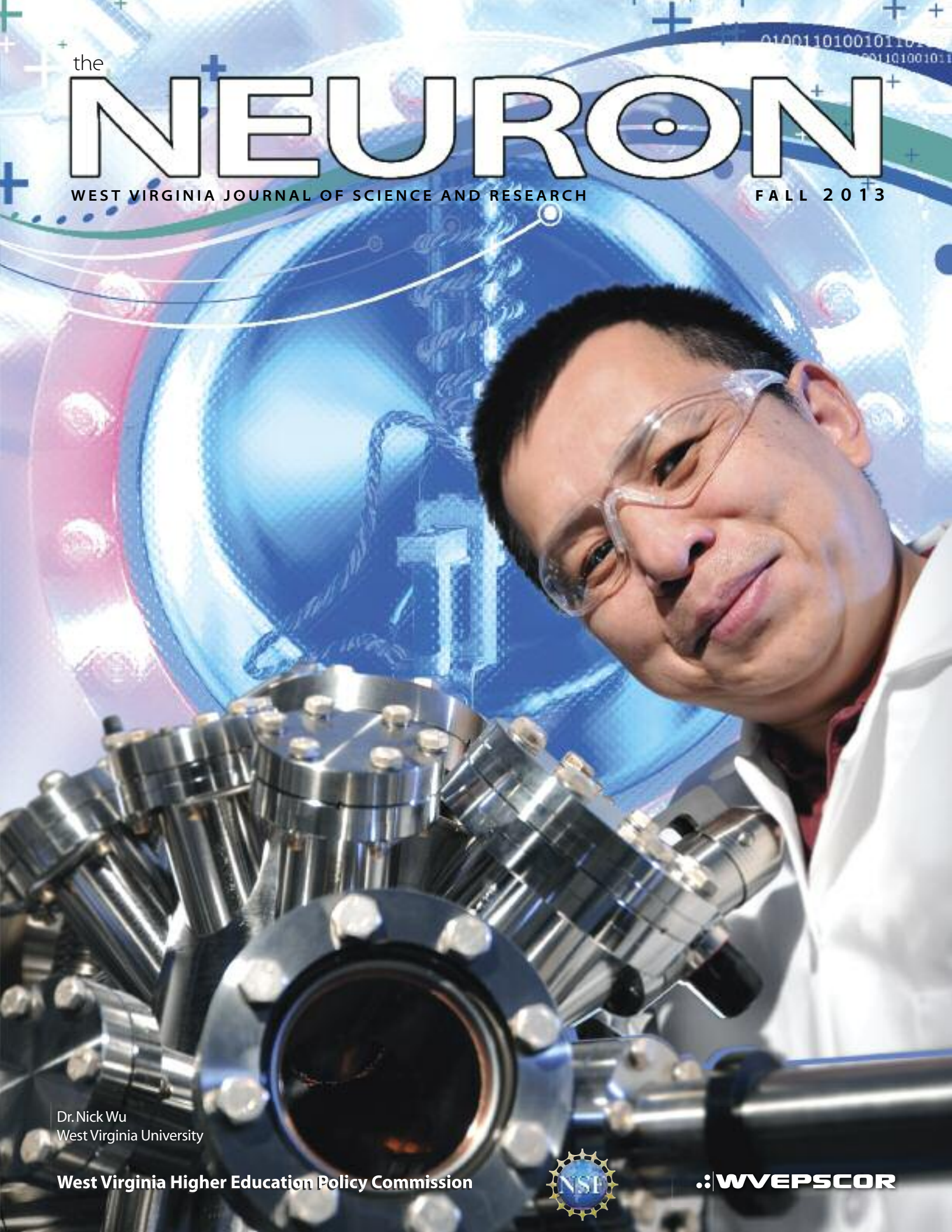


the NEURON

WEST VIRGINIA JOURNAL OF SCIENCE AND RESEARCH

FALL 2013

Dr. Nick Wu
West Virginia University

West Virginia Higher Education Policy Commission

NSF

WVEPSCOR

DR. NICK WU

Professor of Mechanical & Aerospace Engineering, West Virginia University

It's a wonderful life according to Dr. Nianqiang "Nick" Wu, associate professor in West Virginia University's Department of Mechanical and Aerospace Engineering. Not only is his research cutting edge and gaining international attention, he is also an inspiration to his students and, perhaps most importantly, he sincerely loves his work.

He said, "People do what they enjoy in life, and I really love research."

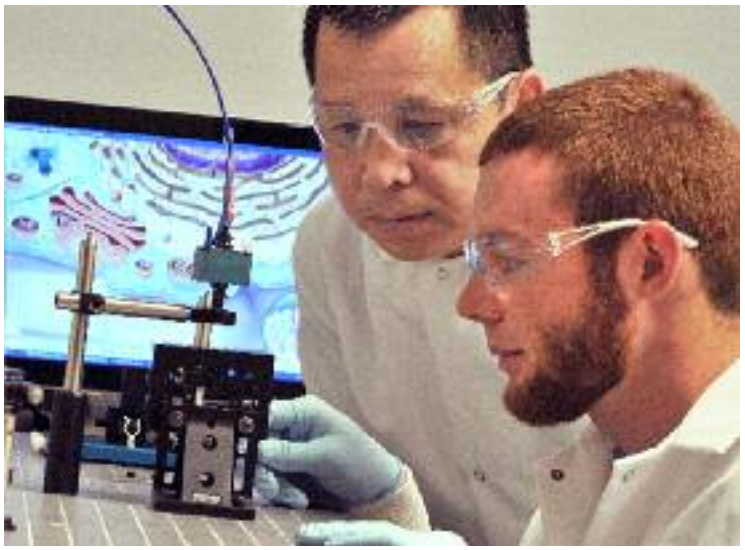
Wu, who was born in southern China, said he has always known he wanted to be a scientist. His path to West Virginia started when he did his post-doctoral research at the University of Pittsburgh so he was already familiar with the area when the opportunity to join the ranks at WVU came about.

He said, "I saw a great opportunity to establish my career at WVU because of the university's nano initiative. My career is growing fast, and I'm very proud to be part of this team."

During his time at the school, he has established strong research programs in both biosensors and photocatalysts, and his research is well recognized internationally. For example, his papers have been cited more than 3,300 times - 800 of those in the first 10 months of 2013.

Wu went on to say that he believes WVU has the structure to compete on a national level with nanotechnology, or nanotech - which is, essentially, the manipulation of matter on an atomic and molecular scale. He is among a team of researchers who are working on something that could be put into practice close to home given that West Virginia's economy has historically been driven by mining, metal manufacturing, agriculture and forest production.

Wu explained that through the activities of coal mining, traces of heavy metals are often released into water. Likewise, pesticides and herbicides often enter the environment from agriculture and forest industries and via household activities. Because of this, the World Health Organization has set allowable levels of mercury, lead and



Dr. Nianqiang "Nick" Wu and student Scott Cushing

The Dr. Nick Wu file:

Ph.D., Materials Science and Engineering, Zhejiang University China, 1997

Postdoctoral Research Fellow, University of Pittsburgh 1999-2001

Keck Surface Science Center, Northwestern University 2001-2005

Associate Professor, Department of Mechanical & Aerospace Engineering, WVU, 2005-present

Cover Photography by Alex Wilson

content

arsenic in drinking water and set a maximum allowable limit for pesticides in ground water. Currently levels of these elements in water are tested via a process that involves a sample being sent to a centralized laboratory and tested using large-scale analytical instruments. This process is expensive, time-consuming and requires professionals to operate.

With support from the National Science Foundation (NSF) Research Infrastructure Improvement Grant and the West Virginia EPSCoR program, Wu and his team are using nano-technology to develop a portable, field-deployable sensor that will detect mercury, lead and arsenic levels in bodies of water – a "lab on a chip".

Wu said, "The luxury of being able to test water and know within minutes, rather than days, if it contains high levels of mercury will be invaluable."

In addition to his environmental interest, Wu is also involved in solar energy research. An article about his solar research was recently selected for inclusion in the prestigious national publication, Nature Communications. It's the first time that a publication has appeared in this prestigious journal with WVU as the primary contributor. Contributors' research routinely gains significant attention after appearing in Nature Communications.

In addition to his love of research, Wu is an enthusiastic teacher and enjoys helping his students learn and develop interests during their time in school. His students tell him that they see a passion in him, which inspires them.

He said, "It is a proud celebration when our students graduate because they came to us as blank slates and now they are ready to take on the world."

And take on the world they have. One of his former students is now a faculty member at a top university in China researching, in part, the use of natural gas to run electrical power. Scott Cushing is another example. He started working with Wu as a freshman and recently won his own NSF Graduate Fellowship that will allow him to continue his research as a Ph.D. student for three more years at WVU. After graduate school, Cushing hopes to become a professor so he can work with students and keep doing research – following in the footsteps of Wu.

"It is a proud celebration when our students graduate because they came to us as blank slates and now they are ready to take on the world."

His students tell him that they see a passion in him, which inspires them.

about the division of science and research

The West Virginia Higher Education Policy Commission's Division of Science and Research directs the National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR) in West Virginia. The division also coordinates scientific research grants to academic institutions and conducts outreach activities to broaden the public's understanding of science, technology, engineering and mathematics (STEM) disciplines. For more information, visit **www.wvresearch.org**.

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WVU researchers develop artificial **'dancing' leaf** for harvesting solar energy

Alan Bristow and Nick Wu

When you look at a leaf, the first thing that comes to mind may not be its ability to harness solar energy. In fact, the surface area of a leaf, with its inherent curves and waves, makes it perfect for the absorption of sunlight, which a plant then uses for growth. Probably the last thing that comes to mind is its ability to "dance."

A team of researchers from West Virginia University is taking both ideas a step further in an effort to create an artificial leaf that can be used to harvest solar energy. Nianqiang "Nick" Wu, an associate professor of mechanical and aerospace engineering who is featured in this issue of *The Neuron*, and Alan Bristow, an assistant professor of physics and astronomy, are using the latest advances in nanotechnology and optics to mimic and improve on the leaf. The team's research is being funded through a grant from the National Science Foundation.

The abundance and renewability of sunlight make it a primary source for meeting the world's growing energy needs, without further harm to the environment. However, previous attempts to create artificial leaves, which basically mimic photosynthesis, have been mixed.

"To date, only low conversion efficiencies have been obtained, primarily because most of the materials used to create artificial leaves have been able to absorb less than five percent of the available solar spectrum," Bristow explained. "The current goal of our research is to extend that range."

The team's approach to extending the conversion range involves using light to stimulate a collective movement—or dance—of electrons, known as a localized surface plasmon resonance.

"When sunlight hits on very tiny gold nanoparticles, which are 10,000 times smaller than the diameter of a human hair, the electrons on the gold nanoparticle surface can dance hand-in-hand," Wu said. "This united rhythm can then store the solar energy inside the gold nanoparticle as if it were hundreds of times its actual size."

"We can also choose what 'music' the electrons will dance to by changing the particles' shape, allowing them to pick what part of the solar spectrum is converted to energy," Wu continued. "Normally, it is difficult to extract the energy stored in the dancing electrons to create the all-important chemical reaction. This difficulty has prevented localized surface plasmon resonances from effectively being used in solar light harvesting technology."

"In our studies, we are able to grow great materials to test our ideas," Bristow said. "We are also able to use extremely short pulses of laser light—similar to flash photography—to actually capture the electrons' dance."

The research team's discovery of this "dance" has been well received in the scientific community, having been published in the Journal of the American Chemical Society, as well as highlighted at the annual meeting of the American Physical Society.

Grant to support **commercialization** of **technology** to repair **skin injuries**

The Chemical Alliance Zone's Chemicals and Materials (CAM) Commercialization Fund has awarded $20,000 to a Marshall University scientist to help bring to market a technology he has developed for repairing skin injuries.

The award to Dr. Jingwei Xie of the Marshall Institute for Interdisciplinary Research (MIIR) will help Xie's research team produce device prototypes and samples, market to potential customers and conduct patent analysis.

Dr. Kevin DiGregorio, executive director of the Chemical Alliance Zone, said, "We are pleased to present these funds to Dr. Xie and hope this award will play at least a small part in the commercialization success of this exciting technology. In addition to the purposes for which the funds will be directly used, this grant can act as seed money to attract attention and potential investors to his work."

Research in Xie's lab involves using one of science's fasting-growing fields to develop products that can be used to improve treatment of burns and other skin wounds. He and his colleagues at MIIR, including postdoctoral fellows Dr. Bing Ma and Dr. Jiang Jiang, are using nanotechnology to create scaffolds made of tiny fibers, invisible to the human eye, to be used as skin grafts.

According to Xie, their devices also can be used to deliver medications topically for chemotherapy, anti-infection or pain relief purposes.

He added, "The treatment of large-area, full-thickness burns still constitutes a major surgical repair challenge. The current clinical 'gold standard' for burn wound treatment and repair is to use patients' own skin as skin grafts to close the wounded area. This method can have a number of drawbacks, including the limited supply of available donor sites on a badly burned patient, heavy scarring and poor functional recovery.

"Our product shows great promise for addressing all these shortcomings and improving the healing of these types of wounds."

DiGregorio said the CAM Commercialization Fund assists researchers, entrepreneurs, startup companies and small-to-medium firms with the commercialization of technology and products related to the chemicals and materials sectors in West Virginia. Funds are provided through a grant to TechConnect West Virginia from the Claude Worthington Benedum Foundation. The Chemical Alliance Zone administers the program with the assistance of an advisory group made up of representatives from the INNOVA Commercialization Group, Mountaineer Capital, the West Virginia Angel Network and the West Virginia Jobs Investment Trust.

Xie said the grant is special because it is intended specifically for commercialization activities. "This is exciting for us because we can use these funds to get our product closer to the market and potential customers," he added. "There are many grant programs out there to support research itself, but there is not as much funding available for these purposes. Having an actual product to show people will be invaluable as we continue toward our goal of starting up a company and commercializing our products."

WVSU student researchers named **Outstanding Chapter** by American Chemical Society

The student chapter of the American Chemical Society (ACS) at West Virginia State University (WVSU) recently received its second consecutive Outstanding Chapter Award for its 2012-2013 activities. The group also received Green Chemistry Chapter recognition for the fourth year in a row.

Since forming in 2009, the group has won two outstanding ratings, two commendable ratings, four Green Chemistry Awards, three community interaction grants and two travel grants to attend the annual ACS national meeting.

"I am extremely proud of these students for their outstanding representation of West Virginia State University and service to the local community," said WVSU President Brian O. Hemphill. "These students are excelling inside and outside of the classroom by sharing their passion for science with the next generation of Yellow Jackets and serving as an example and inspiration to so many."

The group of more than 20 students was praised for their outreach and educational efforts by award judges, with reviewers citing what they called an outstanding job promoting chemistry to area youth. Student participants regularly visit schools in the Kanawha Valley to teach science to students in K-12.

"The ACS students are quite busy in their outreach and science work," said Dr. Micheal Fultz, assistant professor of Chemistry at WVSU. "We are taking science into both public and private schools on a regular basis to enhance science education at all grade levels."

Second Annual Energy and Environmental Research Showcase **highlights innovation** by **WVU faculty**

An event on October 3 hosted by the Linking Innovation, Industry and Commercialization (LIINC) program at WVU brought together energy and environmental industry representatives with faculty researchers from the university with the goal of connecting (or "linking") people from the entities together to promote shared interests and future collaboration.

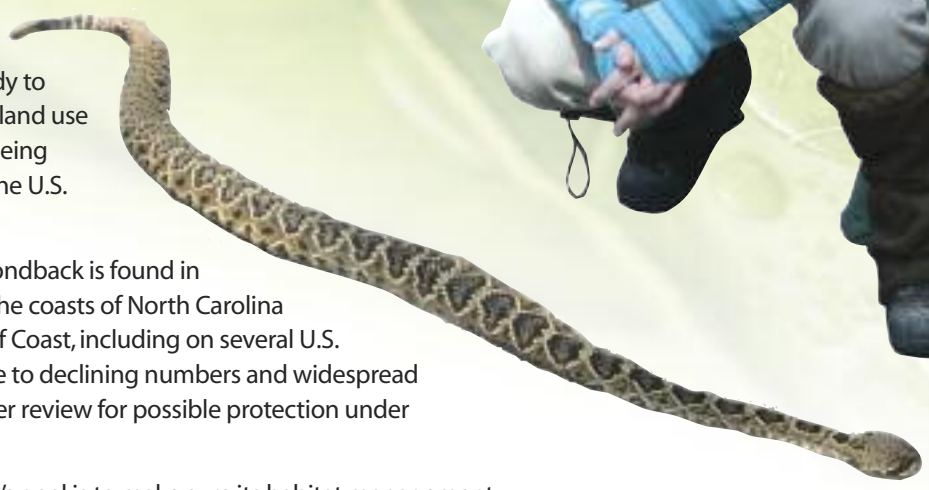
The event began with brief presentations by industry presenters who included Dan Headley, President of HCS Technologies, Inc., Greg Sullivan, Managing Partner of TreMonti Consulting, LLC, Tim Croushore, Consulting Engineer from FirstEnergy Corporation and Dr. Mike Makowski, Innovation and Technology Manager of PPG Industries. The presenters then formed a panel and fielded questions from the audience about company philosophies regarding research and how university research can tie into company objectives. A networking reception immediately followed where faculty had the opportunity to showcase their energy or environmental innovative research and technologies to industry leaders.

Marshall **Biology professor** receives federal grant to **study rattlesnake habitat**

Dr. Jayme Waldron often can be found crawling through dense brush in search of the largest venomous snake in North America—the eastern diamondback rattlesnake.

An assistant professor of biology at Marshall University, she has spent much of her career tracking the snakes to learn more about how and where they live, and how far they roam.

Waldron's newest research project will take her to the Marine Corps Recruit Depot Parris Island in Beaufort County, South Carolina, where she will be leading a study to examine the effects of common military land use practices on the snakes. The research is being funded through an $87,800 grant from the U.S. Department of the Army.



According to Waldron, the eastern diamondback is found in the southeastern part of the U.S., along the coasts of North Carolina down through Florida and along the Gulf Coast, including on several U.S. Department of Defense installations. Due to declining numbers and widespread loss of habit, the species is currently under review for possible protection under the Endangered Species Act.

Waldron said that, ultimately, the military's goal is to make sure its habitat management practices both ensure the success of its training operations and address the conservation of at-risk species.

She said Parris Island provides an ideal setting for the study given a history of eastern diamondback rattlesnake research at the facility and recent changes to the habitat.

"Recently, they've implemented new land management activities at Parris Island, including prescribed forest thinning and fire, to improve their training operation," she said. "These activities have significantly modified the habitat structure and are potentially changing the amount of suitable diamondback habitat."

For the study, she and her team will conduct mark-recapture surveys and use radio telemetry to monitor free-ranging diamondbacks over a period of two years. They also will be monitoring the vegetation associated with the new land use treatments.

Waldron said the results will be applicable to the region's other military installations that may employ similar land use practices.

She said, "At the end of the study, we will be providing the Department of Defense with an objective, preliminary assessment of the snakes' response to the new land management practices in the training areas, as well as regionally applicable home range maps and habit use models for use by natural resource managers.

"These natural resources managers play a critical role in maintaining long-term access to training facilities, particularly when imperiled species like the diamondback occur within training areas. Studies like ours can provide them with a degree of confidence needed to employ adaptive policies for species conservation. It's fulfilling to think that our results will be used to decrease the likelihood that diamondback imperilment will conflict with military training activities."

STaR Symposium **2013** a success

the evolution of energy

The 5th biennial Science, Technology and Research (STaR) Symposium, hosted by the West Virginia Higher Education Policy Commission's Division of Science and Research, took place on Oct. 22-23 in Morgantown. The registered attendees included industry leaders, business representatives, researchers and college and university faculty and students who have varying interests in the energy industry in West Virginia.

In addition to the energy-focused program, students at colleges and universities entered a student science video competition which concluded at the Symposium. "We challenged students to produce the best three-minute video that explains their research to a non-scientist." said Dr. Jan Taylor, Director.

To see the winning videos and additional photos from the event, visit wvresearch.org/star.

David Pogue – science and technology author and host of PBS's **NOVA ScienceNOW** gave an outstanding keynote address. His well-received talk was about why America is failing science and how we can turn it around.

Graduate winners of the student science video competition with Dr. Jan Taylor

First Place and People's Choice Winner, Oshadha Ranasingha, WVU

Second Place Winner, Justin Chambers, WVU

Undergraduate winners of the student science video competition with Dr. Jan Taylor

First Place Winner, Hannah Cavender, WVSU

Second Place Winner, Shawn Cheeks, MU

Pictured at left: Lisa Sharpe, Kim Quedado and Robert Paysen

WVU Solar House to be integrated into curriculum through NSF Award

While the immediate use for the solar house built by students from West Virginia University was determined more than a year ago–it was entered into the 2013 U.S. Department of Energy's Solar Decathlon in October–its future use was recently secured, thanks to a grant from the National Science Foundation (NSF).

Co-principal investigators Konstantinos Sierros, assistant professor of mechanical and aerospace engineering, and Dimitris Korakakis, associate professor in the Lane Department of Computer Science and Electrical Engineering, will work with an interdisciplinary team of students and faculty to use the home as a test-bed for the use of nanotechnology in developing sustainable, healthy and smart indoor environments. Participating faculty include representatives from the Statler College of Engineering and Mineral Resources; Eberly College of Arts and Sciences; Davis College of Agriculture, Natural Resources and Design; P.I. Reed School of Journalism; and the College of Education and Human Services.

The project, known as NanoFit, which is short for nanosystems fabrication, integration and testing, will seek to create a number of project-based opportunities for students to combine cutting-edge nanotechnology research and product development, device integration and system performance testing in an innovative environment.

"The three main research areas covered in the grant–energy harvesting, storage and management; indoor health monitoring; and smart living–make the solar house an ideal test-bed facility," Sierros said. "Examples of research projects that could be conducted include the fabrication, integration and testing of nanostructured flexible solar cells, solar-powered water treatment systems and smart biometric sensors."

The $200,000 grant, which was one of only nine funded by the NSF, leverages the existing framework of WVU's new nanosystems minor. Students pursuing a minor in the discipline are required to complete a capstone requirement by engaging in interdisciplinary nanosystems research within host faculty labs. The minor was established, in part, through support provided by a previous NSF Nanotechnology Undergraduate Education, or NUE, award made to WVU in 2008.

"The idea of using the solar house as the center piece for the capstone projects, where students can utilize their knowledge of nanotechnology and implement nano-systems and devices in a hands-on manner, was viewed as highly innovative by the NSF review panel," said Korakakis, who served as the PI for WVU's entry into the Solar Decathlon. "The house can also be used as a community learning studio for educating the local community on the benefits of sustainable, smart-home living.

"Our goal is for WVU students to grow together as collaborating professionals using this unique environment," said Korakakis.

"The three main research areas covered in the grant–**energy harvesting, storage** and **management; indoor health monitoring;** and **smart living**–make the solar house an ideal test-bed facility."

WVU School of Medicine's Li receives **prestigious award**

For the second time in three years, Bingyun Li, Ph.D., associate professor in the West Virginia University School of Medicine Department of Orthopaedics and director of the WVU Biomaterials, Bioengineering and Nanotechnology Laboratory, has been recognized internationally for his research.

Most recently, Dr. Li received the Asia Pacific Orthopaedic Association (APOA)-Pfizer Best Scientific Paper Award. The award was presented at the 2013 Combined Conference of the Fifth APOA Infection Section Scientific Meeting, Ninth Asia Pacific Spine Society Congress and Ninth APOA Paediatric Section Congress. It took place at the end of August in Kuching, Malaysia.

In 2011, Li was awarded the Berton Rahn Research Fund Prize from the AO Foundation, a Switzerland-based medically guided nonprofit organization led by an international group of surgeons specialized in the treatment of trauma and disorders of the musculoskeletal system.

Li and his team received the APOA-Pfizer Best Scientific Paper Award for their paper "Intra-cellular Staphylococcus aureus alone causes infection in vivo," which was published in "European Cells and Materials," the official research journal of AOTrauma, AOCMF (craniomaxillofacial), the European Orthopaedic Research Society, the Swiss Society for Biomaterials and Regenerative Medicine and the Tissue and Cell Engineering Society.

The awarded study is part of the Ph.D. dissertation of Therwa Hamza, who graduated in December 2012 from the WVU School of Pharmacy. The goal of the study was to determine whether intra-cellular Staphylococcus aureus (S. aureus) can induce bone infections in an open femur fracture animal model. The study found that intra-cellular S. aureus of as low as 100 colony forming units induced severe bone infections in animal models. This may suggest that intra-cellular S. aureus can "hide" in host cells during symptom-free periods and, under certain conditions, may escape and lead to infection recurrence in which disease episodes may be separated by weeks, months or even years.

"The study is clinically significant because recurrent bone infections are difficult to treat but occur frequently and have not been explained," Li said. "This study suggests that intra-cellular bacteria may be responsible for recurrent infections."

The APOA-Pfizer Best Scientific Paper Award is announced every two years and is the only award given out at the APOA Combined Conference. APOA was established in 1962 and currently has 19 member chapters and more than 1,800 orthopaedic members from more than 40 countries.

"This study suggests that intra-cellular bacteria may be responsible for recurrent infections."

MU **biomedical sciences student** selected for **Chancellor's Scholar Program**

Marshall University biomedical sciences graduate student Kristeena L. Ray was selected for the university's Chancellor's Scholar Program, an initiative to help ensure the academic success of underrepresented minority doctoral students.

The program provides Ray with a stipend of $10,000 per semester. In addition, she will receive mentoring and research opportunities through the university, networking opportunities through the Southern Regional Education Board Doctoral Scholars Program, and financial support for her dissertation and thesis work.

A native of Glen Allen, Virginia, Ray received her Bachelor's Degree in biomedical engineering from Duke University in 2009. She worked as a research assistant at Duke and as a process development engineer at Talecris Biotherapeutics in Clayton, North Carolina. She has been a graduate student at Marshall since 2011.

Ray said, "Being part of this program is such a gift and an honor. The stipend lightens the burden of locating funding and allows me to really focus on my research. I am also excited to take advantage of the additional benefits, including networking opportunities and membership in key organizations in my field."

Ray works in the lab of Dr. Nalini Santanam, a professor in the Department of Pharmacology, Physiology and Toxicology at Marshall's Joan C. Edwards School of Medicine. Her research is focused on endometriosis and the pain caused by the disease, which is characterized by cells normally present in the uterus migrating outside the organ and attaching to other places in the pelvis. At least one in seven women suffers from the condition.

She said, "We're looking at epigenetic markers in patients with endometriosis. We believe that our continuing research in this area will help us better understand what leads to endometriosis in some women and find alternate treatment options for its symptoms."

The Chancellor's Scholar Program at Marshall is funded through the West Virginia Higher Education Policy Commission.

Marshall gives **Scouts** a look at **virtual technology, 3-D printing**

Boy Scouts who attended the 2013 National Scout Jamboree in July at the Summit Bechtel Reserve in Mount Hope, West Virginia, had the opportunity to explore state-of-the-art virtual technology and 3-D printing, thanks to Marshall University's engineering and advanced manufacturing programs. Thousands of Scouts who attended the July 15-24, 2013 Jamboree visited the exhibits sponsored by the university's Center for Environmental, Geotechnical and Applied Sciences (CEGAS) and the Robert C. Byrd Institute (RCBI) for Advanced Flexible Manufacturing.

CEGAS Director Dr. Tony Szwilski says his group demonstrated its latest research and development efforts, including an interactive virtual program designed to support mine emergency response training.

The multi-user program simulated an underground coal mine using a video game engine—a platform familiar to Jamboree participants. The format allows users to practice their communications and decision-making skills in dangerous and stressful environments.

"Although this exhibit is just a small-scale version of the Visualization Lab we have on our Huntington campus, the Scouts were fascinated by the 3-D stereo display technology and the virtual environments we created," said Szwilski. "It was a wonderful way to share what we are doing and showcase our programs to future students. It was a great experience all the way around."

RCBI gave the Scouts an opportunity to experience first-hand one of the world's most exciting technologies—3-D printing, which turns digital designs into actual objects. The technology is beginning to be used in the aerospace and automotive industries, health care, architecture, engineering and countless other fields.

"I really like the challenge of mathematics. It's really hard sometimes, but when you finally get it, that's a good feeling."

Concord student participates in **Summer Program for Women** in **Mathematics** in **Washington, D.C.**

Concord University senior Felicia Stover finds mathematics challenging. But the Sandstone, West Virginia, resident says that's the appeal of her major.

"I really like the challenge of mathematics," she says. "It's really hard sometimes, but when you finally get it, that's a good feeling. Plus, you get to do some pretty cool stuff."

Stover spent a good part of this past summer involved in just such an activity. She was one of only 16 participants in George Washington University's 2013 Summer Program for Women in Mathematics held June 29 - Aug. 3 in Washington, D.C.

"I was exposed to a lot of math that I had never seen before," she said. "The coolest thing I saw was how they calculate the orbits of satellites and make adjustments in space so that collisions don't occur. I also really like how they use GPS satellites for triangulation."

Stover considers the weekly field trips the most interesting aspect of the summer program.

The elite group of young mathematicians visited six locations in the D.C. area including the National Cryptologic Museum, the U.S. Census Bureau and the National Air and Space Museum.

"At each location they told us about potential math careers. They also told us the various types of math that they were interested in and that they used at work," she said.

The summer program also offered seminars and panel discussions. Additionally, participants took four classes and gave oral presentations. Stover's schedule included: Symbolic Dynamical Systems, Introduction to Wavelet and Fourier Analysis, Discrete Models in Biology, and A Modern Approach to Mathematical Statistics: Resampling and Simulation.

"Some of the things I learned were more at a grad school level, so hopefully they'll help me when I go to grad school next year," she said.

Stover plans to pursue a Ph.D. in mathematics with aspirations of a career in industry or government.

Currently, she is working with fellow Concord students Joshua Beverly and Mariah Farley, in researching exponential domination on graphs. Their research is funded through the Center for Undergraduate Research in Mathematics (CURM) located at Brigham Young University. Dr. Christopher McClain, assistant professor of mathematics at Concord, received the grant.

WVU neuroscience research featured on cover of **The Journal of Neuroscience**

For the first time, The Journal of Neuroscience cover on August 7 featured an image taken from an animated video. The video is hosted on The Journal's website and was created by a team of researchers from the West Virginia University Center for Neuroscience.

This cover is the first in a series of three that features videos from the study "Synaptic Inputs Compete During Rapid Formation of the Calyx of Held: a New Model System for Neural Development," which was co-authored by researchers from WVU and the University of California – San Diego (UCSD) and led by George A. Spirou, Ph.D., director of the WVU Center for Neuroscience. Paul Holcomb, a neurobiology graduate student in the Spirou lab, is the study's first author.

The first video shows nanoscale-resolution images from serial block-face scanning electron microscopy (SBEM) of the developing auditory brainstem during the first few days of mouse development. SBEM is new technology that permits visualizing the wiring of the brain in 3D with resolution of several nanometers, or about the size of a protein molecule. One single image volume can require up to 2 TB of computer storage space; new data sets that will each be at least triple this size are currently being collected by Dr. Spirou's group using the microscopes at UCSD.

"The era of really big data has come to biology through studies of brain structure; it's very cool and challenging, made possible by advances in computing speed but pushing the need for even faster computers and rapid access storage of huge files. We are on the road to understanding more about what's happening within the brain as it develops. This new field of mapping brain circuitry at the nanoscale is called Connectomics," Spirou said. "SBEM and related new technologies are opening new ways to look at brain-based disorders, such as epilepsy, schizophrenia, depression, etc. Eventually, as image volumes become much larger, we'll be able to see where the human brain's wiring went wrong and understand the neural basis for these pathologies. This is just the first step, but it's a big step."

The image on the August 7 cover depicts the calyx of Held partially extracted from the image volume. The calyx of Held is the largest nerve ending in the mammalian brain and is located in the auditory central nervous system.

Each video featuring WVU research also includes an original score by musician Bill Mallers.

"When he saw the video, he was really impressed by the visuals and asked if he could compose some music," Spirou said. "Each score has a very different sound that reflects his interpretation of each video. As he explained it, the purpose of the music is to draw the viewer through the visual scenes."

The videos are available online at www.sfn.org.

WVU chemistry professor receives grant to explore petrochemicals

Brian Popp, assistant professor in the C. Eugene Bennett Department of Chemistry at West Virginia University, was recently awarded an American Chemistry Society–Petroleum Research Fund Doctoral New Investigator Grant for his research on transition-metal-catalyzed reactions of petrochemical raw materials. The grant, which is offered to professors with research groups at institutions offering doctorates in chemistry, is a form of "seed funding" to help launch their independent research careers.

"Petrochemicals are derived from a small fraction of every barrel of crude oil and serve as the starting materials for many consumer goods, including plastics, medicines and some textile goods, to name only a few," Popp said.

Most of the processes that transform petrochemicals into consumer goods employ a variety of catalytic reactions that use a catalyst that acts to "jump-start" the reaction and allows reactions to proceed that normally would not. Popp's research group focuses on reactions employing catalysts based on earth-abundant metals, like iron and cobalt, and precious metals, like rhodium, iridium and platinum. The funded research is specifically focused on synthesizing new metal catalysts that are zwitterions, neutrally charged molecules with both a positive and negative electrical charge, to study how these catalysts affect how the petrochemical substrates react.

The area of zwitterionic-transition-metal catalysts, Popp said, is relatively unexplored and ripe with potential for discovery. His ultimate goal, he added, is to develop the science of the catalysts and the corresponding catalytic reactions to be suitable for application in a variety of fields.

"Successful realization of this research program is expected to provide the foundation to transform multiple classes of petrochemicals into higher-value fine chemical and pharmaceutical products, an important objective for researchers in the various petrochemical fields," Popp said.

Commentary

Charles Patton
President & Chief Operating Officer
Appalachian Power Company

We talk a lot about a national energy plan. Yet, we don't have one. In lieu of a national plan, West Virginia needs a state strategy that can someday feed into a national strategy while respecting the state's unique energy situation.

First discovered here in 1742, coal exists in 53 of West Virginia's 55 counties. It's hard to imagine West Virginia without coal. But environmental concerns and the economics of shale gas and oil are threatening the historic mainstay of our economy.

Conventional wisdom suggests an "all of the above" energy strategy: natural gas, nuclear, renewables, coal and conservation.

Coal

EPA-proposed carbon limits for new generation mean no coal plants will be built until carbon capture and storage technology is adequately demonstrated and cost-competitive. However, how we move forward on carbon regulations for existing plants will be critical to coal's future. Billions of dollars have already been spent to retrofit thousands of megawatts of existing coal plants with emissions control technology to meet current EPA regulations.

U.S. carbon emissions are at their lowest levels since 1994. We are making progress, and we must remain vigilant. Our policies must be flexible and recognize the economic hardships of higher rates and the potential decimation of a pillar of the state's economy.

"Conventional wisdom suggests an **'all of the above' energy strategy:** natural gas, nuclear, renewables, coal and conservation."

Natural Gas

A potentially game-changing opportunity for West Virginia's future is the promise of the Marcellus and Utica shale gas, which cover almost as much of the state as coal seams do.

Advancements in fracturing technology now allow for horizontal drilling instead of only vertical and have opened massive quantities of oil and natural gas to extraction. We are blessed to have both deposits – with Utica underlying Marcellus in most of the state.

The presence of the Marcellus and Utica shale present job growth opportunities in that industry and should mitigate energy cost increases for West Virginia consumers. It also will help attract businesses as entrepreneurs seek cost-effective locations.

Renewables

One promising sign of our technological transformation stems from West Virginia's 2009 renewable energy legislation. The law requires utilities to employ 25 percent renewable generation by 2025. It includes clean coal technologies and also counts three credits instead of one per MW generated by any renewable facility located on a reclaimed surface mine. As renewables become cheaper their role as part of a strategic generation portfolio will expand; however, they cannot replace baseload generation.

Conservation

Appalachian Power currently has a $6 million energy efficiency program. We must continue to expand that program and find ways to ensure that more West Virginians recognize its value.

Appalachian Power and AEP are actively engaged in nationwide efforts to pursue an "all of the above" strategy. We remain bullish on coal. We are excited with the economic resurgence of our nation's shale gas. And, we are committed to advancing renewables and conservation.

"All of the above" should not imply a disjointed free-for-all. Whether state or federal in nature, some type of coherent, strategic energy policy is required for success.

Division of Science and Research
West Virginia Higher Education Policy Commission
1018 Kanawha Blvd E Suite 1101
Charleston WV 25301-2800
304.558.4128 X 7
www.wvresearch.org

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FROM THE DIRECTOR: Exchanging ideas about energy and research

At our 5th biennial Science, Technology and Research (STaR) Symposium this fall, the prevailing theme was energy. Attendees included industry leaders, researchers and college and university faculty and students who have an interest in the industry in West Virginia. Conversations led by our panel presentations over the two-day event included some of the most remarkable dialogue I have heard recently. Our state has an incredibly rich energy history and continues to break new ground with related research and promising programs. The Symposium was an opportunity for energy insiders and people with little knowledge of energy in our state to learn and discuss West Virginia's multi-faceted energy economy.

The STaR Symposium also featured an outstanding keynote address by David Pogue – science and technology author and host of PBS's NOVA ScienceNOW. His rousing talk and follow up discussions with reception attendees were about why America is failing science and how we can turn it around.

Bolstering interest in STEM-related fields was also one of the goals of our first-ever student science video competition which concluded at the Symposium. Students from colleges and universities around the state who entered the competition were challenged to produce the best three-minute video that explains their research to a non-scientist. In an effort to pave a new path, the competition replaced the traditional student poster competition typically associated with research-themed events. Student finalists who attended the Symposium told us that this method of competition was beneficial to them because they're not often asked to explain their research to a non-scientist – especially by way of a short video. We were happy to be able to reward the winners with cash prizes for their efforts!

For up-to-date news about science and research taking place in West Virginia, be sure to "like" us on Facebook (**www.facebook.com/WV-ScienceResearch**) and follow us on Twitter (**www.twitter.com/researchwv**).

Jan R. Taylor, Ph.D.
Director of Science and Research
West Virginia Higher Education Policy Commission