UNLV

Innovation

The Research Magazine of the University of Nevada, Las Vegas

NATIONAL SCIENCE FOUNDATION CAREER AWARDS

Meet Five UNLV Winners of One of the NSF's Most Prestigious Research Awards

SCIENCE AS ART

Beautiful Microscopic Images Pave the Path to Discovery

SHINING EXAMPLES

The Harry Reid Silver State Research Award Honors the Best in UNLV Research

Dr. Neal J. Smatresk
UNLV President

Our Commitment to Economic Development

When I arrived at UNLV, I gave considerable thought to how the university could better embrace the identity of our city. What I didn't quite anticipate at the time was just how much the city wanted to embrace UNLV.

Since then, I've witnessed an outpouring of support for the university from a wide variety of individuals, businesses, agencies, and other organizations that recognize the value of a thriving research university. Their support is much appreciated, and we are likewise committed to the success of those in our surrounding community. We recognize that our support is particularly important during the difficult economic times we are experiencing. UNLV wants to help lead the way back to greater prosperity.

Most research universities across the country are engaged in various forms of economic development, many involving partnerships with businesses and the public sector. Some of these partnerships result from faculty working to address private-sector challenges through industry-sponsored research. Others grow out of faculty discoveries of inventions, drugs, or processes that may be commercialized, thus producing revenue for the institution and creating a climate that invites investment in the area.

These are just the kinds of mutually beneficial partnerships that we are interested in expanding at UNLV. Our newly formed Office of Economic Development is helping the faculty to attract industry-sponsored research and to develop, protect, and commercialize their intellectual property.

These endeavors remain clearly linked to our mission of education. Students are integral contributors to these projects; their experiences on such projects enable them to expand their skill sets, learn the research process, and ultimately become more employable in high-paying sectors of the economy.

It is clear that research fuels business opportunities in a variety of ways – by building a sophisticated work force, by producing intellectual property with commercialization potential, and by developing research that solves real-world problems. With a combination this powerful, we can hardly go wrong. And, what better way to embrace the identity of our community than with plans to become more innovative, responsive, and entrepreneurial? These are qualities that have made our city and state what they are today, and we're proud to embrace them.

Dr. Neal J. Smatresk
UNLV President

Dr. Thomas Piechota
Interim Vice President
for Research and
Dean of the Graduate College

Welcome to UNLV Innovation!

It's a pleasure to introduce another issue of *UNLV Innovation*, the university's annual research magazine. Year after year, we provide in-depth stories that capture why it's so critical for UNLV to conduct research. In these pages, we explore not just what research is being done, but why it's being done, how it benefits students, and what impact it has on the community and beyond. We want you to come away with more than just interesting stories of research; we want you to understand the *value* of research.

In this issue, you'll meet some of our most respected scholars, scientists, and engineers. You'll learn about the far-reaching effects of their research and the originality with which it was conceived. In short, you'll see why we named this publication *Innovation*. Please enjoy this issue, and visit our website to learn more: http://research.unlv.edu/.

Dr. Thomas Piechota
Interim Vice President for Research and
Dean of the Graduate College

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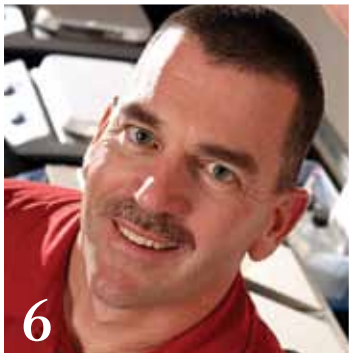

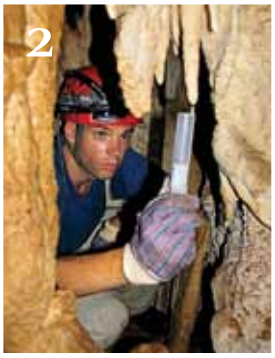

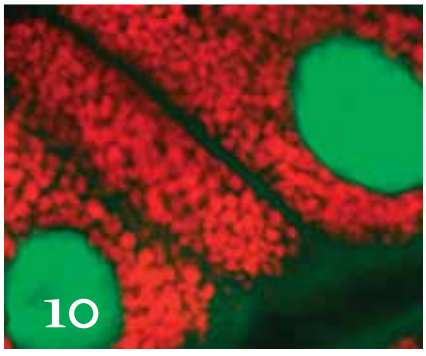

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Graduate students Matthew Graham, left, and Michael Webber

AARON MAYES

New Scorpion Species Discovered

Two UNLV graduate students have discovered a new species of scorpion in Death Valley.

Doctoral student Matthew Graham first encountered the specimen as he was conducting an inventory of scorpion species in Death Valley as part of a collaborative project with UNLV professor Jef Jaeger and the National Park Service.

The Ph.D. candidate from the UNLV School of Life Sciences nearly dismissed the specimen as a juvenile of a common species in the area. But the insect was especially small, about the size of a thumbnail, and something about its claws just wasn't quite right.

When Graham brought it back to UNLV, he identified it as a member of the genus *Wernerius* but wondered why it was more than 400 kilometers from its usual home. He knew of only two species of the rare genus: one from along the Colorado River and one in Joshua Tree National Park. The specimen sat for several months in his office as he got back to his studies and teaching duties.

Curious about his bizarre find, fellow Ph.D. candidate Michael Webber, who worked in a cubicle in the same room as Graham, asked if she could take a closer look at the scorpion.

Graham and Webber each bring a different expertise to their collaboration. Graham studies the biogeography of scorpions of the American West, so he knew that the tiny scorpion from Death Valley was definitely out of place. He uses the DNA from scorpions to investigate how geologic and climatic events have influenced the evolution of desert organisms. Webber is an ecologist who studies the reproductive biology of scorpions and different aspects of their behavior.

"The first thing we did was a literature search," Webber says. "We knew it was of the *Wernerius* genus because of the unique spine on its tail, so we looked up published descriptions of the other two species – *Wernerius spicatus* and *Wernerius mumai* – and compared them to the Death Valley scorpion."

She noted that the Death Valley specimen had a distinct tail, pincers, and reproductive organs. "Differences in anatomical characters like these can indicate that you are dealing with a different species," Webber says.

After describing the specimen in meticulous detail, the pair submitted a paper to a scientific journal for review. They submitted their findings to ZooKeys, a peer-reviewed, open-access journal that supports free exchange of ideas and information in systematic zoology, phylogeny, and biogeography.

The team named the scorpion *Wernerius inyoensis* because it was found in the Inyo Mountains. Graham hasn't found another of this new species, but he continues to search. He hypothesizes that it could live completely underground and might emerge to the surface only rarely.

"Some would argue that the more species we find, especially new venomous animals like scorpions, the better our chances are for discovering new biochemical tools that could aid in human health and medicine," says Graham, who grew up collecting scorpions, reptiles, and amphibians as a hobby. "It's also cool to show the world that there are still places to explore and new things to discover."

Medication Errors by Both Domestically and Internationally Trained Nurses Studied

UNLV researchers will compare medication errors made by internationally educated nurses and those educated in America in a new study that aims to improve patient safety.

The team will investigate whether language and cultural barriers impede nurses' ability to provide quality care. Researchers will examine medication data from about 2,000 nurses in nine Las Vegas hospitals, examining information such as how errors occur, if the correct medication and dosage levels were administered, and if the medication was given at the proper time.

Results from the study could be used to help form national regulations and requirements for nursing education and training.

"Our ultimate goal is to help im-

prove patient safety and quality of care in health care delivery at hospitals and other health care settings," says Jay Shen, an associate professor of healthcare administration and policy at UNLV. "If we can determine why and how nurses are making these errors, hospitals can come up with suitable intervention programs to reduce medication errors and improve patient safety."

The two-year, $300,000 study is funded by the National Board of Nursing and is being led by Shen from UNLV's School of Community Health Sciences and Yu (Philip) Xu, a professor with the School of Nursing. UNLV's research team will partner with hospitals to examine recent medication error data. Participating hospitals will hire data collectors to assure that the information is accurate and the identity of individual nurses is protected. The hospitals will receive funding from the National Nursing Board to assist with the data collection.

"This is a labor intensive endeavor that deals with important information, and we are pleased that the hospitals realize the significance of this research and how it could potentially improve patient safety and quality of care," Shen says.

Healthcare administration and policy professor Jay Shen

Nationwide and in Las Vegas, the healthcare industry is experiencing an unprecedented nursing shortage, resulting in the recruitment of internationally educated nurses. In Las Vegas alone, researchers estimate that up to 40 percent of registered nurses were educated outside the U.S. Nationwide, approximately 15 percent of all registered nurses were educated outside of the country, according to health care industry estimates. This percentage is on the rise; the Health Resources and Services Administration has predicted that 800,000 nurses will be hired in the United States by 2020 to fulfill current staffing needs.

This is the second major study UNLV researchers have conducted on how the population of internationally educated nurses adjusts to the American healthcare workforce.

In 2010, Xu and Shen completed "Speak for Success," the nation's first research project that evaluated the effectiveness of a comprehensive language and communication training program for currently employed internationally educated nurses.

Researchers Discover Magnetic Bacteria with Potential for Emerging Biotech Industry

UNLV microbiologist Dennis Bazylinski and an international team of researchers were the first to identify, isolate, and grow a type of magnetic bacteria that could one day contribute to the emerging biotech and nanotechnology industries.

Their findings were recently published in the prestigious journal *Science*.

Magnetotactic bacteria are simple, single-celled organisms that are found in almost all bodies of water. As their name suggests, they orient and navigate along magnetic fields like miniature swimming compass needles. This is due to nano-sized crystals of the minerals magnetite or greigite that they produce.

The presence of these magnetic crystals makes the bacteria and their internal crystals (called magnetosomes) desirable for commercial applications like drug delivery and enhancement of medical imaging.

While many magnetite-producing bacteria can be grown and easily studied, Bazylinski and his team were the first to cultivate a greigite-producing species. The greigite-producing bacterium, called BW-1, was found in water samples collected more than 280 feet below sea level in Death Valley National Park's Badwater Basin.

"Because greigite-producing bacteria have never been isolated, the crystals haven't been tested for the types of biomedical and other applications that currently employ magnetite," says Bazylinski, who has been studying magnetotactic bacteria for more than 30 years. "Greigite, an iron sulfide, may be superior to the iron oxide magnetite in some applications due to its slightly different physical and magnetic properties, and we'll now have the opportunity to find out."

After the BW-1 was collected, it was isolated and grown at UNLV by Bazylinski and then-postdoctoral associate Christopher Lefèvre. The bacterium was found to produce both greigite and magnetite.

A detailed examination of its DNA revealed that BW-1 has two sets of magnetosome genes, unlike others that produce only one mineral and have only one set of magnetosome genes. This suggests that the production of magnetite and greigite in BW-1 is likely controlled by separate sets of genes. This could be important in the mass production of either mineral for specific applications.

According to Bazylinski, the greigite-producing bacteria represent a new, previously unrecognized group of sulfate-reducing bacteria that breathe the compound sulfate rather than oxygen.

The study was funded in part by a grant from the U.S. National Science Foundation, the U.S. Department of Energy, and the French Foundation for Medical Research.

Partnering with Bazylinski were Christopher Lefèvre and David Pignol of the Institute of Biology and Biotechnology, French National Center of Scientific Research and University of Aix-Marseille II; Nicolas Menguy of Pierre and Marie Curie University; Fernanda Abreu and Ulysses Lins of the Federal University of Rio de Janeiro; Mihaly Posfai of the University of Pannonia; Tanya Prozorov of Ames Laboratory; and Richard B. Frankel of California Polytechnic State University, San Luis Obispo.

Stalagmites Provide Clues on the Demise of Early Civilizations

Deep in the caves of Southern Mexico, UNLV geoscientist Matthew Lachniet hopes to discover why some of North America's most prosperous early civilizations died out.

The evidence he's looking for isn't among some hidden treasure that Indiana Jones might pursue or depicted in ancient cave paintings. Lachniet is looking for his evidence in stalagmites, the conical stacks of mineral deposits rising from cave floors.

These common cave formations act as ancient rain gauges that have recorded long-term climate change. Lachniet and an international team of researchers have used them to establish 2,400 years of the climate history of southwestern Mexico; this history, coupled with archaeological evidence, links the rise and fall of ancient Mesoamerican civilizations to changing rainfall.

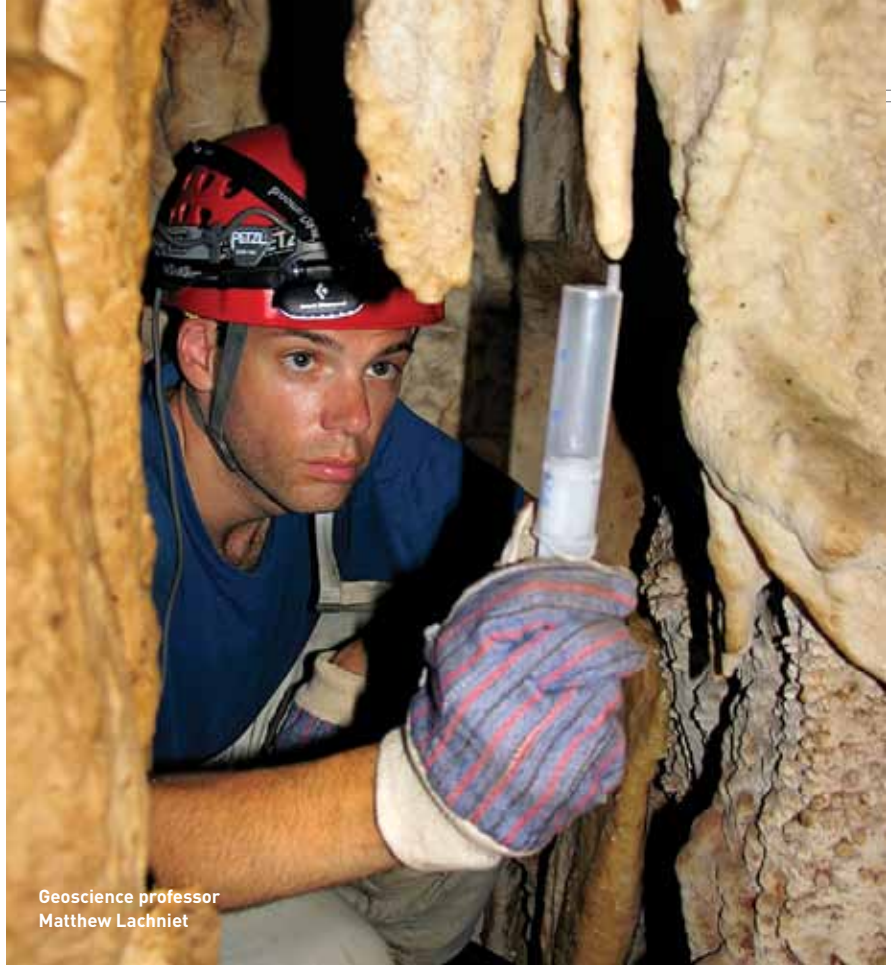
The team's findings were published online recently in the journal *Geology*.

Stalagmites form below stalactites, which form on cave ceilings. When tiny drops of water and calcite minerals drop off stalactites and accumulate on the cave floor over thousands of year, stalagmites develop – and much like the rings of a tree, they accurately record the rainfall history of an area.

Little is known about what contributed to the growth and downfall of the ancient Mesoamerican city of Teotihuacan, though historical evidence suggests periods of above average rainfall followed by extreme drought might have played a role.

To find the answers, Lachniet and his team collected and analyzed a stalagmite from Juxtlahuaca Cave in the Mexican state of Guerrero. The cave is located in the core region affected by the North American Monsoon, a climate phenomenon primarily responsible for rain in most of Mexico and parts of Arizona, New Mexico, and Southern Nevada.

Researchers first verified the rainfall record of the stalagmite by comparing deposits from the tip of the stalagmite with known rainfall amounts from the more recent past. Water samples were also collected deep within the caves to calibrate chemical variations in the stalagmites and unravel the climate history hidden within.



Geoscience professor Matthew Lachniet

KEITH CHRISTENSON

"Mexico may seem far removed from Southern Nevada, but the two regions are in fact linked by climate processes in the Pacific Ocean. Our new record shows that dry conditions, likely linked to El Niño processes, recurred frequently over time," Lachniet says. "The point to be made is that civilization runs on water. Take away a water supply, and the civilization may fail."

Lachniet and his colleagues correlated the region's cultural milestones with measured rainfall amounts. Above average rainfall between the first and third centuries, for example, coincided with the rise of the largest early Mesoamerican city of Teotihuacan. At its peak, more than 125,000 people lived in the highly developed city.

Conversely, a 500-year drying trend, including a drought of more than 150 years, coincided with rapid population decline in Teotihuacan around 550 CE. The drought likely impacted dry-land agriculture practices in the semi-arid Mexican Highlands.

Researchers argue that another drought, this one from 690-860 CE, made it difficult for the basin area to sustain large urban areas. Archaeological evidence from this dry period also includes smashed "Storm God" artifacts, which may have signified abandonment of the civilization's rain god.

"We can't say with certainty that other social factors weren't drivers of the cultural change, but we now have well-dated and robust climate information to compare," Lachniet says.

The study was published in the journal *Geology* and was supported by grants from the National Science Foundation and the National Geographic Society. Partnering with Lachniet were Juan Pablo Bernal of Mexico's Centro de Geociencias in Juriquilla; Yemane Asmerom and Victor Polyak of the University of New Mexico; and Dolores Piperno of the Smithsonian National Museum of Natural History.

Anthropologist Explores the Impact of Honey on Human Evolution

Honey and bee larvae were foods vital to human evolution and the development of early man's large brain, a notable characteristic of the human species, according to a new study by UNLV anthropology professor Alyssa Crittenden.

Crittenden found early human ancestors and hunter-gatherer societies of today rely on honey to supplement meat and plant foods. Available almost year round, honey is packed with energy-producing nutrients essential to brain growth.

"Honey is a food that defined who we are," says Crittenden, a nutritional anthropologist. "The relationship between humans and honeybees goes back much farther than we ever expected; the relationship, desire, and enjoyment of honey is a part of our species."

Crittenden studies among the Hadza of Tanzania, one of the world's few remaining hunter-gatherer societies. Hunting and gathering food characterized a way of life for humans for most of evolutionary history. Today, the Hadza forage for honey and larvae in an area where scientists believe early humans lived. Crittenden has worked alongside the Hadza for more than eight years, witnessing their search for honey, a coveted food source in their community.

Scientists believed meat and plant foods were primary food sources for early humans. However, Crittenden cites evidence of rock art from the Paleolithic era, which depicts human ancestors targeting beehives. She links honey consumption to past and current hunter-gatherers of Africa, Australia, and Asia, like the Hadza.

While ape species consume honey, an important food source among primates, Crittenden notes the advent of stone tools made it easier to tear into beehives, allowing humans to advance ahead of other species in reproduction and biology.

Anthropology professor Alyssa Crittenden

"Honey was the Cliff Bar for early humans – an energy-dense, sweet, high-glucose food that's also peppered with fat and protein," Crittenden says. "These nutrients played a critical role in neural development and its function."

Crittenden argues that studying the evolution of the human diet and which foods people are naturally designed to consume is critical to understanding nutrition's role in combating today's diseases.

The study, "The Importance of Honey Consumption in Human Evolution," appears in the December 2011 edition of the journal *Food and Foodways*.

Digital Scholarship@UNLV: Expanding the Reach of Scholarly Communication

The advent of the institutional repository – an online locus for collecting, preserving, and disseminating the intellectual output of an academic institution – has changed the research landscape in remarkable ways, according to Patricia Iannuzzi, dean of the University Libraries.

She notes that UNLV's institutional repository (IR), called "Digital Scholarship@UNLV," provides a global showcase of the research and scholarly endeavors of the university's students and scholars.

"As UNLV's research productivity accelerates and access to alternative forms of intellectual content is in greater demand, preservation and visibility of scholarship become increasingly meaningful to scholars," Iannuzzi says. "Digital Scholarship@UNLV is an innovative solution to highlight scholarship both individually and collectively, to connect researchers, and ultimately to expand the reach of UNLV's scholarly communication."

Through this tool, which is hosted and managed by the University Libraries, UNLV's scholarly output is archived in a centralized location in perpetuity and made more visible through search optimization.

Many scholarly works already exist within Digital Scholarship@UNLV, from peer-reviewed research studies to conference presentations, white papers, and student research projects. Several of these types of scholarly communication were difficult to obtain online before institutional repositories were introduced.

Through the IR, scholarly communication is literally more accessible; users are able to locate peer-reviewed, freely available materials to build upon others' work and to complement their own scholarship. Graduate and undergraduate research findings are being downloaded more frequently, greatly facilitating scholarship. Journal editors may elect to migrate entire journals to the host platform, which automates the peer-review process, saving time and resources.

Dean of the University Libraries Patricia Iannuzzi

In addition to connecting researchers and enhancing scholarly communication, Digital Scholarship@UNLV may be used as a recruitment tool. By searching the IR, prospective UNLV faculty and students are able to review intellectual output in areas of interest and gain perspective on academic rigor. The IR also provides evidence of the breadth and depth of UNLV's scholarly output for administrative purposes such as accreditation.

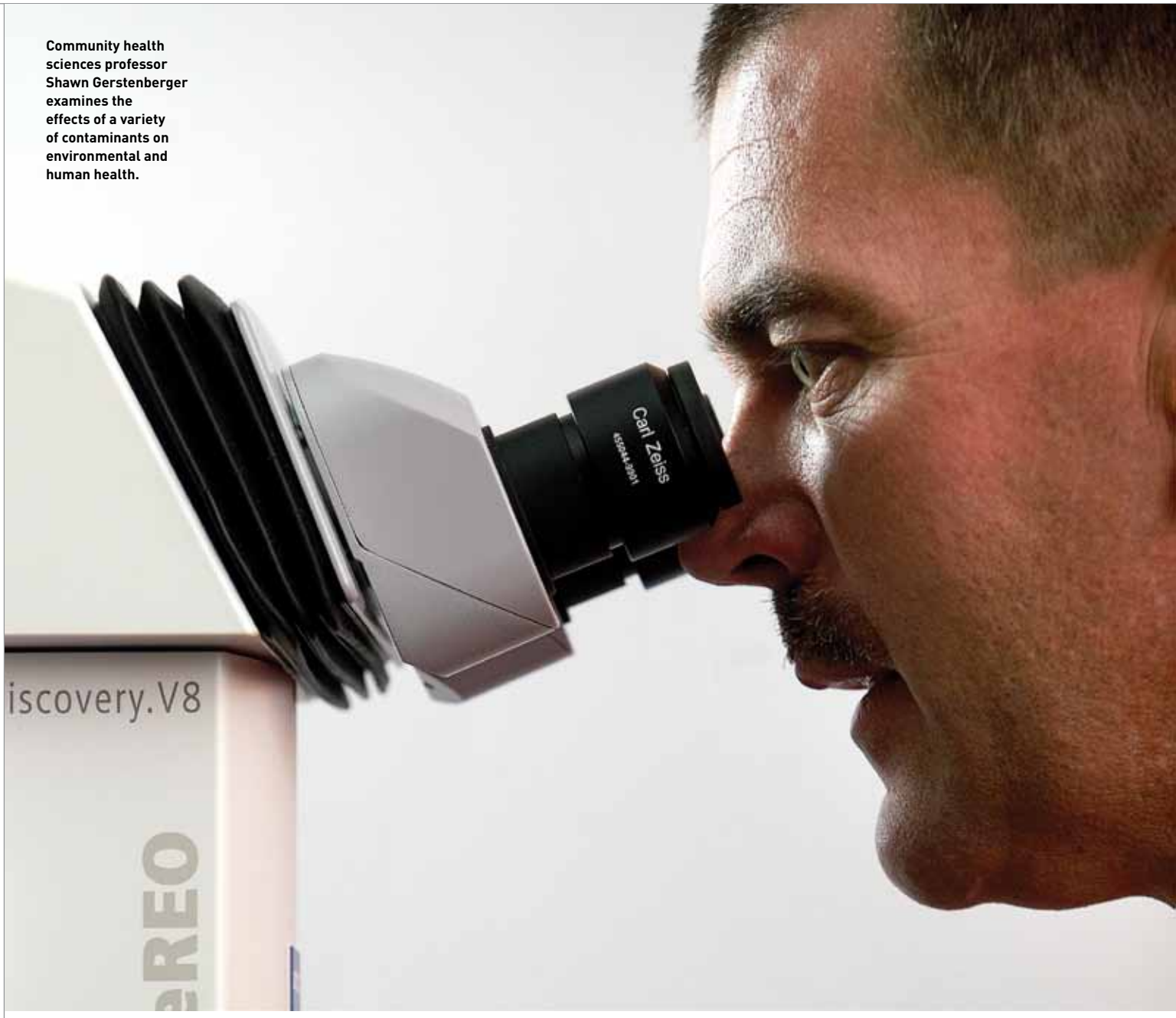
UNLV students who have deposited electronic theses and dissertations, capstone projects, professional papers, articles, and/or posters can also email research links to prospective and current employers or to graduate admissions offices to highlight their work.

Faculty and students have already embraced showcasing their intellectual content in Digital Scholarship@UNLV, Iannuzzi says. Subject areas span engineering, sociology, English, life sciences, chemistry, environmental/public affairs, nursing, sustainability, and specialized research at the Harry Reid Center for Environmental Studies, Brookings Mountain West, and the Black Mountain Institute.

In the last year, Digital Scholarship@UNLV received more than 64,000 visits from 170 countries and more than 365,000 downloads. As of June 2012, there were nearly 4,700 items deposited in the IR.

"The institutional repository is a wonderful asset to the research community," says Stan Smith, associate vice president for research. "Not only is it useful to our faculty, staff, and students, but it also expands the reach of UNLV research to a much broader audience."

For more information on Digital Scholarship@UNLV, contact Marianne Buehler, the Libraries' IR administrator, at marianne.buehler@unlv.edu.



Community health sciences professor Shawn Gerstenberger examines the effects of a variety of contaminants on environmental and human health.

Silver State Scholars

The Harry Reid Silver State Research Award honors the best of UNLV's faculty researchers.

Photography by R. Marsh Starks

UNLV faculty members Shawn Gerstenberger and Woosoon Yim recently received the university's most prestigious research honor, the Harry Reid Silver State Research Award.

The two faculty members join a small, elite group of UNLV professors who have won the annual award, which was created in 2001 as a tribute to the U.S. senator for his support of UNLV. The award, which recognizes research that is both highly regarded and responsive to the needs of the community and state, provides recipients with a $10,000 stipend funded with private donations from the UNLV Foundation.

Gerstenberger and Yim, who received the honor in 2011 and 2012 respectively, recently described the research that earned them this important distinction.

SHAWN GERSTENBERGER

PROFESSOR OF COMMUNITY HEALTH SCIENCES

BY SUZAN DIBELLA

Shawn Gerstenberger's path to the laboratory started in an unlikely place: the wilds of Wisconsin.

"Growing up, I always enjoyed fishing, hunting, and the outdoors," he says. "When I discovered in college that I could conduct research out there, I knew what direction my career would take."

Since then, Gerstenberger has transformed his love for the outdoors into a highly successful research career by focusing on the effects of various contaminants, specifically mercury, lead, and polychlorinated biphenyls (PCBs), on environmental and children's health.

But he hasn't stopped there; he has also envisioned and implemented a number of community outreach projects designed to eliminate or diminish the effects of these contaminants. In partnership with various agencies, he has helped improve the health of thousands of children and under-served individuals throughout Nevada.

His exceptional ability to translate his research into programs with impact recently netted Gerstenberger the 2012 Harry Reid Silver State Research Award.

"I'm flattered to receive this award," he says with a smile. "But it really belongs to my team. I work with such great people; it's really a case of everyone making me look good."

Gerstenberger's curriculum vita belies his modesty. He is credited with acquiring more than $10 million in extramural funding over the course of his career. He has authored more than 50 peer-reviewed publications and has served as thesis advisor for 65 graduate students.

And, if his research and community programs were not enough, Gerstenberger was also instrumental in the creation of the UNLV School of Public Health (recently renamed the School of Community Health Sciences) and the department of environmental and occupational health, of which he is chair. He was also integral to the formation of the first Ph.D. program (in public health) to be offered jointly by UNR and UNLV.

"Shawn has combined his research interests with a passion for translating his research into meaningful quality of life improvements for people in his community," says Mary Guinan, the director of UNLV's School of Community Health Sciences. "He exemplifies the kind of scientist for which this award was developed."

While appreciative of the award, Gerstenberger doesn't have the luxury of considering any accolade for long. He's too busy juggling activities associated with managing grants, community partnerships, and graduate students to stop and think about it.

His latest project is the Nevada Healthy Homes Partnership, a statewide effort to identify the home as a critical determinant of health, for which he recently received a $1.7 million grant from the Centers for Disease Control and Prevention.

"It started with research examining lead in homes; we tested hundreds of private residences, and all daycare facilities in Las Vegas built prior to 1978," he says. "We were trying to identify the presence of lead in paint, soil, and water and to assist the owners/managers with action plans to address these issues.

"As a follow up to this work, we recently acquired a 'healthy homes' grant that will allow us to address multiple home hazards while we are searching for lead-based paint. We've submitted four substantial grants to support this more recent effort."

The purpose of these grants, he says, is to develop strong community partnerships that connect health experts and housing professionals in order to leverage resources from the local community. They then work together to address pressing health issues that stem from peoples' homes, from asthma triggered by contaminants to trip-and-fall hazards.

Through the project, Gerstenberger and his team have established a National Healthy Homes Training Center at UNLV and have trained more than 100 community partners from over 35 different health and housing agencies.

"My biggest goal right now is to find the funding necessary to make this healthy homes initiative permanent," he says. "We have to find a way to integrate the activities into an agency or find a source of sustainable funding."

No one underestimates his chances of succeeding, given his record with follow-through; he has a long history of working with agencies and other organizations to implement practical, long-term change.

For example, in partnership with the Southern Nevada Health District (SNHD), he created a program that provides routine lead screening in children under the age of 6, distributes ethnically and culturally appropriate education and outreach designed to help prevent lead poisoning, completes testing for lead-based paint in homes, and conducts regular surveillance of poisoned children and contaminated homes and worksites.

"Before this screening program existed, there were less than 10 children a year screened for lead poisoning in Nevada," he says. "Last year over 20,000 children were screened through this program."

When he and his team identified the presence of lead in candies imported from Mexico, they acquired a grant from the Environmental Protection Agency to establish a national candy database and registry to identify the problem products. They also worked with the health district to remove tainted candies from some 2,000 local stores and to require major candy manufacturers and distributors to improve their testing and sampling protocols.

"The actions taken by the SNHD have been monumental, as this is the first location in the U.S. to institute a complete ban on the sale of imported candy containing lead, and it has set the standard that many other states are likely to follow," he notes.

Also based on his research, the Nevada Division of Wildlife Board has

banned the use of lead shot in all state wildlife areas.

"We conducted lead research in collaboration with our local wildlife managers and identified elevated concentration of lead in migratory waterfowl and soils in Nevada's Wildlife Management Areas," he says.

His work on mercury and PCB's in the environment has also influenced Native American fishing and regulatory practices in Nevada, and his research on the concentration of mercury in canned tuna has impacted practices in the commercial fishing and tuna fish food preparation industry.

He and his team are also examining mercury concentrations in wildlife from Lake Mead, including fish, migratory waterfowl, bullfrogs, and, most recently, the invasive quagga mussel.

"Research has always been, for me, the perfect way to connect my vocation to relevant issues and activities I'm extremely passionate about," he says, noting that his love of the outdoors still drives much of his research.

But he is quick to note that of all his research accomplishments, he is most gratified by his interactions with students.

"I have an army of graduate students working on these projects with me, and mentoring them is the best part of my job," he says. "Two of my doctoral students have been awarded the UNLV Outstanding Dissertation Award for their exceptional work, and I've authored peer-reviewed publications with 30 different students who actively participated in the experimental design, data collection and analysis, and write up of scholarly works. They know research from top to bottom, and I couldn't be more proud of them."

He says most of his time now is devoted to mentoring his students, guiding the research, and keeping the dollars flowing to the myriad projects that can help enhance quality of life in his community and beyond.

"Sometimes I feel like I'm spinning plates on sticks," he says with a smile. "But it's all good."

WOOSOON YIM

PROFESSOR OF MECHANICAL ENGINEERING

BY DAWN BARLOW-CURTIS

Woosoon Yim is at home exploring the world around him and probing the properties of materials.

But ask him about the source of his inspiration or how he first became interested in engineering, and that will take a little time. He'd rather talk about the future – and his research on robotic fish.

Robotic fish? Yes, he has developed an undulating, eel-like device, powered remotely, that has some surprising – and very useful – applications.

Yim, who won the 2011 Harry Reid Silver State Research Award, is exploring biomedical applications for his research. It was for this type of creative and innovative work that he received the campus's most prestigious research honor.

"I always wanted to receive the Silver State Research Award, but didn't think I could get it," says Yim, who hoped his National Science Foundation funding would help his case.

The long road to the Silver State Research Award began years ago when a colleague from another university introduced Yim to an electroactive polymer (EAP) that changes shape when electrically stimulated. Yim, who was fascinated with robotics, immediately saw an application for the polymer.

Electroactive polymers are a class of soft actuators that change shape when subjected to electrical stimulation. (An actuator is a type of motor for moving or controlling a mechanism or system.) Yim thought to employ the EAPs to develop small-scale robots that mimic the movement of swimming creatures.

The EAPs were a good fit for this application, as their smooth, wave-like motion recreates eel-like movement. Yim used the EAPs to create a robot that could be used to propel tiny vehicles through fluids.

Yim was awarded his first NSF grant in 2003 for this research; the second grant, awarded in 2007, helped him develop a microwave-based power supply for the EAPs to create a wireless link between the remote mobile units and a power source. This provided a continuous power supply to the robotic units, eliminating the need for the heavy battery and complex internal wiring typically needed for bio-inspired robots. It also makes the mobile units more adaptable, as they can use different types of locomotion in response to changing environments.

Yet, the novelty of a fish-like robot alone wasn't enough to hold Yim's interest. He recently began work on his third NSF grant, which involves developing a robotic catheter for medical uses; it will be designed to employ the EAPs as a source of movement through the fluid in lumen (tubular tissue, such as intestine or blood vessels) inside the human body.

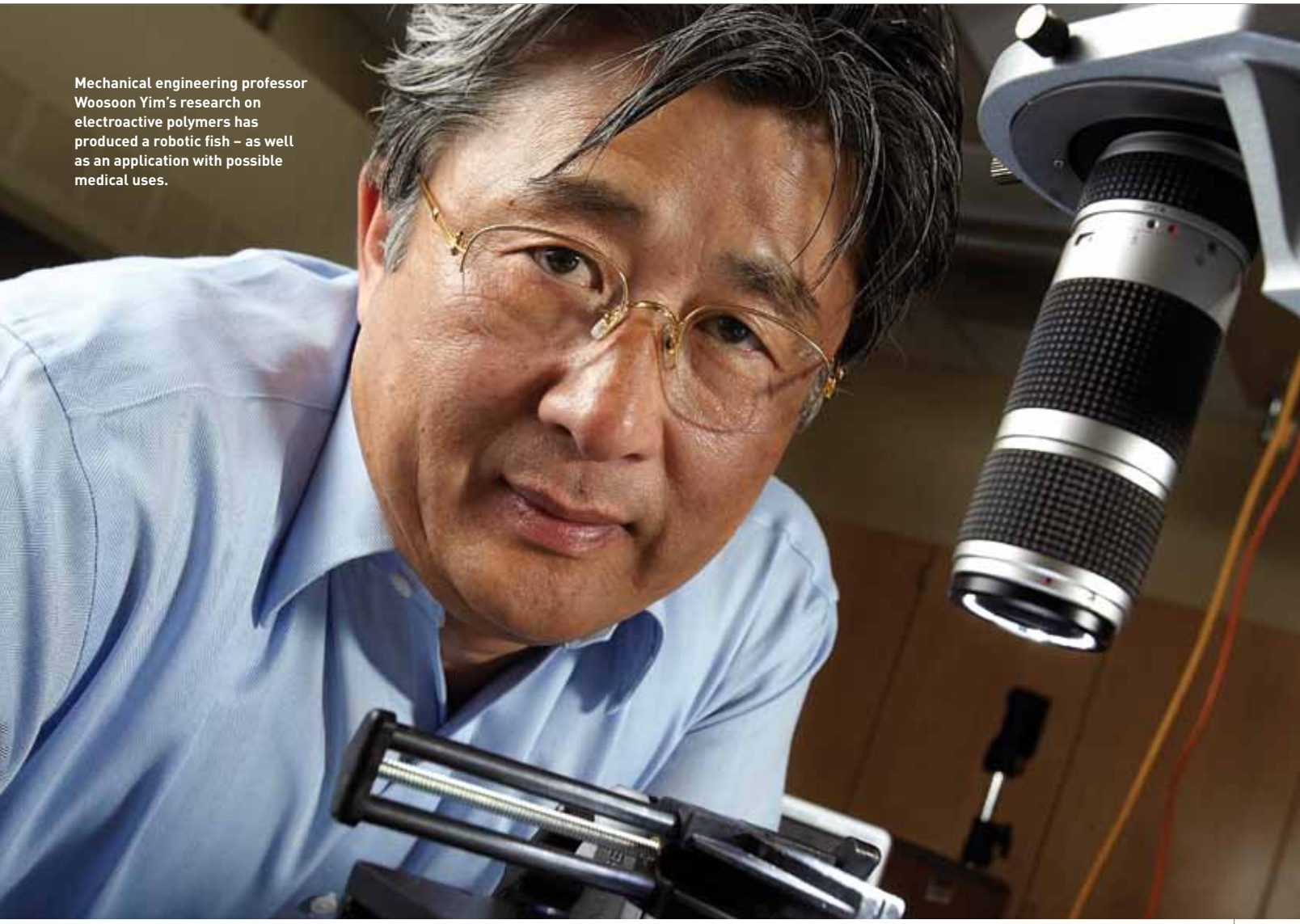
Catheters need a source of energy for their movement, and this EAP device would provide it. Because the catheter can sense human tissue, there is little risk of the robotic device puncturing lumen during catherization procedures through complex, small passages of the body.

Though the catheter idea is still in the conceptual stage, Yim and his team are seeking an application where it will work more effectively than a traditional catheter. They are currently working on the prototype, and then it must be tested. If it's successful, it may one day improve the efficiency and safety of catheterizations and could even spawn commercialization opportunities.

According to Mohamed Trabia, the associate dean of the engineering college, Yim's research has been instrumental in providing insight into the modeling and control of electroactive polymers.

"His work in this area elegantly combines abstract concepts and uses them to address many practical problems," Trabia says, noting that it has been cited by many of the leading researchers within and outside the U.S. in his field.

Yim's enthusiasm for robotics grows out of his belief that they will eventually come to play even more important roles in our lives than they already do; he sees them as freeing us from labori-



Mechanical engineering professor Woosoon Yim's research on electroactive polymers has produced a robotic fish – as well as an application with possible medical uses.

ous, repetitive activities so that human beings can spend more time developing their creativity.

Yim received his bachelor of science degree in mechanical engineering at Hanyang University, Seoul, Korea in 1981. Just after his undergraduate study, he went on to the University of Wisconsin-Madison for his master's degree and Ph.D. in mechanical engineering. It was his dissertation research, tracking moving objects in 3-D space, that sparked his interest in robotics.

After receiving his doctorate, he headed west and joined the UNLV faculty in 1987 as an assistant professor in the department of mechanical engineering.

"I figured I would get work experience before going back to Korea – and now it is 24 years later!" he says.

From the late 1980s through the early 1990s, his research involved a robotic arm with a flexible link. This arm, lightweight and elongated, was used for repair work outside the space shuttle.

"If you make the arm long, you make it flexible; also, there is less material in the arm," he says, adding that the drawback of a long, flexible arm is that it's subject to shaking. His research involved mitigating the shaking and vibration of this flexible arm to obtain better performance.

In addition to receiving the Silver State Award this past year, Yim became a Fellow of the American Society of Mechanical Engineers (ASME) in 2010; he received the Eminent Engineer Award in 2009 from Tau Beta Pi, the Engineering Honor Society. At UNLV, he was honored with the Outstanding Faculty Award in the department of mechanical engineering in 2005 and the department's Teacher of the Year award in 2000.

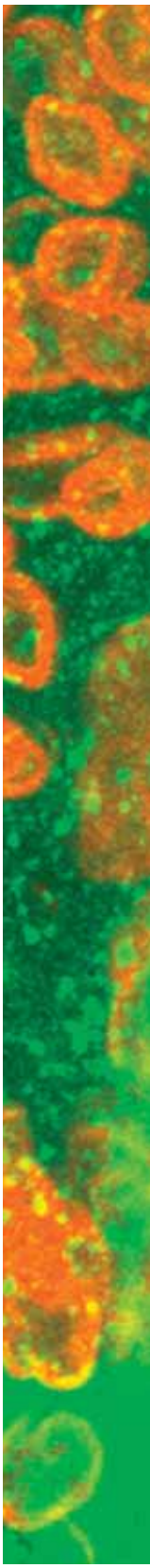
This coming year Yim, who also serves as chair of his department, will continue his work on the NSF grant; his team is already planning their proposal for the next phase of development. He is grateful for the opportunity his grants have provided him.

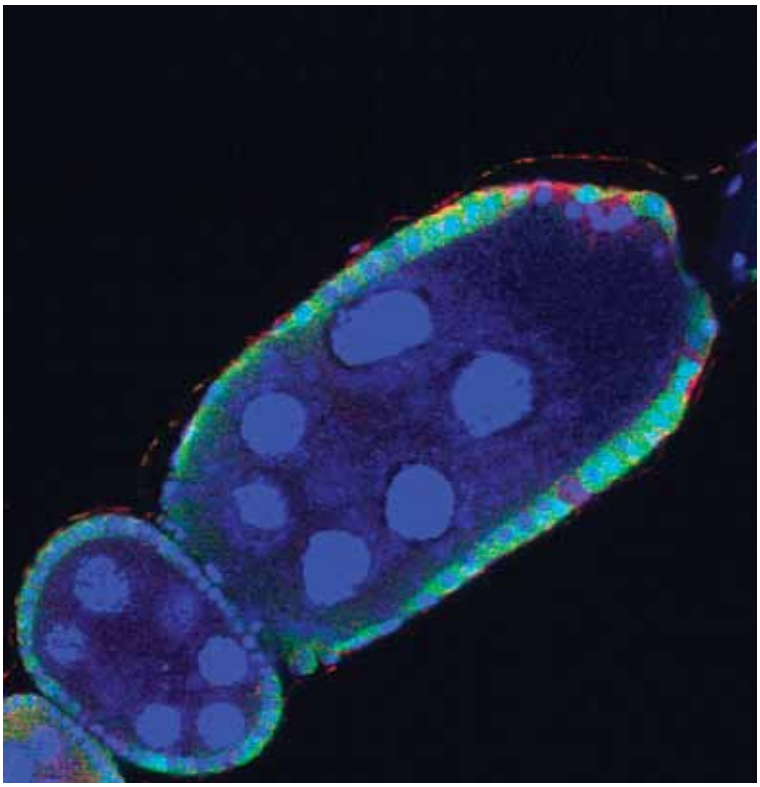
"These monies allow faculty the time and space needed to experiment and to imagine," he says, noting that his research wouldn't have happened without time for imagination.

Julie Longo contributed to this article.

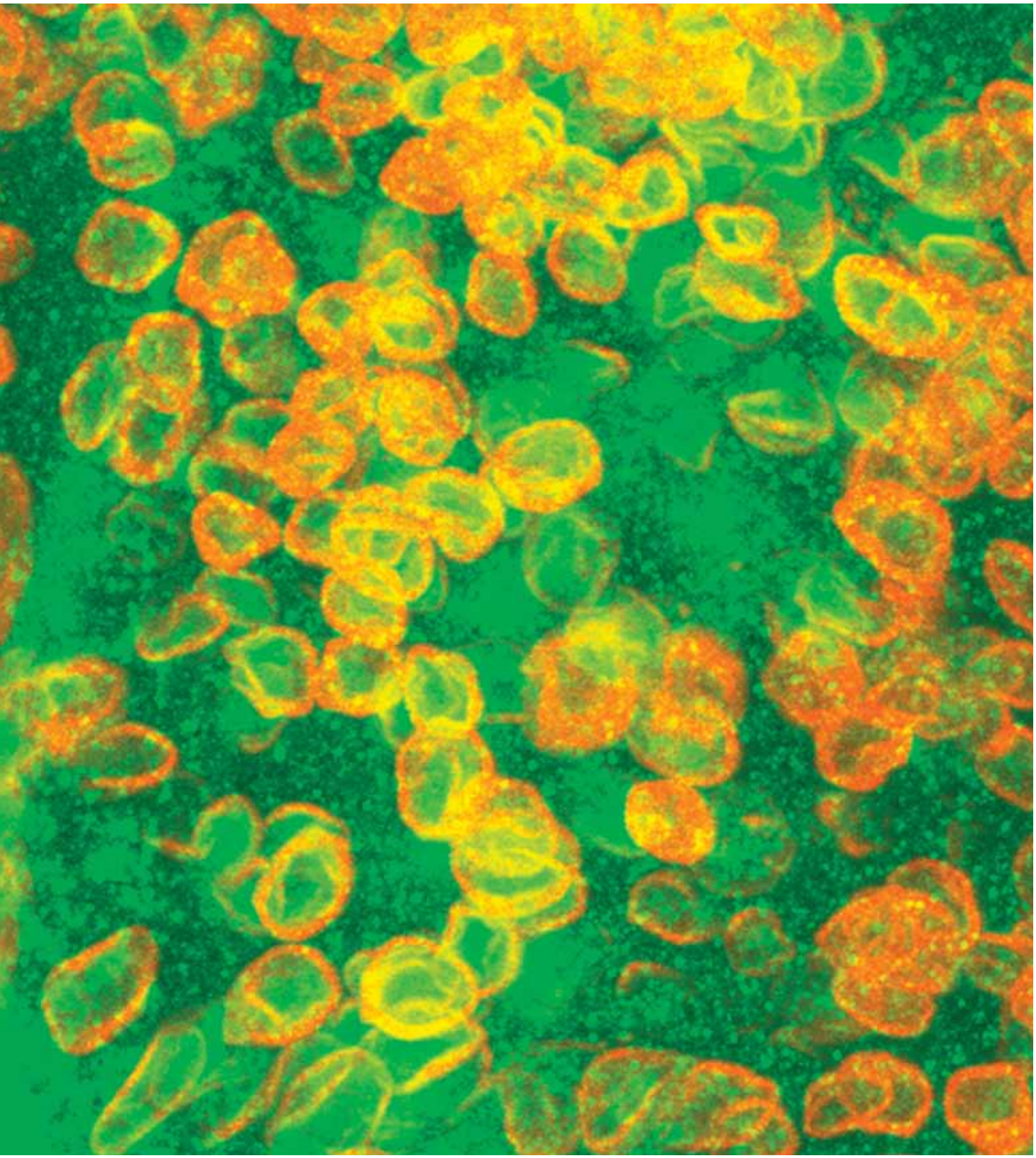
BEAUTIFUL SCIENCE

The path to discovery can be painstaking, complex, and ... aesthetically beautiful. In the following pages, UNLV scientists provide some of the most striking images they've examined as part of their research. Learn how these fascinating photos were captured and what they represent.



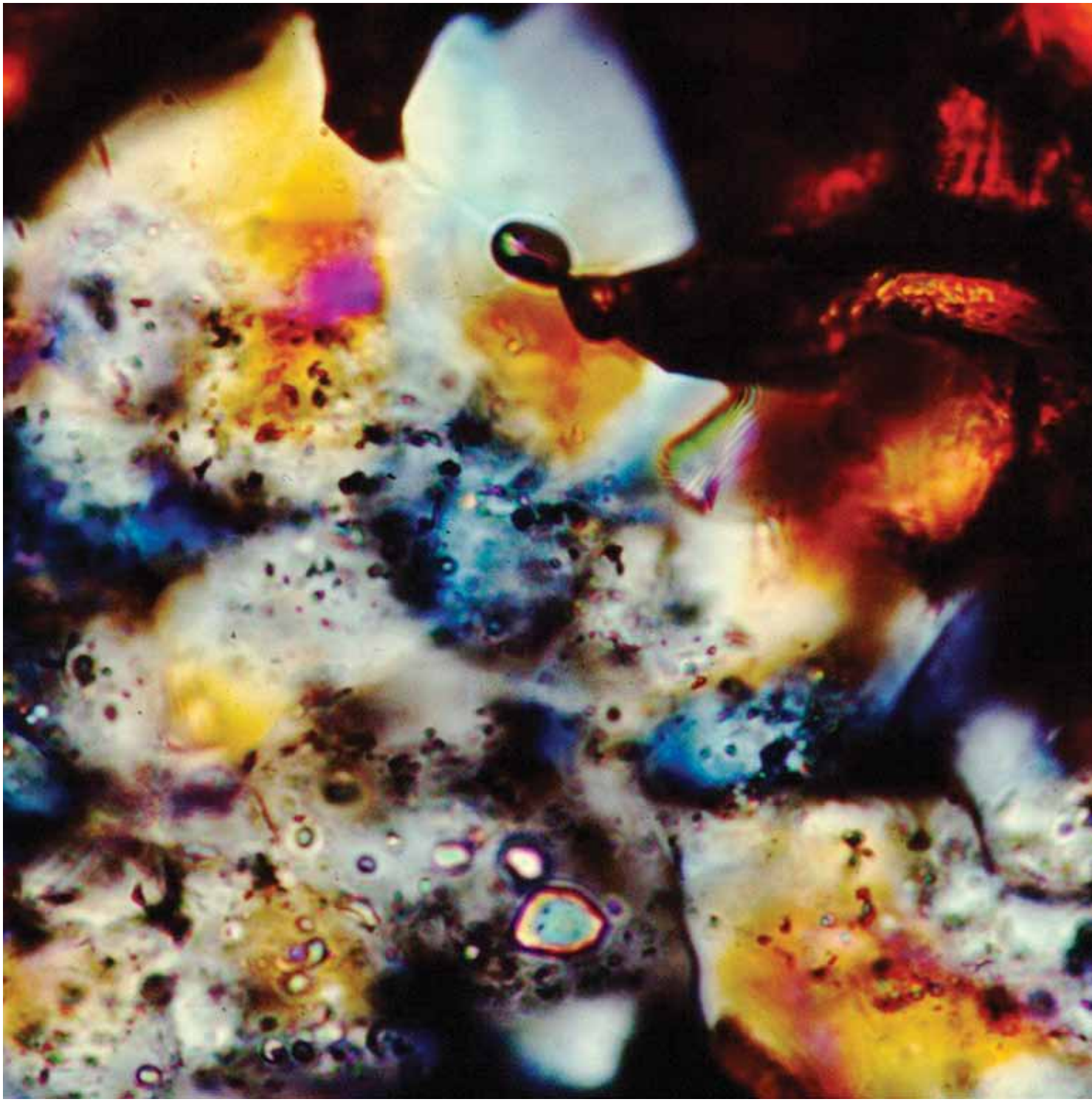


UNLV life sciences professor Laurel Raftery and her former post-doctoral researcher Xiaodong Wu captured this image, magnified 40x with a confocal microscope. It is a portion of a fruit fly ovary that shows developing follicles that will each make a fruitfly egg. The blue dye detects DNA; the big round blue blobs are nuclei of cells that are making RNA and protein to transfer to the egg, which is mostly unstained. The green and blue regions are the cells that will make the eggshell. There are gaps in the green (blue and red cells) that are mutant cells, which are missing a protein called BunA, which regulates gene expression; the cells that are missing BunA are disorganized and have invaded into the area that contains the developing egg. Raftery's team's data suggests that BunA is involved in keeping cells from becoming invasive cancer cells.



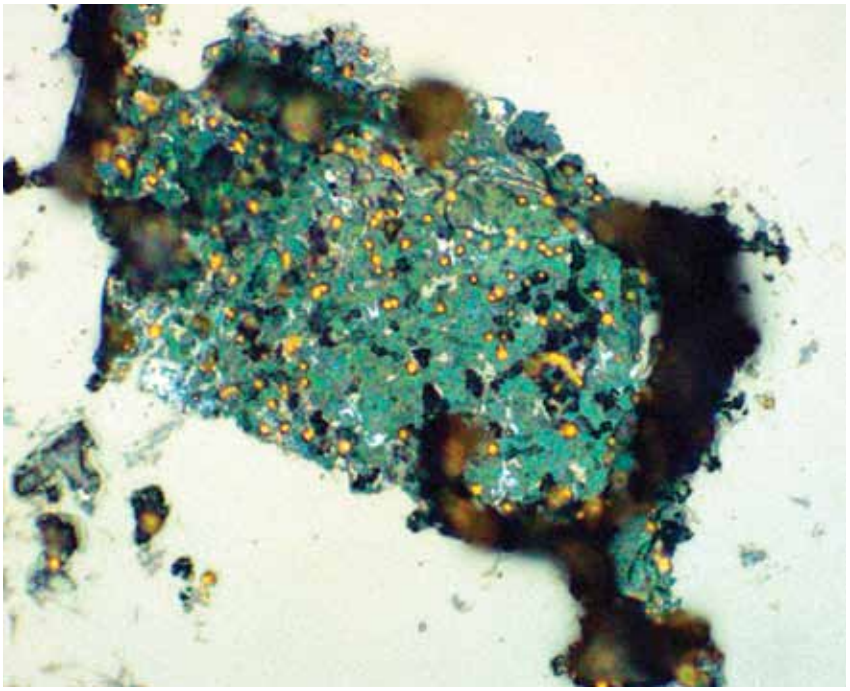
Wing cells that are developing inside a fruitfly larva are stained green to detect the locations of a protein that regulates gene expression relative to the nuclei of the cells, which are outlined in orange. The goal of the research is to understand how cells communicate with each other to coordinate growth and tissue organization. The image was taken with a confocal microscope at a magnification of 40x by UNLV life science professor Laurel Raftery and her former post-doctoral fellow Jing Cao.

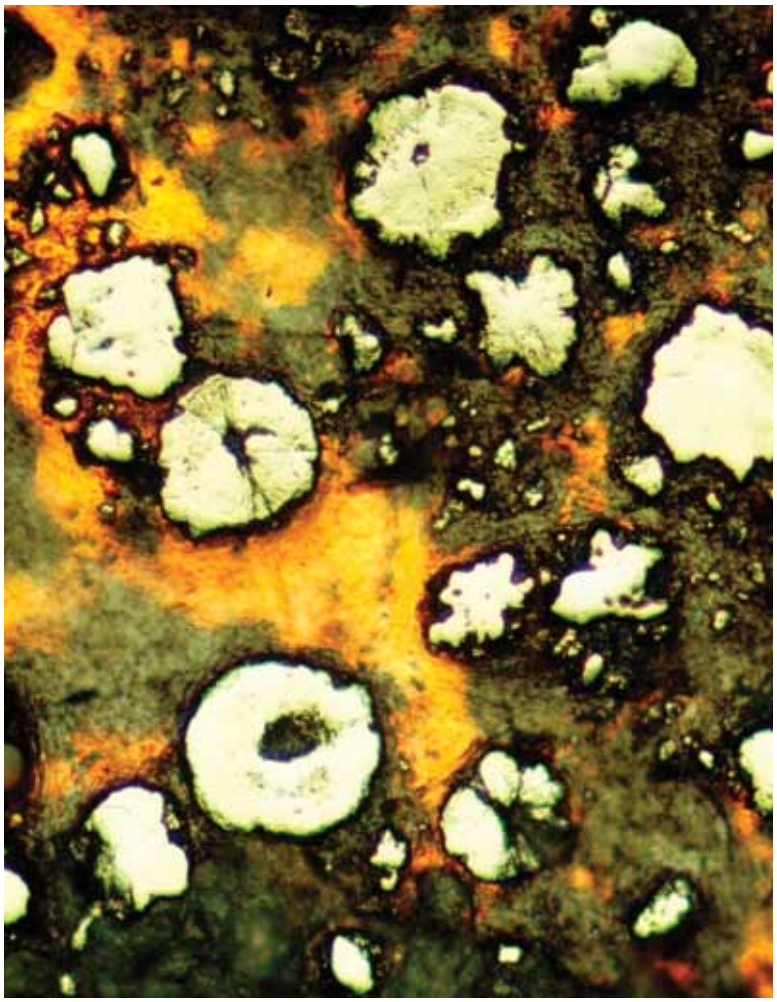
Note: The original images have been enlarged further for publication.



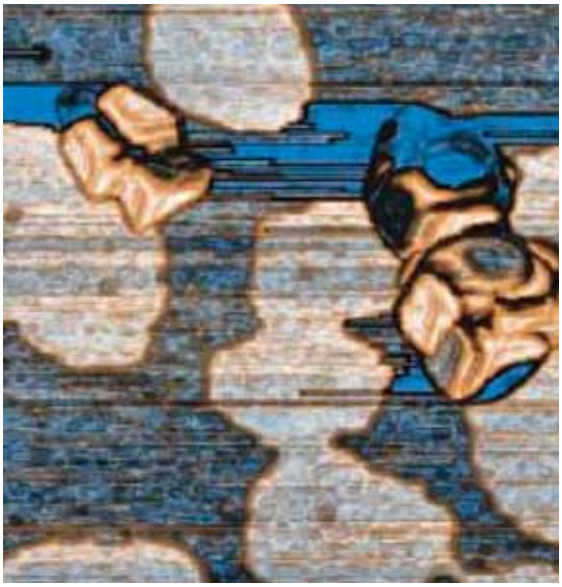
Taken by geoscience professor Jean Cline, this is an image of a thin slice of gold ore that has been magnified 400x with a petrographic microscope. The sample came from the northern Nevada Carlin-type gold deposits, which have been studied extensively by Cline and her team; they are seeking to understand the sequence of the formation of minerals in the ore. The white, blue, yellow, and pink are jasperoid quartz, and the red is realgar.

This image, taken by chemistry professor David Hatchett, shows the size and dispersion of gold particles in a composite material that he created from polymer (plastic) and gold. This material is designed to improve chemical sensors; the plastic provides a larger surface area to increase the sensitivity of the sensor and the gold enhances the sensor's ability to detect specific substances. Hatchett's research focuses on interfacing the two different materials to obtain a single, synergistic material. The original image, obtained with an optical microscope, was magnified 100 times.

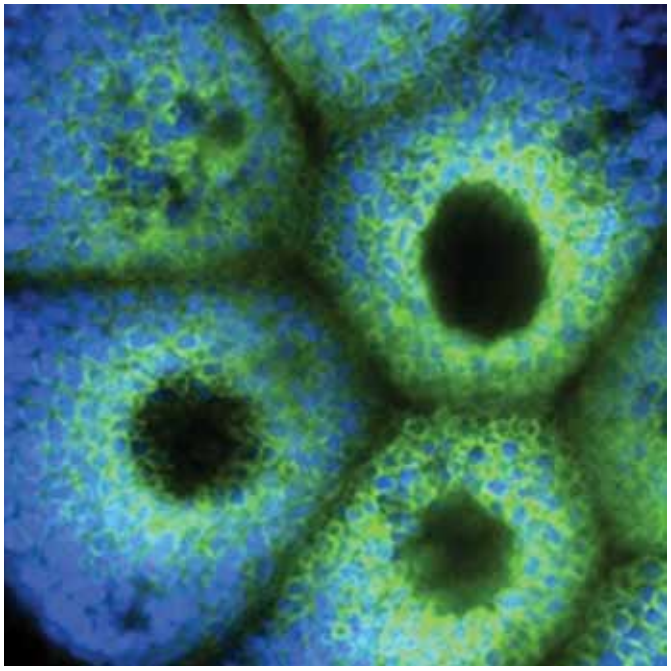




This photograph is of a different sample of gold ore taken from a Nevada Carlin-type gold deposit, and it was also magnified 400x with a petrographic microscope. The gold color in the photo is a mix of the minerals realgar and orpiment, which contain both arsenic and sulfur. The donut-shaped white crystals are the mineral pyrite; the smallest of them contain gold. Through examination of these types of samples, Cline and her team have been able to devise a model to help exploration geologists search for similar deposits around the world.



This image depicts carbon nanostructures that were extracted from soot condensed on a kitchen ceiling. The soot, which is a product of burning biomass materials, was examined as part of ongoing research on carbon nanomaterials in various natural and artificial environments. The original image shows an area on the surface of the sample that is 2,000 nanometers wide. (A sheet of paper is about 100,000 nanometers thick.) Captured with atomic force microscopy, the image was taken by Ich Tran, a postdoctoral researcher in the laboratory of UNLV chemistry professor Clemens Heske.



This image shows a grouping of three prominent salivary gland cells from a fruitfly larva that have different subcellular compartments labeled with fluorescent proteins. Green indicates the membranes surrounding secretory granules containing a glycoprotein cargo protein (blue). These types of images help UNLV researchers better understand how steroid hormones generally trigger tissue-specific responses in animal cells. Fruitfly cells are used because, at the molecular level, they respond to steroids much in the way human cells respond to estrogens and androgens. Ph.D. student Elana Paladino took the photograph with a laser-scanning confocal microscope at 630x magnification.

This photograph of a two-millimeter fluorite crystal was taken with an optical microscope from a thin section of igneous rock. Through examination of this sample and others like it, Minghua Ren, an assistant research professor in geoscience, seeks to understand the relationship between the colors observed and the conditions under which crystals were formed. Fluorite manifests many colors, such as the purple, blue, green, and white. The bands of black to light purple in this sample indicate a variation in trace amounts of manganese, iron, and magnesium. Ren, who captured this image, seeks to better understand how silicic igneous rocks evolved, what conditions contributed to their formation, and what tectonic locations produced these conditions.

Life sciences professor Brian Hedlund studies how life forms thrive in simmering hot springs in Nevada and beyond.

A Career Achievement

Meet several UNLV recipients of the National Science Foundation's prestigious CAREER Award, the highly competitive grant designed to establish leadership in education and research.

Story by Suzan DiBella

The research topics couldn't be more diverse: boiling hot springs, organic semiconductors, face recognition, hibernation ... and the list goes on.

The subjects may vary, but the projects all share one common attribute: They are being conducted by prominent UNLV faculty who are funded through the National Science Foundation's CAREER Awards.

These prestigious awards are presented nationwide to junior faculty who "exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations," according to the NSF website.

A highly competitive grant award designed to establish a "lifetime of leadership in integrating education and research," the CAREER Award is considered a clear indication of achievement. A number of UNLV faculty have received this prestigious award through the years; here are the stories of just a few of the recent recipients.

Brian Hedlund Life Sciences

Boiling and near-boiling hot springs in northern Nevada – or, more specifically, the tiny creatures that thrive within them – are the focus of Brian Hedlund's NSF CAREER Award project.

Hedlund is especially interested in determining how creatures in the hot springs can exist at temperatures above the upper temperature limit of photosynthesis – 163° Fahrenheit (73°C). They don't rely on photosynthesis as a source of energy, as do virtually all creatures on Earth. Most organisms survive through photosynthesis either directly, as plants do, or indirectly, as animals do by ingesting plants.

In the absence of photosynthesis, some microorganisms, such as those in the hot springs, obtain energy by metabolizing chemical compounds humans consider foreign or toxic. For example, many microorganisms can eat chemical compounds such as hydrogen gas, hydrogen sulfide, carbon monoxide, or certain forms of metals, such as arsenic. In turn, they can "breathe" chemical compounds other than oxygen, such as salts like nitrate and sulfate, or gases such as carbon dioxide and nitrous oxide. These are the unusual organisms Hedlund studies in northern Nevada hot springs.

What is the impact of this research?

Not only does Hedlund's research tell us about these creatures, but it also expands knowledge of the diversity of life on Earth and strengthens understanding of the fundamentals of life.

It also may lead to important medical discoveries. Hedlund is working closely with private-sector partners to explore the possibilities.

"My closest partner is Lucigen Corp., a mid-sized company in suburban Madison, Wisconsin. We work together on a variety of projects, and I'm very optimistic that our research will lead to important products."

For example, Lucigen discovered an enzyme from a hot spring virus from Yellowstone National Park that may reduce the cost and increase the speed of diagnosis of certain viral diseases, such as flu, hepatitis, and AIDS. "There are some imperfections with that enzyme, so I'm helping them search for similar enzymes that might work better," Hedlund says. "We recently discovered many candidates in some hot springs in Nevada, and they are now being screened."

Another tangible impact: Hedlund has brought in more than $6 million in grant funding since he arrived at UNLV, mostly from NSF, NASA, and the Department of Energy. His largest project is the Tengchong Partnerships for International Research and Education (PIRE) project, which is a $3.75 million grant from NSF. The Tengchong PIRE project funds a team of researchers at eight U.S. universities and six partner institutions in China. (The Chinese institutions are funded by their own government, so the actual amount of funding is significantly more than $3.75 million.) This five-year project involves study of the microbiology of the largest geothermal field in China.

"We hope to integrate what we learn with what we know about U.S. hot springs to develop a more universal understanding of life at high temperatures," he says.

How did he become interested in this area of study?

"I've been interested in science since I was a child," Hedlund says. "In fact, my parents claim my first word was 'outside.' According to them, I used to stand at the back door and beg my parents to go outside so I could play with insects."

His interest grew through the years and inspired him to become a biology major. "What I learned in microbiology class about the diversity, abundance, and importance of microorganisms blew my mind and dramatically restructured my understanding of life," he says. "I continue to be humbled by the microbial world, and I feel very lucky that I get paid to study microbiology and to teach UNLV students what I learn."

How are students involved?

Hedlund has had approximately 30 undergraduates, several graduate students, and two postdoctoral fellows participate in his NSF CAREER Award project over the years. "It's hard to express how thankful I am to have worked with so many talented and dedicated people," he says. "These people have been incredibly productive. For example, more than 75 percent of the undergraduates have applied successfully for their own research fellowships and almost all have presented their research in at least one scientific meeting. More than 25 percent of the undergraduates have published research papers with me in peer-reviewed journals. A few superstar undergraduates have published several papers."

What other areas does he study?

"Virtually all of my research focuses on some aspect of hot spring microbiology," Hedlund says. "I'm very interested in how high temperature affects ecology, but the lab is also making great progress on the study of major new groups of bacteria and archaea that are completely new to science. About 50 percent of the microorganisms in the Great Boiling Spring, which is a major study site near Gerlach, Nevada, represent a phylum or class that has never been studied in the laboratory. These microorganisms are so different from anything known that we've started to use the term 'biological dark matter' to describe them."

How does he feel about receiving the NSF CAREER Award?

"The CAREER Award is a great honor," Hedlund says. "I feel very lucky to have received the award, and I'm extremely thankful to those who have supported me and my work over the years, particularly my lab team, my colleagues, and my family. I feel a strong sense of duty to make NSF's investment worthwhile. I try to do research that significantly impacts our understanding of life, and I work hard to contribute to our economy and inspire young people to live productive and exciting lives."

AARON MAYES

Psychology professor Jennifer Rennels explores what infants, such as one of her young subjects seen here, experience when looking at human faces.

Jennifer Rennels Psychology

Everyone loves to look at babies. But what do babies think when they look back at us? Jennifer Rennels hopes to find out through her CAREER Award research.

She examines how infants experience seeing faces and how this affects their preferences for different people.

Though it's challenging to know what babies are thinking, Rennels and her team gauge infant interest by determining what faces they tend to look at on a computer screen.

"In visual preference studies, we show infants' two novel faces that differ on one aspect – for example, gender – but are similar in all other aspects, such as emotional expression, age, race, attractiveness, or brightness/contrast," she says. "If they look longer at one face relative to the other, it demonstrates a visual preference for that face."

She notes the team can glean a surprising amount of information from their little subjects, including their ability to scan and categorize faces, as well as to recognize and prefer certain faces.

"Most people are surprised to learn that infants differ in their behavioral responses to individuals based on such facial cues," she says. "Person perception emerges very early in development and is heavily influenced by infants' experience with faces."

What is the impact of this research?

Understanding face perception and the stereotypes associated with facial cues is integral to understanding the social interactions people experience every day, Rennels says. Studying this process in infants provides insights into how and why stereotypes develop.

Within a very short period of time, individuals can assess a person's sex, race, age, attractiveness, dominance, and emotion, Rennels notes, adding that this assessment influences how individuals respond to, treat, and judge others.

Given the growing diversity of the American population, Rennels says, it is essential for people to understand factors influencing judgments and reactions to individuals based on group membership. Such information is critical in terms of raising awareness about diverse groups and ensuring that our communities are socially sustainable.

"Categorizing people is necessary before an individual can form stereotypes," she says. "Infants' facial recognition abilities and visual preferences for faces are related to face categorization skills. Understanding some of these precursors to stereotype development can therefore provide information about how and why stereotypes develop," Rennels says.

"Given the deleterious effects of many stereotypes, it is my hope the research findings can be used to raise awareness about these stereotypes and perhaps be applied to help reduce the negative outcomes of stereotyping."

Rennels has received more than $560,000 total in grant funding. Prior to receiving the NSF CAREER grant, she was funded by the National Institute of Child Health and Human Development. She also received two internal grants at UNLV, the New Investigator Award, and a College of Liberal Arts Center for Advanced Research Award.

How did she become interested in this area of study?

"When I was a graduate student, my mentor was investigating if infants could recognize an 'averaged' face, which is a mathematical average of faces, after being familiarized to several female or male faces," Rennels says. "With female faces, we found they could recognize the average, but despite numerous changes in methodology, we found no evidence that infants could recognize an average of male faces. These results suggest that infants were able to form a summary representation of female faces, but not male faces. I became very interested in exploring reasons for this; one very likely contributing factor is a real-world discrepancy in infant experience with female and male faces."

How are students involved?

This research and her other projects have provided scientific training opportunities for more than 100 undergraduate students since the project started.

"The nature of the research attracts diverse students to work in my lab," she says. "My graduate students and I have a strong commitment to providing a research environment in which all students feel valued and subsequently can benefit from their training."

Currently, six graduate students and 11 undergraduate students work in her lab. "Right now, we are collecting data for approximately 23 different research projects, so my students have a lot to juggle," she says, adding that they are very hard-working, dedicated to the lab, thoughtful about the projects, and eager to learn. "These research projects have provided each of my graduate students opportunities to 'honcho' projects, which means they assist with study design and setup, oversee undergraduate student training and data collection, conduct data analyses, and serve as authors on any presentations or published manuscripts resulting from the research. My graduate students are therefore gaining critical skills in managing a research project from beginning to end."

What other areas does she study?

"All my research is related to understanding face perception and/or stereotypes," Rennels says. With her graduate students, she conducts research on several areas: 1) factors that affect children's recognition of others' emotions and how emotion recognition affects children's decision-making in social situations; 2) how changes in self development affect children's face processing; 3) development of racial stereotypes and the most appropriate measures for tapping into children's concepts about race; 4) ways to reduce racial stereotypes in adults; 5) the relationship between facial appearance, personal attributes, and physical and mental health in adults and children; and 6) the relationship between a person's attractiveness and emotional expressivity and how and if it develops.

How does she feel about receiving the NSF CAREER Award?

"I was honored and excited to receive the award," Rennels says. "It has played a substantial role in my professional growth, my students' training, and our ability to conduct quality research."

R. MARSH STARKS

Dong-Chan Lee Chemistry

Dong-Chan Lee is a patient man. He has to be. He works at the molecular level.

Yes, he can envision his research someday leading to useful applications in electronics or renewable energy. But other scientists and engineers will be the ones to test and perhaps employ his research to develop these products.

Meanwhile, he is delighted to be in his lab, conducting research on the molecular building blocks that may one day enhance these applications.

Lee is conducting fundamental research on new ways of improving the properties of organic semiconductors. Semiconductors are used as key components in all electronics equipment – everything from radios to computers to digital displays.

Commercial semiconductors are typically made of inorganic material, primarily silicon, which has limitations in shape and flexibility. Organic semiconductors, on the other hand, are more flexible, lightweight, and easier to process than those made of silicon, and their properties can be easily tuned through synthetic chemistry.

For these reasons, organic semiconductors, which are typically carbon-based, are now being used to develop novel products, such as bendable TV screens and solar panels. However, there are still some challenges to address with organic semiconductors, primarily "charge transport," or the movement of electrons. Scientists are still grappling with this issue, as it limits the performance of organic semiconductor-based devices.

Lee is one of the scientists studying this area. His research focuses on improving the properties of organic semiconductors using a bottom-up approach starting at the molecular level. His work involves programming carbon-based molecules in a way that enables them to self-assemble into nanofibers that make better material for the creation of organic semiconductors.

What is the impact of this research?

Lee is establishing the concept for his research and has authored scholarly articles in several prestigious journals on the subject. He will soon collaborate with other scientists who will test the efficiency of devices based on his nanofibers; this will, in essence, assess the applicability of his concept and begin to indicate its value. If these nanofibers do facilitate charge transport more effectively than other materials, as he has postulated, they may be used in a whole host of applications, such as improved solar cells, organic LEDs, and transistors. While he acknowledges it is a long way off, if his concept is confirmed, it could make a significant contribution to the field of electronics.

Lee also seeks to expand the impact of his research through outreach into the high schools. Through his summer research programs, students from Basic High School have already participated in the NSF research project for two years. "This program has received positive feedback from both the students and the teacher," Lee says, noting that he hopes the program promotes interest in science among the students.

Lee has also received more than $850,000 in grant funding, including an internal seed grant designed to facilitate external grant acquisition.

How did he become interested in this area of study?

"Previously, I worked in two different areas that I connected for the current research: developing new organic semiconductors and self-assembly of organic molecules," he says. "After seeing the limitations of organic semiconductor research, I had a novel thought: Why not try programming organic molecules so that they self-assemble? This would create nanofibers that facilitate charge transport and could be used to improve the material for organic semiconductor-based devices."

How are students involved?

In addition to his summer research program for high school students, Lee has worked closely with more than a dozen UNLV students in his laboratory.

"I provide research opportunities to undergraduate students to enable them to experience cutting-edge science," he says. "I also provide mentoring and training to graduate students so that they can learn problem-solving techniques through research."

Research opportunities equip all students with analytical skills necessary for their future careers, Lee notes.

He also incorporates his research into his classroom instruction so that students can see how organic chemistry can be applied to create something useful in daily life. "This helps to motivate students and keeps them up-to-date on the real-life application of organic chemistry."

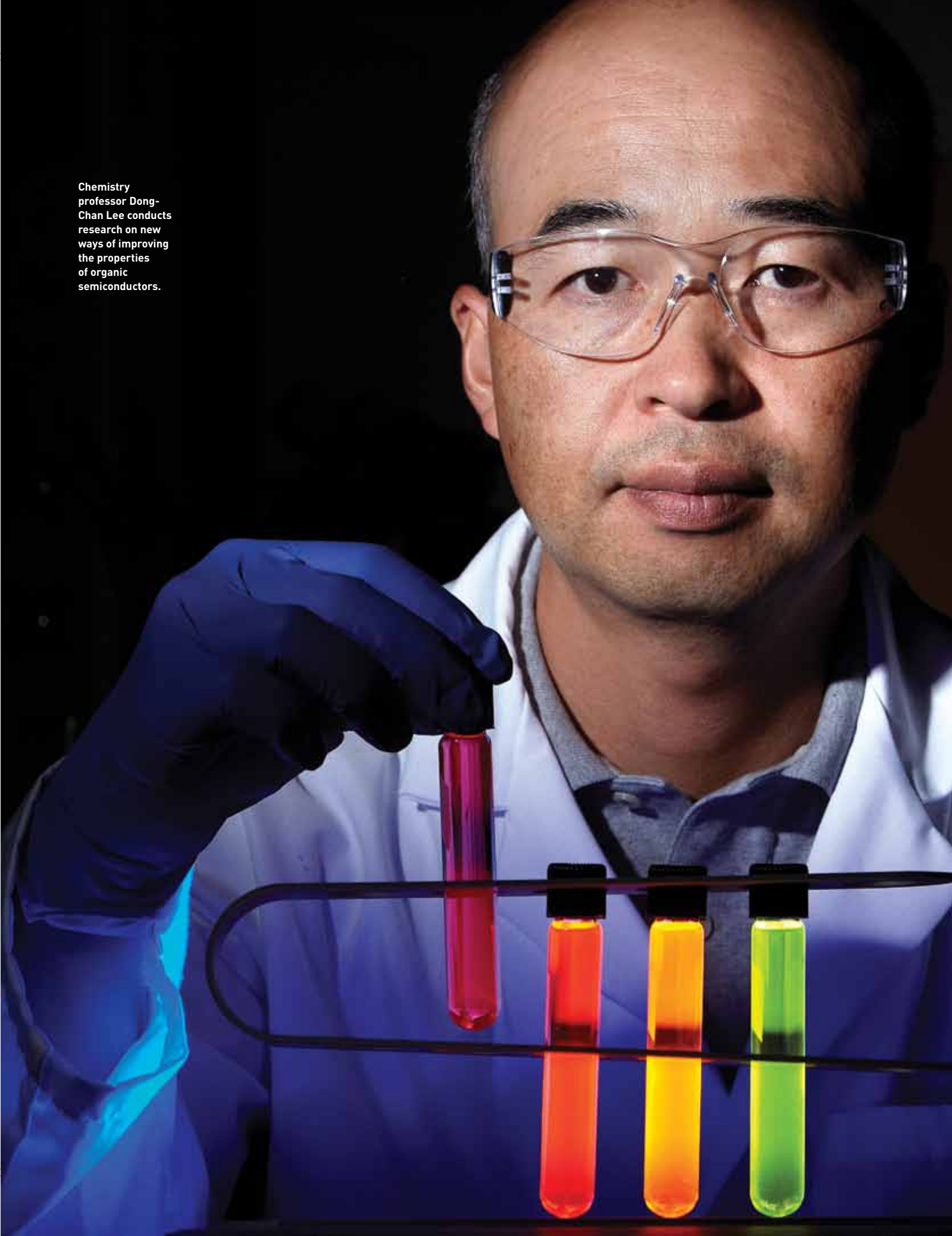
What other areas does he study?

"Resources are limited, and I am deeply involved in my current area of research," he says. "But I'm considering the notion of applying this concept to other types of electronic devices, such as sensors."

How does he feel about receiving the NSF CAREER Award?

"Lucky," he says with a smile, noting that he had heard it was important to speak with an NSF program officer before submitting his proposal, but he didn't have time to do so. He had also heard that it was rare to receive the CAREER Award on the first try. But he threw his hat in the ring along with scientists from some of the most prestigious institutions in the U.S. and received the award in 2009. He says he doubted himself at times as he was applying, but he was very grateful to see how fair the process was and to learn that his idea was validated. Since then, the NSF has asked him to become a reviewer for other NSF awards.

R. MARSH STARKS



Chemistry professor Dong-Chan Lee conducts research on new ways of improving the properties of organic semiconductors.

Frank van Breukelen Life Sciences

Frank van Breukelen's CAREER Award has enabled him to study protein metabolism in hibernating animals, which has some fascinating medical implications for humans.

During hibernation, animals' core body temperatures can fall below the freezing point of water, and their heart rate can be as low as two to three erratic beats per minute. Many fundamental processes are affected, including the ability to make and degrade proteins. "We've made significant strides in understanding how these processes are regulated and the consequences of this regulation," says van Breukelen.

Combining research and education was also an important part of his CAREER Award project. He and his team created a television show called "Desert Survivors" as a part of the project; the show focused on increasing scientific literacy in 5th graders.

What is the impact of this research?

"The medical implications of the study of hibernation are immense," van Breukelen says. "The physiological consequences associated with hibernation provide a natural model for the study of the effects of reduced blood flow similar to that seen during stroke or cardiac arrest, the loss of muscle and bone tissue during bed rest or limb immobilization, accidental hypothermia, organ transplant therapy, obesity, and kidney failure."

He believes that processes like extra-corporeal rewarming of blood during treatment of severe hypothermia might have been adopted sooner had the medical community sought lessons from the hibernator. "Hibernators shunt blood from the periphery as they arouse from hibernation. Only after significant rewarming has occurred does the peripheral circulation become re-established. Essentially hibernators do what extra-corporeal rewarming sets out to do."

He has received well over $1 million in federal funding as a principal investigator, and he was an integral team member on other projects that have garnered more than $17 million in federal funding.

How did he become interested in this area of study?

"As an undergraduate, I worked with a mentor who focused on what allowed hibernators to resist the muscle disuse atrophy normally associated with prolonged periods of inactivity," van Breukelen says, noting that he was intrigued by the larger notion of hibernation.

"At a biochemical and cellular level, virtually every process must be impaired in hibernation," he says. "This idea fascinated me, and I set out to acquire the skills to allow me to address the question of, 'How do animals even hibernate?'"

How are students are involved?

A large number of both undergraduate and graduate students work on van Breukelen's projects. "One of the graduate students, Peipei Pan, recently graduated and has five scholarly publications. Another undergraduate student, David Cotter, did excellent work and is currently an M.D./Ph.D. student at the top-ranked program in the country. All told, dozens of students have gone through the lab, and many have gone on to medical school or prestigious graduate programs."

What other areas does he study?

"My laboratory has a large number of current and completed projects," he says. "Fundamental to virtually all of them is a desire to integrate evolutionary perspectives into mechanisms that allow animals to survive in what we deem to be harsh environments."

Current projects include such diverse topics as protein degradation in freeze-tolerant frogs; gene expression in denning grizzly bears; the design and construction of a direct heat calorimeter to better assess the energy status of animals; and an "enormous collaborative project" on understanding the mechanisms of adaptation in a group of endangered fishes.

How does he feel about receiving the NSF CAREER Award?

"I feel lucky and grateful," van Breukelen says. "The funding success at NSF is extremely low, and the climate is exceptionally competitive. The CAREER Award is even more competitive. Receiving the CAREER Award is an affirmation from peers in the research community that one's research deserves support and recognition. With that support comes an immense feeling of responsibility to use the money effectively."

R. MARSH STARKS

Life sciences professor Frank van Breukelen's research on hibernation provides insights into a variety of human medical conditions, including accidental hypothermia, organ transplant, and kidney failure.

Civil and environmental engineering professor Sajjad Ahmad conducts research on how the flow of water in certain geographical areas is impacted by environmental and human factors.

Sajjad Ahmad
Civil & Environmental Engineering

Sajjad Ahmad's research brings a whole new meaning to the term "flow chart."

The civil and environmental engineering professor conducts research on how the flow of water into certain geographical areas, particularly the Colorado River Basin, is affected by various environmental and human factors.

As part of this research, he produces complex charts and diagrams depicting water infrastructure and then introduces variables to see how they will impact water resources. The variables that he analyzes include climate change, land use, population growth, and energy needs, among others.

"The major contribution of this research is a new theoretical framework, based on a systems approach," Ahmad says. "The goal is sustainable management of water resources that will reduce the vulnerability of water infrastructure to climate variability and change."

He is developing what he calls a "decision support framework" that will be used to evaluate the vulnerability of infrastructure to climate change. Water systems as well as flood control systems will be evaluated. He will also analyze different short- and long-term policies for sustainable management of water resources.

What is the impact of this research?

The theoretical contributions of his work, including the new approaches and modeling tools, will be useful for other researchers in arid regions around the world, he says.

"But locally, the results of the research and the policy recommendations will be useful primarily to water management agencies, such as the Southern Nevada Water Authority and the U.S. Bureau of Reclamation," he says.

His decision support framework will be used to explore important questions in Southern Nevada, including:

- What are the major short- (by 2020) and long-term (by 2035) changes expected in population growth, land use, energy and water demand, and water availability?
- How vulnerable is water infrastructure to climate variability and change?
- What are the most promising, sustainable, and cost-effective policies for water management in response to growth and climate change?

Ahmad has received approximately $1.4 million in grant funding for this research from both the NSF and the National Oceanic and Atmospheric Administration.

How did he become interested in this area of study?

"Floods were one of the frequent natural disasters when I was growing-up in Pakistan," Ahmad says. "I always wondered if something could be done to reduce the damage that they caused.

"Later, as an undergraduate major in civil engineering, I had the opportunity to visit several large dams that were developed to meet flood control, irrigation, and hydroelectric power needs," he adds. "This was the turning point in my life when I decided to do my graduate training in the area of water resources planning and management."

As time went on, Ahmad also developed a larger concern for the environment that still guides his interest today.

"Considering the population growth in the Las Vegas Valley and the limited water supply from the Colorado River," he says, "sustainable water management is a challenge for Southern Nevada, especially in the presence of climate variability and change. With my background in water resources planning and management, working to address this challenge is a natural fit for me."

How are students involved?

Though Ahmad's grant is fairly new, four graduate students have already been fully or partly funded through the grant, and two master's-level students have completed their degrees. Once the project reaches a certain stage, undergraduate students will also be involved. In the final year of the grant, the team will even include several high school students.

What other areas does he study?

"I study stream flow forecasting with long lead times – greater than one year," Ahmad says. "I'm also interested in the water-energy nexus. Our group is studying energy use in water and wastewater treatment plants and energy use in water distribution systems. We are also studying water conservation in semi-arid regions through desert landscaping, water-smart appliances, and water reuse."

Collaborating with colleagues at other institutions, Ahmad has also contributed to research on malaria control efforts in sub-Saharan Africa with his study of water ponds that provide breeding grounds for mosquitoes.

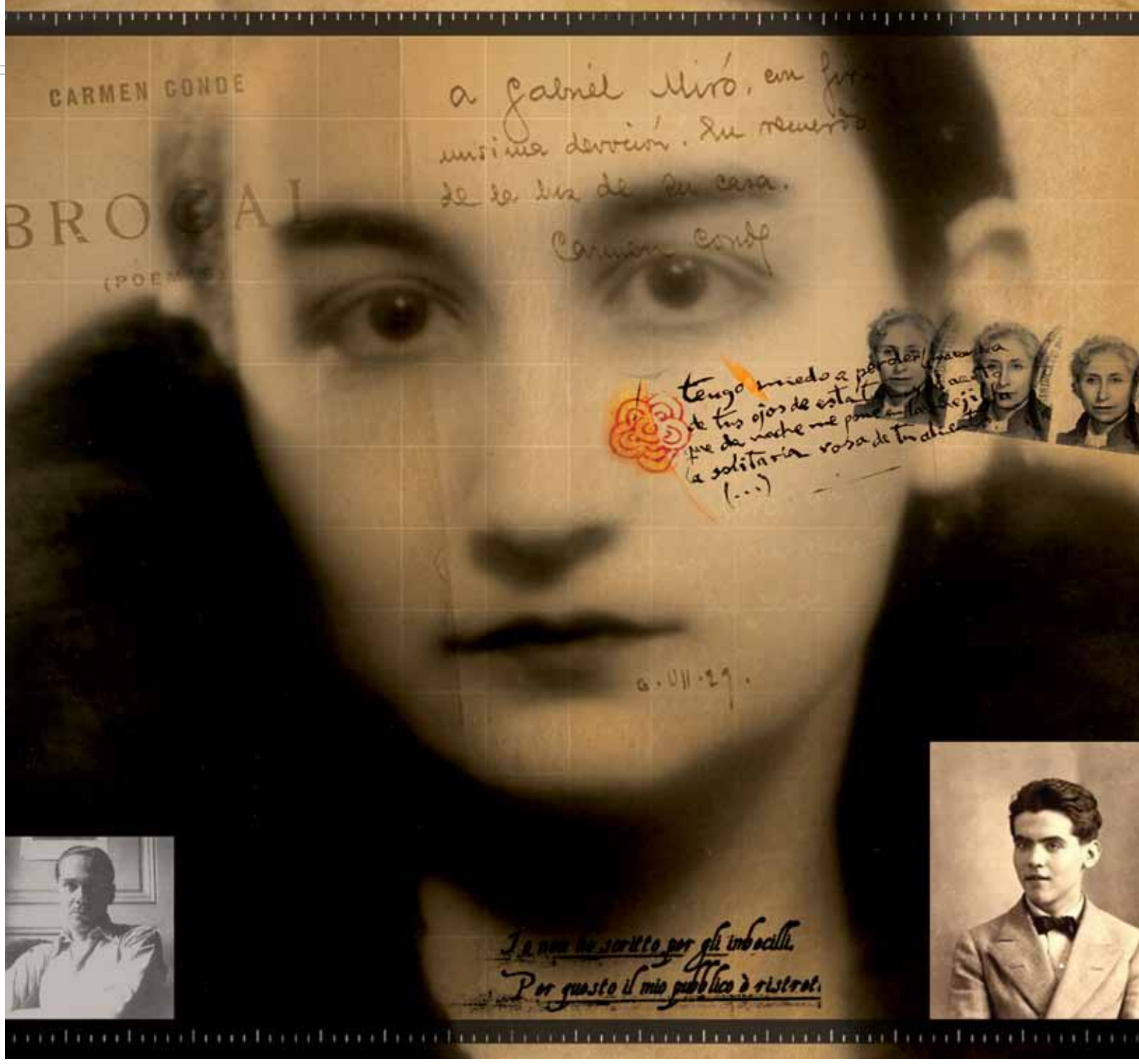
How does he feel about receiving the NSF CAREER Award?

"I am humbled by this honor," Ahmad says, noting that he is also grateful for the support of his colleagues Thomas Piechota and Jacimaria Batista, who provided guidance during the preparation of his proposal.

"The CAREER Award has allowed me to build an excellent team of students and researchers by providing a steady source of funds over five years," he says. "The results produced by our research group have advanced understanding of important issues and have paved the way to other awards and recognition."

Ahmad has also received the Graduate/Professional Student Association Outstanding Mentor Award, the College of Engineering Distinguished Researcher Award; the Barrick Scholar Award; and the Regent's Rising Researcher Award.

AARON MAYES



In Print

Faculty authors explore Spanish vanguard poetry, fatherhood, multi-modal learning, and more.

Photography by R. Marsh Starks

Bodies in Motion: Spanish Vanguard Poetry, Mass Culture, and Gender Dynamics
By Catherine Bellver
Bucknell University Press, 2010

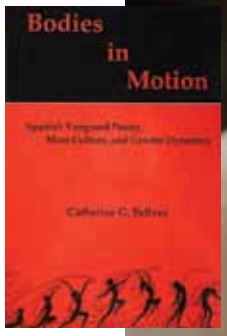
While America was reveling in the Roaring '20s, Spain was similarly enjoying "Felices Veinte," a time of prosperity, exuberance, and social advancement for women.

It was an era full of trends more commonly associated with the 21st century than nearly 100 years ago: wild music, provocative dances, celebrity worship, sports mania, fascination with new technologies, and social change. The era also brought the advent of Spanish vanguard poetry, which blossomed after World War I.

The times and poetry combined to produce a rich cultural milieu that serves as the focus of Catherine Bellver's recent book, *Bodies in Motion: Spanish Vanguard Poetry, Mass Culture, and Gender Dynamics.*

Bellver examines the avant-garde poets of this era, often referred to as the "Generation of 1927," who employed recurring motifs that included dance, sports, and technological change in their experimental poetry.

But Bellver's work goes beyond the analysis of vanguard poetics. It also provides insight into the context in which the poetry was written – an exciting time in Spain when the literary set collided with the nightclub crowd, when athletes and entertainers achieved cult status, and when women emerged as an intellectual force.



"Some of the phenomena that we take for granted today had their origins in the socio-cultural developments of the '20s," says Bellver. "The seeds of today's trends were planted then."

She notes that in the poetry of both male and female vanguardists, dance, sports, and machines were emblematic of the liberation the era promised and the dynamism it exuded.

The poets she covers in her book include Rafael Alberti, Carmen Conde, Guillermo de Torre, Josefina de Torre, Gerardo Diego, Concha Méndez, Ernestina de Champourcin, Jorge Guillén, José María Hinojosa, Federico García Lorca, Lucía Sánchez Saornil, and Pedro Salinas.

Their works displayed a newfound sense of play, liberation, and energy, Bellver says. Perhaps jazz-inspired, vanguard poetry took on new rhythms. Influenced by other modern European writers and artists, the poets employed experimental word play and tried new visual forms.

Bellver finds vivid examples in the poets' words that weave together the strands of music, dance, sports, and motion that together depict the era's energy.

For example, Concha Méndez describes swimmers' "beaming torsos/ jumping waves/in lyrical dances/and acrobatics."

Bellver also discusses the contrasts between male and female vanguard poetry, noting both genders chose some similar subjects and imagery but conveyed very different messages. On the subject of dance, for instance, the men's poetry was more experimental rhythmically and visually, but its voice was that of spectator rather than participant: Luis Mosquera wrote of men watching women "abandoned to the movement/ and under their tight, short dresses/ their hips seem to swell." Ernestina de Champourcin, on the other hand, wrote of being part of the dance herself, "Free of voice and gestures, I am far from everything./ I am I, on my shores."

To capture the essence of the poetry and the times, Bellver traveled to Spain and embarked on some literary detective work, much of it without the aid of online sources. She visited the poets' old gathering places at universities and former music halls. She combed libraries the old-fashioned way – rummaging

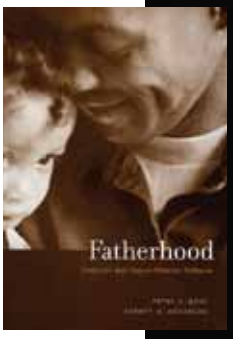

Foreign languages professor Catherine Bellver

through the stacks, seeking out unpublished materials, finding tantalizing scraps of notes and letters, then contacting the agents and heirs of the poets for permission to copy what she had found.

"Gathering all the rights and permissions myself was a daunting task," says Bellver.

Once she had amassed a vast amount of material, her careful assembly began; it took her nine years to complete the book. The footnotes alone, 24 pages of them, are a scholarly tour de force, revealing her mastery of the history, society, language, and art of the times.

Bellver began the book after being named a UNLV distinguished professor, the highest honor bestowed on a faculty member. The designation is awarded to only a select few – those who have demonstrated extraordinary qualities both as teachers and scholars while achieving national and international recognition. Instead of resting on her considerable laurels, Bellver ramped up her research, expanding and combining it with her feminist studies. The result was two books: *Absence and Presence: Spanish Women Poets of the Twenties and Thirties,* published in 2001, and more recently *Bodies in Motion.*



"The latter is the culmination of my academic interests," she says. "It's a natural evolution of my critical and textual background, my fascination with historical and cultural contexts, and my literary feminist studies. I then went back to the study of poetry, where I began my academic career. I feel like I've come full circle."

So, it seems, has society. Her book demonstrates how trends from an era long past portended today's mass media culture. In this way, *Bodies in Motion* offers a larger, more expansive view of poetry of the era, including perspective on history and social change.

Bellver is currently pursuing specific studies on several poets discussed in the book.

—Donna McAleer

Anthropology professor Peter Gray

Fatherhood: Evolution and Human Paternal Behavior

By Peter Gray and Kermyt Anderson
Harvard Press, 2010

Any father will tell you how profoundly his life changed after the birth of his child.

He will tell you of the awe of holding his child for the first time, the exhaustion of the infancy years, the stresses of providing for family, the pride in his child's accomplishments.

But what about other changes he experiences that are not so evident? And, more generally, what does it mean to be a father?

Biological anthropologist Peter Gray and his coauthor search for answers in *Fatherhood: Evolution and Human Paternal Behavior*, a study of the nature of fatherhood from many perspectives – the biological, evolutionary, anthropological, and sociological.

More specifically, UNLV's Gray and fellow anthropology professor Kermyt Anderson explore the physiology, behaviors, and social structures of human fatherhood as it has evolved across time and different cultures.

The publisher, Harvard University Press, captures the book's core premise with a succinct line: "Fatherhood actually alters a man's sexuality, rewires his brain, and changes his hormonal profile." Gray finds this notion fascinating and casts the role of father in a larger evolutionary context.

"One striking feature of human fatherhood is that men in all cultures are expected to be involved with their children to varying degrees," Gray says. "This is not a unique occurrence in the animal world, but it does set us apart. Among all species of mammals, only in about 5 percent of these species do males provide parental care."

Since our closest primate relatives, the great apes, have no paternal investment in their offspring, why are

humans different? Is paternal involvement one of humanity's defining characteristics?

The book attempts to answer such questions with knowledge about humans from their most primitive days, comparing human fatherhood behavior patterns to those of other animal species and surveying detailed anthropological studies of cultures and tribes. The book also examines the effects of fatherhood on health and societies.

The authors also include chapters on cross-cultural diversity, marriage patterns, fertility, paternity, paternal involvement (or the lack thereof), stepfatherhood, and the physical changes men undergo when they become fathers.

Both of the authors drew on fairly recent experiences with the transition to fatherhood to find inspiration for the book.

"Working on this book was a joy," Gray says, noting that they compiled the book in a little over a year. "As the fathers of young children and with similar backgrounds in evolutionary anthropology, Kermyt and I share a passion for studying fatherhood. We also have similar writing styles, so the book came together rather seamlessly."

Their sense of purpose was also heightened because they felt they were filling a significant gap in their field.

"The vast amount of scholarship on parenting focuses on maternal behavior," says Gray. "The role of fathers is much less explored."

The result is a rich and patient assemblage of scholarship that draws no easy conclusions about fatherhood but shows its diversity. *Fatherhood* has been well reviewed and received, generating discussion in the *Boston Globe, Psychology Today,* the *Chronicle of Higher Education*, MSNBC's *Cosmic Log,* and a host of scholarly journals and local publications. The book, first published in 2010, recently came out in paperback.

Gray continues his study of this area, still fascinated by the biological, social, and evolutionary aspects of fatherhood. He is currently part of a team surveying a large sample of Jamaican fathers about their paternal attitudes.

—Donna McAleer

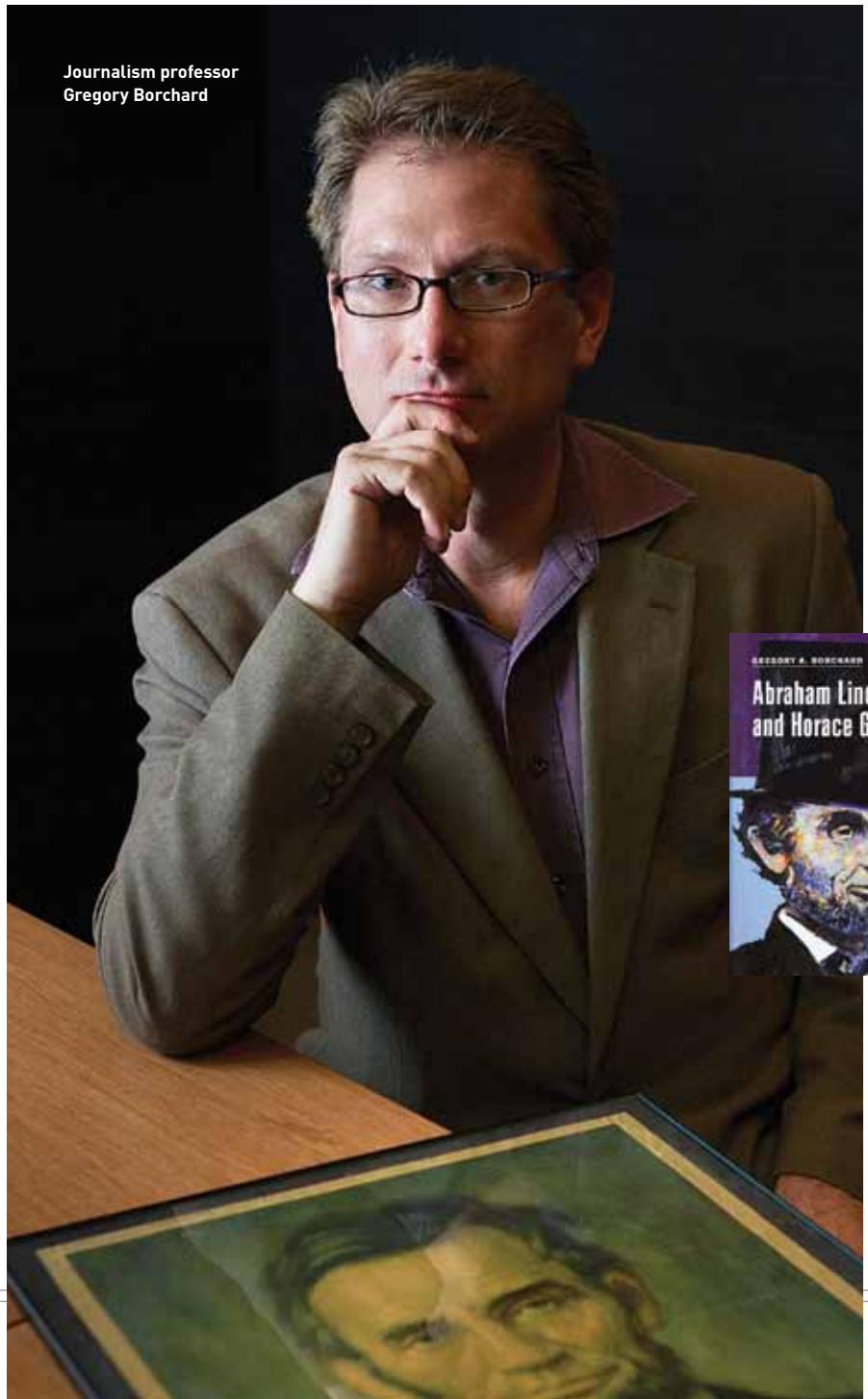
Abraham Lincoln and Horace Greeley
By Gregory Borchard
Southern Illinois University Press, 2011

UNLV journalism professor Gregory Borchard always planned to write a book about newspaper editor Horace Greeley. But when he learned that Greeley's great-great-great grandson was enrolled in his history of journalism class, the project took on new importance.

"It was a surprising twist of fate," Borchard says.

It was also an incredible stroke of luck, as the journalism historian was given access to the Greeley family album, which complemented his own meticulously researched collection of newspaper articles, personal letters, and biographies of Greeley. These materials also helped form a more complete picture of Greeley's interaction with another important 19th century figure: Abraham Lincoln. It is this interaction that interests Borchard.

He notes that although a variety of works have been written about Greeley and Lincoln as individuals, "few, if any,



Journalism professor Gregory Borchard

AARON MAYES

have attempted to interpret the life of each on equal footing, with both contributing to a shared legacy."

His book, *Abraham Lincoln and Horace Greeley*, answers this need with a careful examination of the writings and behaviors of the two men in the years leading up to and encompassing the Civil War.

Borchard begins the book by identifying key beliefs that influenced both men at the start of their careers. Greeley and Lincoln were members of the Whig party and avid supporters of the philosophies of Henry Clay. Both also shared "a belief in a government based upon the will of the people and their natural rights," and both men abhorred and sought to end the practice of slavery in America, Borchard writes. Also, neither Greeley nor Lincoln had the benefit of a formal education, but each possessed the intellect and drive needed to rise above humble beginnings.

Greeley's rise led him to the *New York Tribune*, where he served as editor for nearly 30 years; shortly before he died, he was a candidate for president.

Lincoln famously worked as an attorney and served in the Illinois legislature and the U.S. House of Representatives before becoming president.

Greeley and Lincoln's shared lifelong admiration of statesman Henry Clay united the two men in a way a common commitment to politics could not. In the months preceding Clay's bid for the presidency in 1844, Lincoln spoke eloquently and often on Clay's behalf. Greeley campaigned extensively and risked the *Tribune*'s credibility by claiming "the Whigs would carry New York by 20,000 votes."

When Clay lost to James K. Polk, the event marked what Borchard calls "a critical turning point in the careers of both men – for Lincoln as a Illinois legislator and Greeley as a popular New York publisher – leading both of them to congressional office and revealing to the nation both who they were and what the subsequent trajectories of their lives would be."

Lincoln became a rising star in what Borchard describes as the era when the Whig Party collapsed and the Republican Party was born. At the same time, Greeley's readership and reputation as an editorial writer grew.

"Greeley's contemporaries appreciated his ability to write thoughtful articles and reach an admiring audience that included erudite city dwellers, farmers, and homesteaders," Borchard notes.

In 1848, both men occupied seats in Congress, Lincoln as an elected representative from Illinois and Greeley filling a vacated House seat for three months. In 1860, Abraham Lincoln became the 16th President of the United States, a position that Greeley helped him secure.

In the tumultuous months immediately following Lincoln's election – when abolitionists pressured Lincoln to end slavery and South Carolina led the movement to leave the Union – Greeley regularly excoriated the president through his newspaper, exhorting him to suppress the rebellion and avoid war.

After the first shots were fired on April 12, 1861, however, Greeley changed directions and his paper published a series of columns urging Lincoln into war, asking him to "stand firm in preserving the union and defeat secessionists with military force."

In 1862, Lincoln prepared the first draft of the Emancipation Proclamation and presented it to advisors, some of whom wanted it released immediately. Soon after, Greeley wrote an editorial in the *Tribune* titled "The Prayer of Twenty Million" that called for Lincoln to wage war against the South in the name of ending slavery.

In response to Greeley's piece, the President published a letter in the *National Intelligencer* that argued he would preserve the union as his paramount mission. "If I could save the Union without freeing *any* slave I would do it," Lincoln wrote, "and if I could save it by freeing *all* the slaves I would do it; and if I could save it by freeing some and leaving others alone I would also do that."

Lincoln issued a preliminary emancipation proclamation in September 1862, to which Greeley responded that the president's "conversion to the abolitionist cause" was the result of his paper's extensive coverage of the issue. Although clearly some measure of hubris was involved, Borchard points out that Greeley's role in "popularizing the idea that the Civil War should become a fight to free all people" is often overlooked.

By the time Lincoln was reelected in 1864, Sherman's campaign in Georgia and the Carolinas was moving the war to its end. Following Lincoln's assassination in April 1865, Greeley reacted with words of "respect and emotion." He described Lincoln as "a man, not a superman" – an assessment, Borchard writes, that "students of history almost 150 years later can trust in many ways more than the president's most worshipful contemporaries."

Although a number of accounts have suggested that Greeley and Lincoln were "anything but friends," they were, according to Borchard, "political and intellectual allies."

"As contemporaries, as intellectuals, and as self-made men, Abraham Lincoln and Horace Greeley worked to preserve the union and end slavery," Borchard says. "In doing so, the two men also provided for future generations astonishing examples of citizens – not superheroes or demigods – with individual legacies every bit as large as their sum."

—Laurie Fruth

* * *

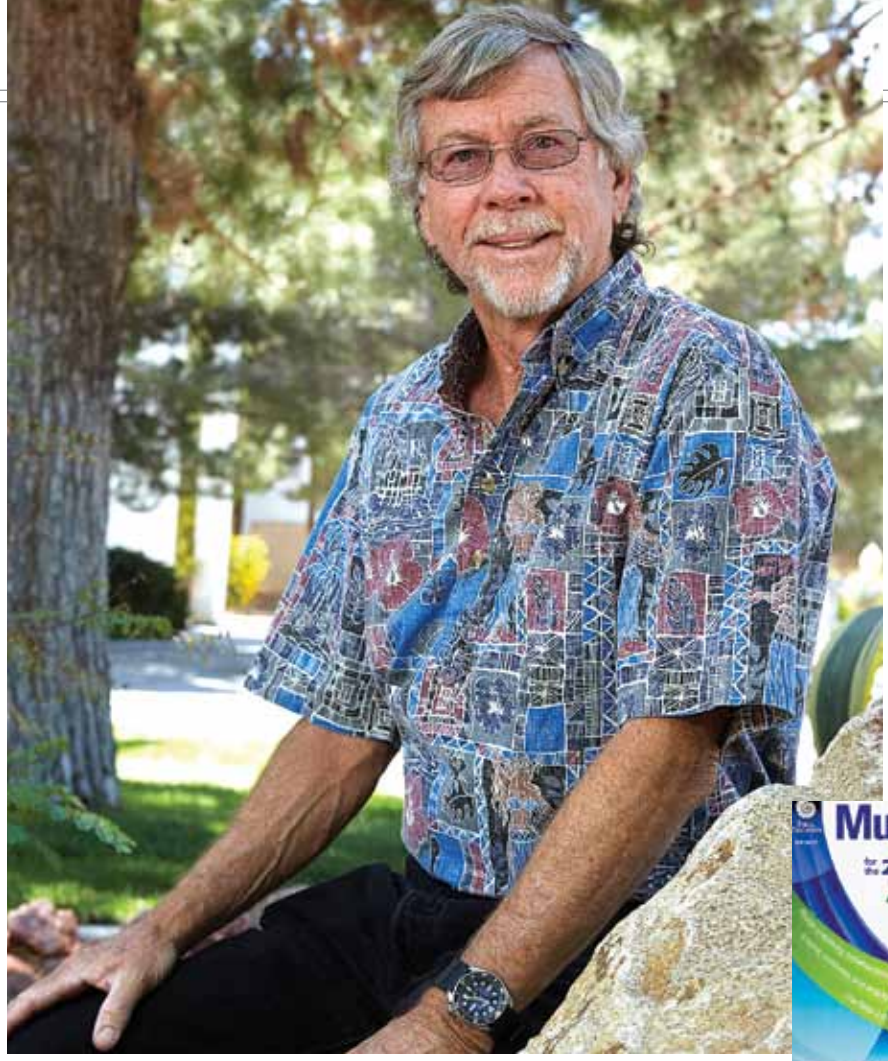
Multimodal Learning for the 21st Century Adolescent

By Tom Bean
Shell Education, 2010

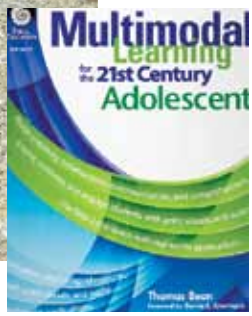
Most teachers wish they could provide their students with a rich array of technology resources in the classroom, but not all are lucky enough to do so.

To UNLV education professor Tom Bean, it's disheartening that some classrooms suffer from limited funding for and access to technology. Gone are the days, he says, of believing that nontraditional technologies and teaching methods are not necessary.

"If we are going to get our students to think critically about the barrage of information that they encounter on the



Education professor Tom Bean



Internet, then we have to incorporate multiple modes of presentation in our lessons," he argues.

In his book, *Multimodal Learning for the 21st Century Adolescent*, Bean explores how teachers can capitalize on the many technologies students now have at their fingertips.

"Technology can be seen as a double-edged sword," says Bean, a nationally recognized expert on content area teacher creativity, literacy, and problem solving. "On the one hand, the Internet and the myriad of devices available – from iPads to smartphones to interactive whiteboards to ebooks – afford access to whole new worlds of information. On the other hand, the very richness of these resources can seem overwhelming."

Just what does multimodal learning include? Beyond the traditional printed text, whether it's in a book or on a screen, multimodal learning features various art forms such as music combined with visual imagery and spatial cues that carry meaning of their own.

"In addition, with Web 2.0's interactive elements, such as Wikipedia and Facebook, the possibilities for student creativity and production have never been better," he says.

Bean, who was nominated by the Association of the Educational Publishers for a Distinguished Achievement Award for this book, hails this time period as the golden age for multimodal approaches. Having teachers and students interacting with and making decisions about design, visual imagery, music, film clips, navigation, and content allows both groups to be creative.

Another positive about the multimodal approach is its ability to recapture disenfranchised students – those not adept at learning through traditional means – and get them engaged once again.

"Our curriculum decisions will start to shift toward an emphasis on problem-solving abilities and away from recalling facts for high stakes assessments," says Bean, who has co-authored 15 books, more than 20 book chapters, and 88 articles. He also formerly served as the editor of the *Journal of Adolescent & Adult Literacy*.

Bean notes that the context for learning is changing, and teachers must be adaptable to help students reach their potential.

"Great teaching takes place through apprenticeships, coaching, and mentoring in problem-based contexts where inquiry is paramount," he says.

Shell Education, which specializes in professional development materials for educators, approached Bean to write the book. His editor, Hillary Wolf, appreciates its friendly tone and useful-right-now approach.

"This book addresses the very specific skills kids are going to need as they look for jobs in the 21st century: collaboration, communication, visual literacy, access to technology, and group projects," Wolf says. "This is different from how most of us learned."

Various studies Bean cites in his book reinforce this reality. A *Time* magazine report, "The Way We'll Work," describes a future when 85 percent of newly created jobs will involve problem solving and critical thinking. Teams of people will be working together across geographical and cultural borders in the global knowledge economy; thus, students need to develop their discernment, creativity, and ability to solve problems.

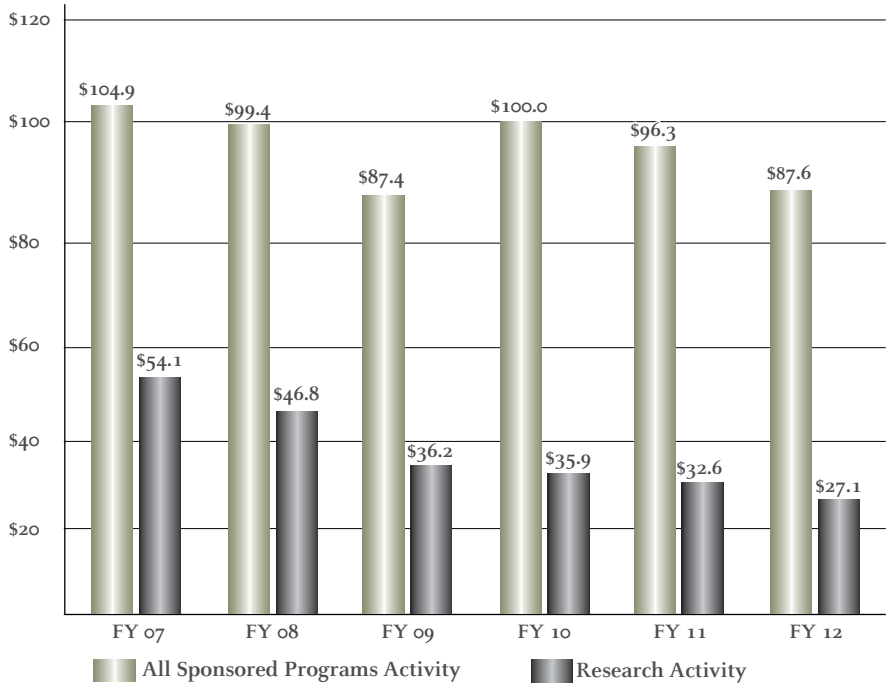
As sole author of *Multimodal Learning for the 21st Century Adolescent*, Bean enjoyed the creative freedom he was given to write the book.

"It was a labor of love and very fulfilling to have my own classroom experiences, content area research, and the insights of teachers and graduate students I have worked with come together in one place."

—Donna McAleer

Research Report UNLV Highlights

Total Sponsored Program Expenditures vs. Research Expenditures in Millions, FY07-FY12



Sponsored program funding serves as one indication of research growth and sophistication

UNLV is a doctoral-degree-granting institution with more than 27,000 students, approximately 5,200 of whom are graduate/professional students. The university is ranked in the category of "high research activity" by the Carnegie Foundation for the Advancement of Teaching. Nearly 120 graduate degree and certificate programs are offered, including 41 doctoral and professional degrees. UNLV offers a broad range of respected academic programs and is recognized as a premier metropolitan research university.

Awards

In FY2012, UNLV received approximately $77 million in external award funding with nearly $22.6 million supporting research, including significant support from a number of federal agencies:

Dept. of Education – $12.4 million
Dept. of Energy – $3.2 million
Dept. of Health and Human Services – $2.5 million
National Science Foundation – $1.8 million
Dept. of the Interior – $1.3 million

Top Five Academic Areas Receiving Sponsored Program Award Funding in FY2012

Sciences – $9.2 million
Harry Reid Center for Environmental Studies – $ 5.5 million
Health Sciences – $4.5 million
Engineering – $3.6 million
Education – $1.6 million

Award Funding By Sponsor Type in FY2012

Federal – $59.7 million
Federal Pass Through – $12.7 million
Foundation/Corporate – $3.3 million
State – $1.2 million
Local – $179,946

Expenditures

Research expenditure data – the amount of funding expended for the purpose of research – is the gold standard for measurement of research activity in higher education. It indicates the amount of external funding spent by faculty and staff to conduct research; hence, it accurately reflects the productivity of funded researchers. Sponsored program expenditure data reflects activity on all types of sponsored program projects, including those dedicated to instruction or public service, as well as research. Hence, research expenditures are a subset of total sponsored program expenditures.

R. MARSH STARKS

UNLV Selected for DOE Nuclear Energy University Program

Two UNLV research teams were awarded more than $1.6 million from the U.S. Department of Energy (DOE) to investigate new ways to safely separate and store radioactive waste from nuclear fuel recycling.

The DOE, as part of its Nuclear Energy University Program, supports a limited number of research projects to advance current nuclear reactor efficiency, find better ways to recycle and/or dispose of spent nuclear fuel, and design reactors that produce more energy and less waste. UNLV is one of just 32 universities nationwide to earn competitive awards under this program in 2012.

Professor Ken Czerwinski (left) works with a UNLV student.

R. MARSH STARKS

Both UNLV projects involve the radioactive element technetium, a common product from nuclear fission. UNLV is one of the few universities in the country that can perform this research with technetium. The radiochemistry program's capability with radioelements is the basis for numerous collaborations with DOE laboratories, universities, and international laboratories.

One team, led by radiochemistry professor Ken Czerwinski, will look at the potential effectiveness of metal alloy storage for technetium.

Developing the right mix of metals requires an understanding of how the radioactive materials will behave on long time scales. Czerwinski and his team will model corrosion on a series of metals and stainless steel alloys containing differing amounts of technetium. UNLV physics research professor Eunja Kim and researchers from Los Alamos National Laboratory, Florida Memorial University, and Sandia National Laboratories will partner on the project.

Thomas Hartmann, a research professor with UNLV's Harry Reid Center for Environmental Studies, will create advanced ceramic structures to immobilize technetium. The research team will determine how well technetium can be stabilized within ceramic structures under conditions expected at a generic geological repository.

According to the research team, advanced ceramics could prove more effective and technically efficient to immobilize technetium than current methods, including specialized glass. Hartmann and his team will compare leaching and corrosion of different advanced ceramic structures with those of current waste glasses to immobilize radioactive high-level waste. Steven Frank with Idaho National Laboratory will partner with Hartmann's team.

The Nuclear Energy University Program was created by the DOE in 2009 to consolidate the agency's university support and fund nuclear energy research and equipment upgrades at U.S. colleges and universities. For more information, visit *neup.gov*.

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Investing in winning ideas

Brett Abarbanel,
UNLV Hospitality Administration
Ph.D. candidate

Gaming industry leaders know that business decisions can't be left to chance. Brett Abarbanel does, too. Brett's research on how external and internal aspects of the industry influence behaviors will give executives data they can use to increase efficiencies and boost revenues. And by providing insights into casino operations and perceptions, her work has the potential to improve relations between the gaming industry and the communities they serve.

Brett's research is generously supported by the privately funded President's UNLV Foundation Graduate Research Fellowship.

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