating the latest information,” she said. ■

A man with glasses and a mustache, wearing a maroon polo shirt and a white apron, stands in a grocery store's produce section. He is holding a red bell pepper in his right hand and a bunch of green asparagus in his left. The background is filled with various vegetables in black crates, including yellow and orange bell peppers, green bell peppers, and green beans. Price tags are visible above the shelves, with numbers like '149' and '9'.

FRANK
TENKORANG

Framing the Future of Fuel

Tenkorang studies ethanol's reputation,
impact on world food prices



By JAN TREFFER THOMPSON

Frank Tenkorang was still a graduate assistant at Purdue University when his officemate mentioned some exciting news: the school had started powering its trucks with soy biodiesel.

It was 2005, and the United States was jumping on the biofuels bandwagon.

In the years since, Tenkorang has seen biofuels – corn-based ethanol in particular – evolve from a budding industry into an established part of the Midwest economy, and now into a controversial commodity with a future that’s up for debate with the current administration. Federal support ended in 2011, and there’s strong opposition to further subsidies.

“There were about \$6 billion in tax credit and import tariffs to protect the ethanol industry. It was then young, and it is cheap to produce ethanol in Brazil, so we had to protect the domestic producers. And there was also a blender’s subsidy, for those who blended ethanol with gasoline to reduce their cost. They have all been taken away,” Tenkorang said.

Biofuels are produced from living matter, unlike fossil fuels that use non-renewable resources. A Renewable Fuels Standard, passed by Congress in 2005 and expanded in 2007,

“We think that ethanol is good because it helps in job creation, supports prices for farmers, also energy independence, but there are many countries out there painting a very negative picture for ethanol.”

requires that the transportation fuel sold in the U.S. include up to 36 billion gallons of biofuel by 2022. While the U.S. is using and producing more ethanol than ever, Tenkorang said the product’s reputation and chances for future government support are hurt by critics who think ethanol takes too many acres of corn away from food production.

“Those of us in the Midwest ... we think that ethanol

is good because it helps in job creation, supports prices for farmers, also energy independence, but there are many countries out there painting a very negative picture for ethanol,” Tenkorang said. “And one of the main reasons we’re seeing a decrease in government support is because of the effect on food prices. And this is not just in the U.S., but it is a global effect. Most developing countries are complaining about U.S. ethanol and high food prices.”

Believing that ethanol production creates higher food prices and food shortages, policy makers are pushing for “second-generation ethanol,” made from materials such as wood chips and algae rather than corn. But Tenkorang said people may be turning away from the corn-based fuel too quickly. His research has shown that ethanol production wasn’t to blame for the doubling of food prices since 2000.

“There was a correlation” between increasing ethanol production and increasing food prices, he said, “but not causation.”

INFLUENCING POLICY MAKERS

A professor and chair of the Economics Department at the University of Nebraska at Kearney, Tenkorang has studied the economic effects of ethanol for almost a decade. He’s looked at how ethanol production affects other crops, consumer decisions related to ethanol, and the fuel’s impact on corn prices.

A paper accepted by the Agricultural Economics Review outlines his findings on ethanol and food prices. In “Ethanol Production and Food Price: Simultaneous Estimation of Food Demand and Supply,” Tenkorang and co-author Bree Dority O’Callaghan used data from 1980-2014 to create food demand and supply estimates. They found that the huge increase in ethanol production by Brazil and the United States didn’t have a statistically significant impact on world food prices. In fact, if producing more ethanol can bring down energy prices, the alternative fuel could help lower food prices.

“One thing we see now is very low energy prices. Oil prices are down, and one of the things we found in that study is that one of the big factors influencing food price was energy price, not ethanol.”

Tenkorang hopes the article will appear in the journal later this year, and that its findings can help influence policy makers toward investing in ethanol.

“It looks as if the current administration wouldn’t mind promoting ethanol, but the current ag secretary (Sonny Perdue), before he became ag secretary, strongly opposed ethanol. We really can’t tell what’s going to happen with policy,” Tenkorang said.

Tenkorang’s research focus on ethanol was a product of timing and location. A native of Ghana, he came to the United States to attend the University of Wyoming. By the time he received his doctorate from Purdue in 2006, the U.S. produced 4.9 billion gallons per year, according to the Renewable Fuels Administration. That number grew to 13.9 billion gallons by 2011.

Demand was high for economists to analyze the effects of the booming industry. Tenkorang’s first interview was at a

research institute keen on research about how ethanol would affect commodity prices. During his visit, he saw another school announcing a job search for an energy economist to work on ethanol.

Once at Kearney, Tenkorang found himself in the middle of corn country – the perfect place for research on ethanol. He has since written several journal articles and presented at numerous conferences about the subject, as well as writing an article titled “Nebraska, Sprinkled with Corn and Ethanol” for the 2015 encyclopedia *Just Plain Folks: Studies of the People of the Great Plains*. His work – with UNK economics professor Debbie Bridges – spans the expansion years for U.S. ethanol, through a production dip after 2011, to the current growth period that’s seen production rise to 15.3 billion gallons, 1 billion of which is exported.

ETHANOL, GASOLINE RELATIONSHIP

While it’s promising to see the ethanol industry grow with less government support, the question now is how to keep the industry expanding.

In a 2015 study published in *Energy Economics*, Tenkorang looked at the relationship between ethanol and gasoline. Analyzing data on fuel consumption, he found that today’s

“... Most gas pumps cannot handle a high percentage of ethanol, so the gas stations may have to change their pumps, and that requires money.”





“These days it’s all ‘Well ethanol is not good, it requires too much energy.’ Others claim it has negative impact on food prices, causing food prices to increase. Is this real, or is this just how people feel?”

drivers consider ethanol a complement to regular gasoline, rather than a substitute. That attitude suggests that usage won’t increase by trying to convince more consumers to choose ethanol. Producers may be better off trying to increase the percentage of ethanol that’s blended with gasoline.

“We’ve gotten to a point that we can’t increase consumption of ethanol without consumption of gasoline. With that, if we are going to see an increase in production, how are we going to use that increased production? We may have to switch from E10 to E15, or maybe E20 or 25,” Tenkorang said.

And that is where federal subsidies could be useful.

“That’s also a concern because most gas pumps cannot handle a high percentage of ethanol, so the gas stations may have to change their pumps, and that requires money,” he said.

Other key studies Tenkorang has done showed that increased ethanol production has decreased Nebraska hay production, and created greater

variability for corn and soybean prices.

Tenkorang’s long-term interest in ethanol issues has also led University of Nebraska-Lincoln professors to include him and other UNK faculty in an upcoming project that will take a more comprehensive look at agricultural and ecological issues. The research depends on the success of a 2016 grant proposal submitted to the University of Nebraska System Science Collaboration Initiative, which Tenkorang describes as FEW – Food, Energy and Water.

“What we want to do is look at the three components together, rather than looking at them separately,” Tenkorang said, to get a comprehensive view of how the three influence each other – how the production of food and energy affect each other, and how they affect water supply and quality. Tenkorang said they’ll begin by gathering data within Nebraska.

“We want to understand it here, then apply for a bigger grant that will allow us to look at it on either a national or a global scale,” he said.



CONSUMER ATTITUDES

So far, Tenkorang's research has used existing data, analyzed using various equations to control for relevant variables. Collecting and working with his own data has been Tenkorang's goal for years, though, and he'll do that in an upcoming project with Fletcher Ziwoya of UNK's Speech and Mass Communications Department.

Their pending grant application would fund a study on consumer attitudes toward ethanol, with the goal of determining what influences the way people feel about the alternative fuel.

"These days it's all 'Well ethanol is not good, it requires too much energy.' Others claim it has negative impact on food prices, causing food prices to increase. Is this real, or is this just how people feel?"

By surveying participants about their backgrounds and lifestyles, he hopes to find a relationship between their ethanol attitudes and some other factors. For example, Tenkorang said, he would expect people from Nebraska and Iowa to have more favorable ideas about ethanol than people from California.

"We want to inform policy makers ... whether the approval or disapproval of ethanol is just based on feelings, or emotional, or is it something realistic, or scientific. That's what we want to inform policy makers about so they can make informed decisions," he said.

Already, Tenkorang knows just how much Americans' attitudes toward the fuel have changed, as ethanol has become a part of their daily lives.

"What I see, first of all, I think we are beginning to accept it. Initially we thought it was going to break down our vehicles, and I think that fear is gone. We don't have that fear any more. The concern that people have, and again most often outside the corn-producing areas and in other countries, is that it still has an impact on food prices. They hold onto that belief strongly, that it has impact on food price, and they just don't like it."

And that's an attitude Tenkorang hopes he'll soon see changing.

"I'm hoping that what we see now, of the low commodity price, more ethanol production, low energy price, people will begin to connect the dots themselves." ■

FRANK TENKORANG

Title: Professor and Chair, Economics

College: Business and Technology

Education: Bachelor of Science, Agriculture, University of Ghana, 1996; Master of Science, Agricultural Economics, University of Wyoming, 2002; Ph.D., Agricultural Economics, Purdue University, 2006.

Years at UNK: 10

Career: Research Assistant, Institute of Statistical, Social, and Economic Research, University of Ghana; Graduate Research Assistant, University of Wyoming; Graduate Research Assistant, Purdue University.

Family: Children, Nana Ama, 15, and Kojo, 11.

Hobbies/Interests: Racquet sports, tennis

Areas of research/specialization: Agricultural issues, specifically the impact of ethanol production on commodity markets.

Courses taught: Principles of Microeconomics, Intermediate Microeconomics, Managerial Economics, Agricultural Marketing, Economics of the Agricultural Sector, Farm and Ranch Management, Agricultural Price Analysis.

Professional Membership and Service: Agricultural and Applied Economics Association, 2005-present; Reviewer, Journal Article, Energy Policy, 2016; Reviewer, Journal Article, Energy Strategy Reviews, 2017; Reviewer, Journal Article, UNK Office of Undergraduate Research, 2015; Session Chair, American Society of Business and Behavioral Sciences Program of the 22nd Annual Conference, Las Vegas, 2015; Reviewer, Journal Article, National Mountain Plains Management Conference, 2010.

UNK Committees: CBT: BD Assurance of Learning Committee, 2010-13; Nebraska Bankers Association Scholarship Review Team, 2011-13; Business Division Assessment Council, 2010; CBT: BD Assurance of Learning Committee, 2009-10; International Studies Advisory Council, 2009; World Affairs Conference, 2009; John Becker Endowed Professorship, 2009; Writing Intensive/Cultural Diversity Committee, 2009; CBT: Business Division Assurance of Learning Committee, 2008-09; CBT Deans Advisory Committee, 2006-08.

Recent Published Articles:

- "Hemp Adds to the Profitability of Corn Soybean Rotation," In The Return of an Ancient Partner, 2016.
- "Hedonic Price Analysis of Non-Barren Broodmares," Review of Economic and Business Studies, 2016.
- "Relationship Between Ethanol and Gasoline: AIDS Approach," Energy Economics, 2015.
- "Implications of Increased Ethanol Production on Nebraska Hay Production: An Initial Investigation," Economics and Business: Inquiries and Perspectives, 2015.
- "Nebraska, Sprinkled With Corn and Ethanol," Just Plains Folks: Studies of the People of the Great Plains Folks, 2015.

GREG BROWN



Strength training, nutrition, exercise science

Brown's findings are practical to people, impact lives

By ANDREW HANSON

KEARNEY – In the 2000s, video games as a source of exercise and physical activity were taking over American basements and living rooms.

Dance Dance Revolution.
Nintendo Wii and Wii Sports.
Kinect for Xbox.

It was a new phenomenon, said Greg Brown, professor of Kinesiology and Sport Sciences at the University of Nebraska at Kearney.

But after four or five years of research on the subject, Brown's work stymied.

"Two things happened. One, those video games were not as active as we had hoped," said Brown. "They were better than doing nothing, but it was about the same as walking. And as people got used to the video games, they were actually moving less. Then the market for active video games died off, too. So I had to move on from that research."

That discovery forced Brown to answer the question of where does one go when a line of research comes to an end.

"I just moved on to the next question," Brown said. "What is something else I'm interested in, and what do I want to do?"

At a conference in Nashville in 2005, Brown met a few colleagues from South Africa who had been conducting research on strength training and aerobic exercise. Brown, along with Brandon Shaw and Ina Shaw of the University of Johannesburg, began collaborating on research and produced a number of publications related to how a combination of the two methods of exercise influence body composition, hunger and heart health.

It combined a number of interests for Brown, who runs approximately 30 to 40 miles a week and completes three hours of strength training each week as well.

It also aimed to answer a variety of questions for individuals of all fitness levels.

"Those video games were not as active as we had hoped. They were better than doing nothing, but it was about the same as walking."

"A lot of times when people exercise, you've got your weight lifters or you've got your runners and cardio people, but we all know you should do both," Brown explained. "We're trying to find out what the benefits of doing both compared to just one or the other are."

Brown's interest in this area of the exercise science stemmed from his research as a graduate student, which focused on strength training and nutritional supplements.

"We want to know how combining aerobic and resistance exercise influences health and appetite," Brown said. "Our research shows that if you do both, you're more likely to eat fewer calories than if you do just one or the other."

"Maybe it's subconscious or maybe there are some



hormones involved, and that's what we want to research. Questions like, 'Is there one that affects body composition more favorably?' or 'Is it all really just calories in and calories out?' And then which type of exercise do people like?"

BRINGING RESEARCH TO THE CLASSROOM

While Brown's research regarding physically active video games may not have led him in the direction he was hoping, he's still able to use the knowledge and insights gained every semester in his exercise science classes.

He has a lab where students measure heart rate while playing video game boxing and sword fighting.

"Sure, we can put them on a treadmill or bike, but they can play the video game and have a little fun with it while learning the same concepts," Brown explained.

In order to keep things fresh in the classroom, Brown incorporates his research in to class as much as possible.

For example, if Brown is lecturing about heart rate in response to exercise, he has research and data that looks at different heart rates in student-athletes during different types of workouts from a previous project.

"That way, it's not just all textbook," he said. "I can say, 'this is stuff I've had students work on to actually confirm this type of information.' By doing research, it keeps me viable for the classroom."

GROUNDBREAKING RESEARCH

When Brown was a graduate student at Iowa State University, working toward his master's and Ph.D., it was at the height of the steroid era in Major League Baseball.

In 1998, Mark McGwire smashed the MLB record for home runs in a season, breaking a mark that had stood for 37 years.

During that season, McGwire took a nutritional supplement called androstenedione, a human hormone that could also be extracted from plants. Because of the plant element, it was sold as a supplement. And the thought at the time, Brown says, is that it was being sold as a legal alternative to anabolic steroids.

People thought McGwire was hitting so many home runs because he was taking androstenedione, but there was no research done on it.

Brown's adviser at Iowa State, Doug King, received a grant from a supplement company to research the hormone.

In the exercise science world, androstenedione was a curiosity. And in the popular culture world it was just as eye-catching.

"It became a big deal because of the whole Mark McGwire thing," Brown said. "ESPN had an hour-long special on the Andro debate because nobody knew what it did."

As a part of Brown's study, 40 college-aged men engaged in strength training three days a week for eight weeks. The subjects were either supplementing or not. The researchers measured body composition, muscular strength, various hormones, cholesterol levels and other related measurements.

That's where the team of Iowa State researchers discovered that androstenedione didn't promote any adaptations to training and did much more harm than good.

"We observed that androstenedione did not augment the adaptations to resistance training. It didn't increase muscle mass. It didn't increase muscle strength. It didn't change body composition. It did not alter testosterone concentrations," Brown explained. "But it reduced HDL cholesterol levels. It increased estrogen levels. It looked like it was not a safe or effective alternative to anabolic steroids."

In 1999, Brown co-authored "Effect of Oral Androstenedione on Serum Testosterone and Adaptations to Resistance Training in Young Men."

It was one of the first developments of research regarding androstenedione.

"It was really cool because we had scooped everybody. Nobody else had research on it," Brown said. "Major League Baseball had commissioned a big study at Harvard, but we published our results before they did. Until then, everybody knew about the Harvard study, not what we were doing at Iowa State."

His research on androstenedione influenced legislation, too.

The Anabolic Steroid Control Act of 2004 and the Designer Anabolic Steroid Control Act of 2014 both determined that androstenedione and several other pro-hormone supplements could not be bought anymore because of their negative side effects.

INVOLVING OTHERS

So much about Greg Brown's area of study is the inclusion of other individuals – both as researchers and subjects.

Ever since he was a graduate student, Brown has had undergraduates assisting with research. But once he came to UNK he was especially able to involve students through the University of Nebraska at Kearney's undergraduate research programs.

Brown, who just completed his 13th year of teaching at UNK, began working with students in the Summer Student Research Program. Then once the Undergraduate Research Fellows developed, he quickly started mentoring students through that program as well.

By working with students on research, it serves a dual purpose for Brown.

"By helping them with their questions, I can look at what research is being done," he explained. "It helps me keep current to know what is being researched and what areas are open to research, what questions have or haven't been answered.

"If you're researching the same thing all the time, it feels like it can get a little boring. The students keep it from getting boring."



"If you're researching the same thing all the time, it feels like it can get a little boring.

The students keep it from getting boring."

It also enriches the student experience and helps develop interest in research.

Going back to his work with androstenedione, Brown has always had questions about supplements.

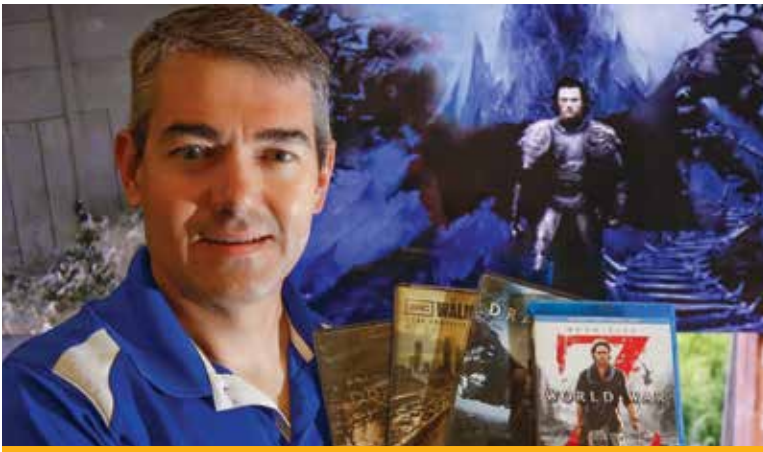
He also has many students with questions about energy drinks and their impact on exercise.

Energy drinks are widely available and popular among athletes and non-athletes, and Brown set out to find the effects of energy drinks on resting and exercise energy expenditure and metabolism.

Through the Summer Student Research Program, he was able to guide the student, Janae Nienhueser, to the conclusion that many claims made by energy drink companies weren't true. The research, "Effects of Energy Drinks on Metabolism at Rest and During Submaximal Treadmill Exercise in College Age Males," was published in 2011 in the International Journal of Exercise Science.

The study measured resting metabolic rate (RMR) and respiratory exchange ratio (RER) in 10 healthy males. The subjects consumed one of three commercially available energy drinks. RMR and RER levels were then measured one hour later. The individuals involved with the testing then engaged in 15 minutes of treadmill exercise.

The data indicated that energy drink consumption increased RMR and carbohydrate use at rest, but metabolism during submaximal exercise remained unchanged.



“People always have questions about their energy drinks,” Brown said. “Hopefully the students don’t take the advertisements at face value and start to think critically about what they’re being told by advertisements.”

Brown is also able to tie his research into the Kearney community.

Every year, one or two Boy Scout troops come to the Wellness Center, and his exercise science students help with fitness testing for the Personal Fitness merit badge.

When the Susan G. Komen Race for the Cure was hosted in Kearney, Brown served as the race director for three years. His students were involved with marking the course, packing t-shirts, timing the race and serving as course marshals.

“The thing that would make the day the best for research is when it’s not just me,” Brown said.

ANSWERING PRACTICAL QUESTIONS

One of Brown’s favorite aspects regarding his field of research is his ability to provide knowledge that benefits others.

“I really like to answer questions that are practical to people,” he said. “It’s always cool if you can find something that means something to other scientists, but I want something that affects other peoples’ lives.”

The video game research is a good example.

Brown said that while he would have loved to tell people to buy a Wii to help them lose weight, he knew it would not provide drastic changes. However, he also knows there’s value in the fact that using a Wii is better than not exercising at all.

Most importantly, Brown wants something with a take-home message that can have a meaningful impact on people.

“I would love to be able to say with my research that if you are engaged with aerobic training and strength training, and you do it this much this many times a week, you are more likely to lose weight because you eat fewer calories and you burn more,” Brown explained.

“Or, something like when people go for a snack, they’re more likely to choose a health snack versus a candy bar or soda.

“It’s easy to say that, but to actually have numbers to back it up is important. Those may not be the answers we get, but hopefully we can find something that will make a difference.” ■

GREG BROWN

Title: Professor, Kinesiology and Sport Sciences

College: Education

Education: Bachelor of Science, Physical Education, Utah State University, 1997; Master of Science, Exercise and Sport Science, Iowa State University, 1999; Doctor of Philosophy, Health and Human Performance, Iowa State University, 2002.

Years at UNK: 13

Career: Graduate Assistant, Iowa State University Department of Health and Human Performance, 1997- 2002; Assistant Professor, Jiann-Ping Hsu School of Public Health, Georgia Southern University, 2002-04

Family: Wife, Amber Shumway Brown; Sons, Kelton, 20, and Conner, 17.

Hobbies/Interests: Church; hunting; fishing; Running, with a special interest in mud and obstacle runs such as Warrior Dash and 5K the Hard Way; Movies, with many incorporated into his lectures to illustrate a concept.

Honors/Awards: Mortar Board Faculty Excellence Honors, Xi Phi Chapter, University of Nebraska at Kearney, 2006, 2007, 2008, 2012, 2013 and 2015; College of Education Outstanding Scholarship / Research Award, UNK, 2009 and 2014; College of Education Award for Faculty Mentoring of Undergraduate Student Research, UNK, 2007, 2010 and 2013; Pink Tie award, Susan G. Komen Nebraska Affiliate, for outstanding service to the Central Nebraska Race for the Cure, 2013; Star Reviewer, American Physiological Society and Advances in Physiology Education, 2010; Fellow of the American College of Sports Medicine, 2008; University Research Excellence Award, Iowa State University, 2002; The Zaffarano Prize for Graduate Student Research, Iowa State University, 2002; Helen Hilton Lebaron Excellence in Research Award, Dept. of Health and Human Performance, Iowa State University, 2000 and 2002.

Areas of research/specialization: Health benefits of strength training, Energy costs of novel physical activities, The scholarship of teaching in Exercise Science, Nutritional ergogenic aids (sports dietary supplements).

Courses taught: Sports Nutrition, Physiology of Exercise, Education Research, Introduction to Exercise Physiology, The Living Dead in Fact and Fiction.

Recent Published Articles:

- “Kinesiology in 360 Degrees,” International Journal of Kinesiology in Higher Education, 2017.
- “Mechanical and Physiological Analysis of Minimalist Versus Traditionally Shod Running,” The Journal of Sports Medicine and Physical Fitness, 2016.
- “The Use of Mobile Applications to Enhance Learning of the Skeletal System in Introductory Anatomy & Physiology Students,” International Journal of Kinesiology in Higher Education, 2016.
- “Resistance Exercise is Medicine,” International Journal of Therapy and Rehabilitation, 2015.
- “Online Quizzes Promote Inconsistent Improvements on In-Class Test Performance in Introductory Anatomy & Physiology,” Advances in Physiology Education, 2015.



Motivated by Mint

Drew travels world to collect plants, extract DNA

By KIM HACHIYA

Mints.

Those aromatic plants that brighten mojitos, tabbouleh and chewing gum, comprise one of the largest families of plants in the world. The mint family, known by its scientific name Lamiaceae, has about 7,000 members; they are found on all continents except Antarctica. And they often are found in exceptionally scenic areas, or maybe in your backyard garden.

This widespread abundance of Lamiaceae is a big reason the plants are of intense interest to the horticulture industry. And they attract botanists such as Bryan Drew, assistant professor of biology at the University of Nebraska at Kearney.

Drew says, somewhat in jest but also with more than a whiff of seriousness, that his love of travel pushed him to choose the mint family for intense research. And his focus on one genus, *Salvia*, has led him worldwide in searching out its 1,000 members. That search has taken him all over the United States, Mexico, South America, and in the summer of 2017, Turkey, southeastern Europe and China.

Lamiaceae are known for their square stalks and simple, opposite leaves. Most have showy flowers and many have fragrant volatile oils prized for culinary or medicinal uses. Culinary herbs include mint, basil, rosemary, sage, oregano, thyme and lavender. Other members of the family are grown for their beauty, such as *Coleus*,



Monarda, Salvia and Ajuga. Salvia yields edible seeds – chia. Even catnip is a member of this large family.

Drew, however, is interested in the plants’ backstory – the story of how and why they evolved and dispersed worldwide. Of the 250,000 or so known plant types worldwide, two percent are in the Lamiaceae family, which is the sixth largest plant family. Drew is interested in radiations of Lamiaceae – why and how this huge family diversified and created new species. Scientists know that Lamiaceae began to diversify about 66 million years ago after the KT (Cretaceous-Tertiary) extinction, when all of earth’s large animals such as dinosaurs, and many plants, went extinct, virtually overnight.

“Extinctions wipe the slate clean,” Drew said. “That opens new ecological niches. New things become dominant.”

EFFECTIVE POLLINATION

Changes in climate favored the rise of Lamiaceae. They thrive best in open areas where they don’t compete with dense shrubs or trees. They like slopes and hills, and cooler, drier climates. Often these plants thrive in landscapes that are not conducive to farming. The diversification in the family coincided with the rise of flying things that would pollinate the flowers.

Pollination is the process through which pollen

(plants’ sperm) from stamens transfers to the stigma, the external female reproductive organs of plants, enabling fertilization and the production of seeds in the plants’ ovaries. Some plants are pollinated by wind, others by insects, birds or even animals. Insect pollinators for Lamiaceae included bees in Africa, Asia and Europe, and the Americas. Avian pollinators such as hummingbirds came later, starting about 25 millions years ago, in North and South America. Bird pollination is almost exclusive to the New World, Drew said. In any event, both birds and bees are attracted to flowers.

Lamiaceae flowers are generally double lipped – the plants used to be called Labiatae, derived from the Latin word for lips, labia – with open mouths, tubular corollas (petals) and five-lobed bell like calyxes (sepals). Scientists believe that flowers diversified and adapted to accommodate and take advantage of pollinators’ needs. Some plants are so specialized that only one type of pollinator

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clean. That opens
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dominant.”*

can effectively pollinate them.

“One of the coolest things about *Salvia*, one of the unique things, is they have this staminal lever mechanism,” Drew said. “They have two stamens, and each stamen has two pollen sacs (theca). One theca is fertile, the other is usually infertile. Functionally, a bee or bird hits the infertile portion and it pivots the fertile portion onto the head or abdomen of the bee or bird. This lever sits in the flower in such a way that to get to the flowers’ nectar, the pollinator must hit it.”

When the pollinator moves to another flower, it carries pollen to it, fertilizing that flower and picking up a new pollen load.

“This type of pollination process promotes outcrossing among flowers and increases fitness,” Drew said. “But the levers are often specific to specific pollinators, which maintains species boundaries.”

These levers are unique to *Salvia*, Drew said.

“Typically in a big genus, there are special and unique attributes or ‘key innovations’ that set them apart and favors them over others. This lever mechanism is it for *Salvia*.”

Although *Salvia* are among the most numerous members of the Lamiaceae family, with some 1,000 species, they are a relatively young genus – maybe 35 million years old in the Old World, and just 10 million years old in the New World. Because of its relative youth, there are not a lot of genetic mutations, which allow scientists to examine relationships and divergences.

NEXT GENERATION SEQUENCING

Drew and his colleagues are parsing the evolutionary story. They are identifying which pollinators are specific to which *Salvia* species and trying to correlate underrepresented bees with particular *Salvia*. Did bee evolution correlate with mint evolution? It is possible that certain bee groups diversified, he said, as the mint group diversified.

The botanists are also interested in how chemistry is correlated with diversification in *Salvia*. They note, for example, that the particular smell of mint repels insects from eating the plants.

The way to fill in the blanks is to collect and study plants.

Drew and a colleague from the University of Wisconsin, Ken Sytsma, are co-principal investigators on a \$1 million grant from the National Science Foundation to focus on *Salvia*. Drew and Sytsma note that the staminal lever mechanism of *Salvia* originated independently three different times within *Salvia*. This makes the genus an interesting model to study how key innovations led to diversifications in different areas of the world. They propose to collect specimens from about 700 known *Salvia* species and subject them to “next generation sequencing” to infer relationships between the species to determine when, where and how the various species diverged and developed.

The physical collection of specimens has taken Drew worldwide, including the 2017 trips to Turkey and China.



“The flowers are so delicate. They wilt quite quickly. The goal sometimes is to get them into a cooler to extend their life, but scanning in the field is ideal.”





Because *Salvia* tend to grow in remote areas, collection trips can turn into scenic adventures. Typically, he said, he starts with information from herbaria consortia and sorts by dates when plants likely will be blooming. He goes to the sites, rents a vehicle, taxi or sometimes has hitchhiked to likely locales. And then he just looks around.

Once species are found, he will take full specimens by the roots if possible, or perhaps just a few branches or stems, and labels the specimen as to date, time, place, type, etc. in a field notebook. In a perfect world, the plants are deposited in herbaria within the local country, at Wisconsin, at UNK and sometimes at University of California-Berkeley. Leaves from the plants are placed with a desiccant pack of silica into a cellophane envelope and then into a plastic bag, again well labeled. He takes leaves for DNA extraction and seeds for garden experiments.

An important part of the project is photographing and making high-resolution scans of the images, in the field if possible to avoid wilt and to capture the specimens at peak freshness. He scans flowers, leaves and sex parts against both black and white backgrounds and from varying angles and positions. Later, he uses software to correlate floral features to assess which flower components may be responsible for the kind of diversification that has made *Salvia* such a successful group of plants.

“The flowers are so delicate. They wilt quite quickly,” Drew said. “The goal sometimes is to get them into a cooler to extend their life, but scanning in the field is ideal. It can take about 20 to 30 minutes to fully scan each flower.”

RARE FIND

Drew and another Wisconsin colleague, Ricardo Kriebel, have made an attractive poster of flowers the two have scanned at UC-Berkeley Botanical Garden. The flowers at the top of the poster are blue, and they gradually move to pink and red. Blue flowers, Drew notes, are bee pollinated, and pink and red flowers are bird pollinated.

The most surprising find for Drew occurred in 2008 when he and colleague Ivalú Cacho were searching in Mexico for a plant not part of the *Salvia* group (but still a mint) called *Neoepplingia*. That plant was first described in 1982, but it had never had its DNA sequenced, and is only known to come from one place in the world.

It is endemic to the State of Hidalgo in Central Mexico, and there is only one known species in the genus, *Neoepplingia leucophylloides*. Drew and Cacho spent three days searching in a beautiful area near the Barranca de Tolantongo, but they were searching in the wrong place. They finally found it by inquiring about the plant at a small courthouse, and found the location of the plant was actually near a bus stop, which had the pet name Molanguito (little hill) locally, and not



near the spot on their map marked Molanguito. Somewhat surprisingly, the plant ended up being a part of the genus *Drew* was studying for his Ph.D., *Lepechinia*.

“It was a total surprise. It was fun. It was quite a saga,” he said. *Neoepplingia leucophylloides*’ DNA figured prominently in Drew’s doctoral dissertation, which he earned in 2011 from Wisconsin-Madison. He is entering his fourth year at UNK.

Drew became interested in *Salvia* because his dissertation work was on a closely related plant and *Salvia* are “big, low-hanging fruit in terms of research possibilities.” Another scientist in the Wisconsin lab, Jay Walker, had been working with *Salvia* for more than 20 years and had a large body of research, Drew said. Walker decided to change careers from research to high school teaching, and he turned his work over to Drew.

The NSF project is funded for three years. In addition to adding to the scientific knowledge of *Salvia*, the research team has put together an international group of *Salvia* “enthusiasts,” and the team will host a world *Salvia* Summit IV in the coming years. Three have been held so far and each attracts 80 to 100 people, most from the horticulture industry. In addition, they will present or host scientific/academic symposia where outcomes will be discussed. They also hope to help preserve and conserve *Salvia* species through deposits in U.S. and foreign botanical gardens and herbaria.

A website hosted by the Wisconsin State Herbarium will be upgraded and enhanced; the team believes it will help gardeners and horticulturists find potential *Salvia* for landscape uses and to encourage use of these plants to aid pollinators, many species of which have been struggling as habitats degrade.

Drew said the project will employ undergraduate and graduate scientists. They also envision developing undergraduate field courses.

A native of Illinois, Drew did his undergraduate work in botany at California-Berkeley, earning a B.S. in 1996. He spent a number of years traveling, and working for AmeriCorps, the U.S. National Park Service and Forest Service in California before returning to school to earn his doctorate. ■

BRYAN DREW

Title: Assistant Professor, Biology

College: Natural and Social Sciences

Education: Associate in Arts, College of the Siskiyous, 1994; Bachelor of Science, Forest Ecology, University of California, Berkeley, 1996; Graduate Studies, Utah State University, 2002; Doctor of Philosophy, Systematic Botany, University of Wisconsin-Madison, 2011.

Years at UNK: 3

Non-Academic Career: Wetland ecologist, Wisconsin Department of Natural Resources, 2011-12; Contract botanist, Ottawa (Mich.) National Forest, 2008-09; Biological technician, U.S. Forest Service, Klamath National Forest, 2002-05; Biological technician, Pinnacles National Monument, 2004; Biological technician, U.S. Forest Service, Teakettle Experimental Forest, 2003; Service volunteer, AmeriCorps Watershed Stewards Project, 2000-01; Timber cruiser, Natural Resource Management, Eureka, Cal., 1999.

Research Assistantships: Department of Botany, UW-Madison, 2007 and 2010-11; Soil Nutrient Cycling, Smoky Mountain National Park, 2002; Soil Nutrient Cycling, Utah State University, 2002.

Teaching Assistantships: Survey of Botany, Dept. of Botany, UW-Madison, 2010; Introductory Biology, Dept. of Zoology, UW-Madison, 2009; Vegetation of Wisconsin, Dept. of Botany, UW-Madison, 2009; Flora of Wisconsin, Dept. of Botany, UW-Madison, 2009; Dendrology, Dept. of Botany, UW-Madison, 2008; Flora of Wisconsin, Dept. of Botany, UW-Madison, 2008; Vegetation of Wisconsin, Dept. of Botany, UW-Madison, 2007; Plant Biogeography, Dept. of Botany, UW-Madison, 2007; Plant Systematics, Dept. of Botany, UW-Madison, 2006; Vegetation of Wisconsin, Dept. of Botany, UW-Madison, 2006; Flora of Wisconsin, Dept. of Botany, UW-Madison, 2006; Plant Systematics, Dept. of Botany, UW-Madison, 2005.

Hobbies/Interests: Traveling, botanizing, hiking, camping, reading

Honors/Awards: Courtesy Faculty, University of Florida, 2014-present; Honorary Research Fellow, Department of Botany, UW-Madison, 2013-present; ON and BK Allen Fellowship, Department of Botany, UW-Madison, spring 2010; Newcomb Summer Research Fellowship, Department of Botany, UW-Madison, summer 2008.

Areas of research/specialization: Phylogenetics and evolution of the Lamiaceae, especially the genera *Agastache*, *Lepechinia*, *Monardella* and *Salvia*; Temporal and spatial origin of the California Floristic Province flora; Plant speciation processes in Western North America; Pollination biology; Conservation genetics; Salmon habitat restoration; River and stream rehabilitation

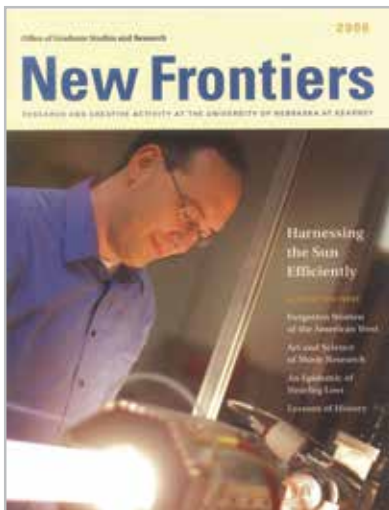
Courses taught: Natural History of the Southwest, Insect Biology, The Six Global Mass Extinctions, Scientific Communication, Introduction to Soil, Flowering Plants: Systematics and Evolution, Plant Diversity and Evolution, Plant Taxonomy, Plant Ecology

Recent Published Articles:

- “*Salvia* United: The Greatest Good for the Greatest Number,” *Taxon*, 2017.
- “Synthesis of Phylogeny and Taxonomy Into a Comprehensive Tree of Life,” *Proceedings of the National Academy of Sciences*, 2015.
- “Another Look at the Root of the Angiosperms Reveals a Familiar Tale,” *Systematic Biology*, 2014.
- “Lost Branches on the Tree of Life,” *Plos Biology*, 2013.
- “Phylogenetics, Biogeography, and Staminal Evolution in the Tribe Mentheae (Lamiaceae),” *American Journal of Botany*, 2012.

New Frontiers Through The Years

2008



PRADEEP BARUA
Professor, History
SUSANNE BLOOMFIELD
Professor, English
TIM BURKINK
Dean, Business and Technology
VALERIE CISLER
Professor, Music and Performing Arts
SCOTT DARVEAU
Professor, Chemistry

CHRIS EXSTROM
Professor, Chemistry
KATE HEELAN
Professor, Kinesiology and Sport Sciences
SRI SESHADRI
Professor, Marketing and Management
KENYA S. TAYLOR
Dean, Graduate Studies and Research

2009



KATHRYN N. BENZEL
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KURT BORCHARD
Professor, Sociology
GREGORY BROWN
Assistant Professor, HPERL
KIM CARLSON
Assistant Professor, Biology

VICTORIA GORO-RAPOPORT
Associate Professor, Art
SUSAN JENSEN
Associate Professor, Marketing
JEANNE STOLZER
Assistant Professor, Family Studies

2010



WILLIAM AVILÉS
Associate Professor
Political Science
JOSEPH CARLSON
Professor, Criminal Justice and Social Work
LINDA CROWE
Chair/Professor,
Communications Disorders
DARLEEN COWLES MITCHELL
Professor,
Music and Performing Arts

KYLE LUTHANS
Chair/Professor,
Management
DAWN MOLLENKOPF
Associate Professor,
Teacher Education
MARGUERITE TASSI
Professor, English
FRANK TENKORANG
Chair/Assistant Professor,
Economics

2011



TEARA ARCHWAMETY
Education Research
Consultant
SYLVIA ASAY
Chair/Professor,
Family Studies and
Interior Design
HERBERT CRAIG
Chair/Associate Professor,
Modern Languages

MARK ELLIS
Chair/Professor, History
CHAD FONFARA
Associate Professor,
Art and Art History
KEITH GELUSO
Associate Professor,
Biology
MAX MCFARLAND
Professor, Counseling
and School Psychology

2012



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Associate Professor,
Music and Performing Arts
BRENDA ESCHENBRENNER
Assistant Professor,
Accounting/Finance
SATOSHI MACHIDA
Associate Professor,
Political Science
JAKE MESSERSMITH
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Management

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Biology
JOHN STANKO
Associate Professor,
Art and Art History
JANE STRAWHECKER
Professor,
Teacher Education

New Frontiers Through The Years

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Performing Arts

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and School Psychology

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Professor, English

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Political Science

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Professor,
Teacher Education

HEATHER SCHULZ
Assistant Professor,
Marketing

JULIE SHAFFER
Professor, Biology

KATHRYN ZUCKWEILER
Associate Professor,
Management

2014



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Associate Professor,
School Library Science

TONI HILL
Assistant Professor,
Family Studies

CAROL LILLY
Professor,
History

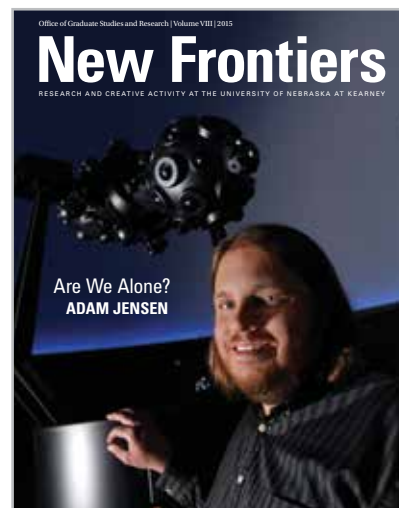
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Associate Professor,
Communication Disorders

PAUL TWIGG
Professor,
Biology

SAM UMLAND
Professor,
English

DOUG WATERFIELD
Professor,
Art

2015



CHARLES "CHUCK" ROWLING
Assistant Professor,
Political Science

MALLORY WETHERELL
Assistant Professor,
Ceramics

PHU VU
Assistant Professor,
Teacher Education

ADAM JENSEN
Assistant Professor,
Physics and Physical
Science

NOEL F. PALMER
Assistant Professor,
Management

BREE DORITY
Assistant Professor,
Economics

MATTHEW R. BICE
Assistant Professor,
Kinesiology and Sport
Sciences

2016



KAZUMA AKEHI
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Kinesiology and Sport
Sciences

HAISHI CAO
Associate Professor,
Chemistry

CHRISTINE CHASEK
Assistant Professor,
Counseling & School
Psychology

ANTHONY DONOFRIO
Assistant Professor,
Composition and Theory

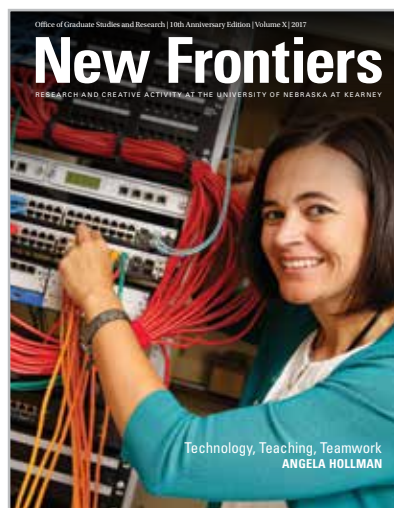
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Professor, Management

TIMBRE WULF-LUDDEN
Assistant Professor,
Criminal Justice

DAVID PALMER
Professor, Management

REBECCA UMLAND
Professor, English

2017



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Associate Professor
and Chair, Educational
Administration

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Ron and Carol Cope
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Professor, Drawing
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Assistant Professor,
Industrial Technology,
Information Networking
& Telecommunications

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BRYAN DREW
Assistant Professor,
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