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SUMMER 2018

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ABOUT
West Virginia Science & Research, a division of the West Virginia Higher Education Policy Commission, provides strategic leadership for the development of competitive academic research opportunities in science, technology, engineering and mathematics. The office directs the National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) in West Virginia, coordinates scientific research grants to academic institutions from federal and state agencies, and conducts outreach activities to broaden the public's understanding of science.

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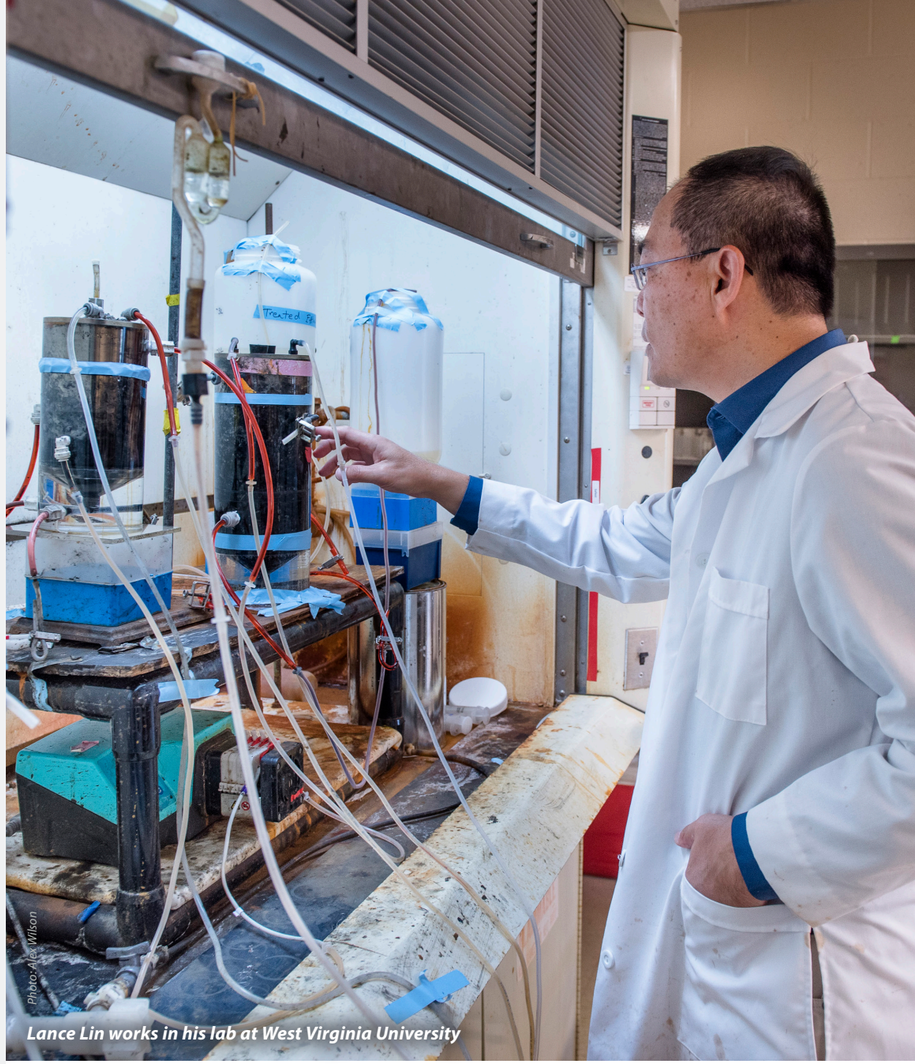

Lance Lin works in his lab at West Virginia University

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Summer research feature

ENGINEERING

WVU researcher hopes to improve coal waste management through technology innovation

Written by **Angela Sundstrom**
Photos by **Alex Wilson**

Acid mine drainage is one of the more significant sources of water pollution in Appalachia. West Virginia specifically generated a total of 107 million tons of coal combustion products in 2016, according to the American Coal Ash Association. Managing these liabilities leads to engineering challenges, but one researcher is tackling them head on.

Lian-Shin Lin, who goes by Lance Lin, is a professor of civil and environmental engineering at the Benjamin M. Statler College of Engineering and Mineral Resources at West Virginia University. A native of Taiwan, Lin completed his Ph.D. work at Purdue University in 1997. His current research focuses on technology innovation that improves resource utilization efficiency in coal mining regions.

"Right now, the way we use resources – water, energy, food production – we do it in a piecemeal fashion," Lin said. "For example, we withdraw water for energy production. It then becomes wastewater containing pollutants and it goes back to the environment. We do the same thing for drinking water. In a similar way, we take fresh water for food production, which turns into runoff carrying excessive nutrients, such as nitrogen and phosphorus, back to the environment. It can create all kinds of problems."

Though both nitrogen and phosphorus occur naturally in aquatic ecosystems, the United States Environmental Protection Agency states that too much of these elements leads to pollution. In coal mining regions like West Virginia, water quality is affected by acid mine drainage from active or abandoned coal mines. Coal waste has traditionally been managed on-site with impoundments and coal refuse piles. This leads to many potential issues for nearby communities including acidification, elevated total dissolved solids in receiving waters, toxic chemicals leaching and storage structure failures. Lin believes that technological advancement will aid in solving these wastewater problems.

"I found what I call valuable elements in coal wastes such as iron, aluminum and rare earth elements. Can we extract these chemical elements from coal wastes for different kinds of beneficial uses? That would not only reduce the burden of disposal of wastes, but also create values. It takes new technology to bring about such an innovative economy for the region."

Lin has focused on developing new iron-based applications in varying sectors including drinking water and wastewater treatment, removal of phosphorus from nutrient-laden runoff, and crop production. This approach introduces the idea of extracting iron from acid mine drainage and using it in food, energy and water sectors for value creation. These new applications enable interlinkages of material flows among these different sectors and improves resource utilization efficiency.

An innovative iron-based wastewater treatment concept is a primary focus of Lin's research. The treatment process involves taking iron from acid mine drainage and using it in domestic wastewater treatment. The new technology has several advantages over existing systems that require aeration, or bubbling air, into wastewater to provide oxygen for bacteria. However, that aeration is very energy intensive, representing approximately 50 to 75 percent of electricity consumption for an entire treatment facility. Lin's new technology uses ferric iron instead of oxygen and different kinds of bacteria to achieve the same result, thus eliminating the need for aeration and making the wastewater treatment process energy efficient.

Another advantage is the removal of phosphate from domestic wastewater. This reduces the environmental nutrient loading.

"In this case, extracting iron greatly reduces the burden for disposing acid mine drainage sludge and creates value in domestic wastewater treatment. So, this technology results in a win-win situation for both sectors."

One of the products from Lin's research is sand coated with the iron from acid mine drainage. This sand can be used as a tool for nutrient management in crop production. It helps retain phosphate and reduce

"I think West Virginia has the opportunity to be at the forefront in developing these kind of technologies and making a huge impact in coal producing regions worldwide."

- Lance Lin

Photo: Alex Wilson

Lance Lin at work in his lab

Lance Lin inspects tomatoes grown from iron-coated sand

phosphorus loading from nutrient-laden runoffs and provides a sustaining source of nutrients for crop production. Lin and his colleagues have conducted experiments with growing tomatoes using the coated sand. Though slightly delayed in growth compared to the batch provided complete fertilizer, the results were comparable and the potential savings for growers could be substantial.

"The growers here in the region, in Ohio and Pennsylvania, are very interested in this because this not only can reduce the fertilization rate so they don't have to apply as much, but with the iron-coated sand they help retain the phosphorus to provide a consistent source that helps plants grow and reduces amounts of nutrients in the runoff."

Lin credits his recent, consistent funding to the National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) Research Infrastructure Improvement (RII) Program Track-1, a grant administered at the state level by West Virginia Science & Research. Lin is affiliated with the Appalachian Freshwater Initiative project.

"This Appalachian Freshwater Initiative, the EPSCoR program, provides me the steady funding source to continue to develop these technologies. It helps in many different ways. It gives me the flexibility, the resources to try new ideas and then generate the data I need to talk to potential investors."

Innovative technology often boosts economies and creates jobs, but change can be a challenge.

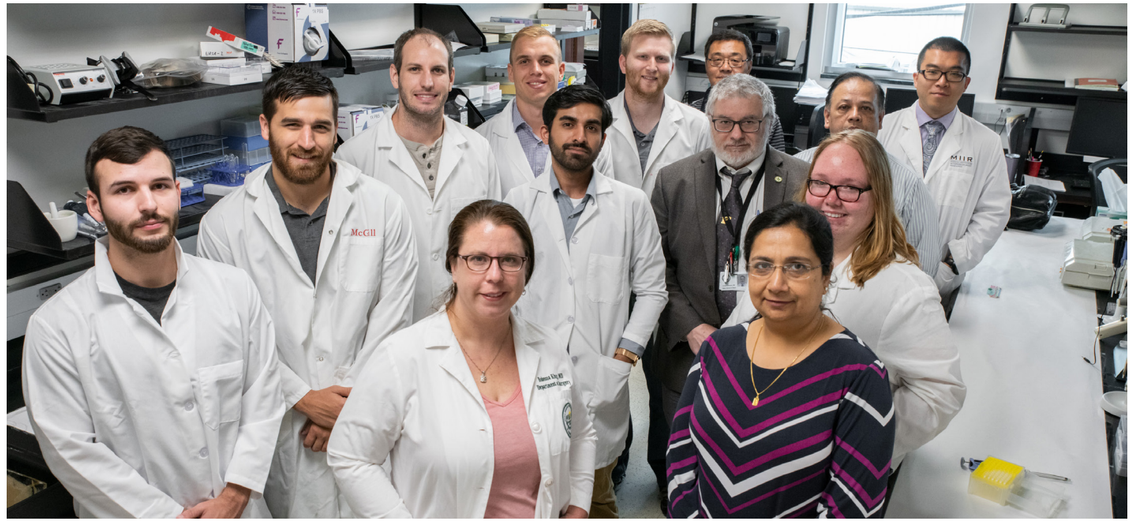
"Overcoming the social barriers for adopting new technology is really huge. It's very difficult, even more difficult than overcoming a technical barrier for new technology. In my opinion - of course, I'm biased - I think West Virginia has the opportunity to be at the forefront in developing these kind of technologies and making a huge impact in coal producing regions worldwide."

Lin is grateful for the support of West Virginia University and specifically the Statler College for standing behind his vision.

"We can turn coal waste management as a liability into revenue generating operations for the region through technology innovation."

Photo: Alex Wilson

Marshall School of Medicine research team defines possible anti-aging intervention



By **Sheanna Spence**

New research from a team at the Marshall University Joan C. Edwards School of Medicine demonstrates that the Na/K-ATPase oxidant amplification loop (NAKL) is intimately involved in the aging process and may serve as a target for anti-aging interventions. The researchers were also able to successfully demonstrate the therapeutic potential of pNaKtide, a synthetic peptide, in improving impaired physiological functions and slowing disease development.

The findings are published in the June 26, 2018, edition of Scientific Reports, an online journal from the publishers of Nature.

"I am extremely excited about the research involved in the current Scientific Reports article," said Joseph I. Shapiro, M.D., senior author and dean of the Joan C. Edwards School of Medicine. "I believe that our team has not only implicated the NAKL discovered by our colleague, Dr. Zijian Xie, in the aging process but identified a novel therapeutic target as well as a specific pharmacological strategy to actually slow the aging process. Although it will be some time before we can test these concepts in human subjects, I am cautiously optimistic that clinical therapeutics will ultimately result."

The team's extensive, yearlong study first focused on aging mice who were given a Western diet to stimulate oxidant stress to antagonize the NAKL. The Western diet increased the functional and structural evidence for aging; however, the introduction of pNaKtide slowed these changes in the mice. The same results were then replicated when human dermal fibroblasts were exposed to different types of oxidant stress in vitro by stimulating the NAKL, increasing expression of senescence markers, and causing cell injury. With pNaKtide treatment, the researchers demonstrated that the negative attributes associated with aging were significantly dampened.

Above: (front row, from left) Cameron Cotrill; Rebecca L. Klug, M.D.; Komal Sodhi, M.D.; (center row, from left) Scott Thiesfeldt, MS-2; David E. Bartlett, MS-2; Athar Nawab; Joseph I. Shapiro, M.D.; Rebecca Pratt;, (back row, from left) Brian Snoad, MS-1; Richard B. Miller, MS-2; Jiang Liu, M.D., Ph.D.; Juan R. Sanabria, M.D.; and Xiaoliang Wang, Ph.D.. Not pictured are: Alexandra Nichols; Amrita Mallick, Ph.D.; Krithika Srikanthn, M.D.; Perrine Goguet-Rubio, Ph.D.; Megan N. Lilly; Zijian Xie, Ph.D.; Nader G. Abraham, Ph.D., Dr. H.C., FAHA.

Photo: Marshall University

Dr. Jeff Groff, chair of the Institute of Environmental and Physical Sciences, is designing prototype beehive frames embedded with temperature sensors to monitor his hives.

Shepherd University professor is developing beehive sensor technology

By **Valerie Owens**

A Shepherd University professor is exploring new ways to monitor honeybees using technology that measures temperature in the hive.

Dr. Jeff Groff, chair of the Institute of Environmental and Physical Sciences, established two bee colonies in which he installed a prototype frame embedded with 32 temperature sensors. The sensors wirelessly relay information to an online application that Groff developed.

"Bees in the colony are engaged in many different activities, such as taking care of the brood - which are the baby bees (eggs, larvae, and pupae) - food storage, maintenance and temperature regulation," Groff said.

"This can all be taking place on a single frame in the hive. We expect each of these activities to have different temperature signatures."

For example, Groff said the brood is kept at a relatively constant temperature between 90 and 95 degrees Fahrenheit.

"If the brood gets too cold, heater bees will start vibrating to warm it up," Groff said. "If it gets too hot, bees will start fanning to cool it down. They even use evaporative cooling to regulate temperature. Foragers will bring water into the hive, and bees will sit there with little water droplets on their tongues to evaporate."

The data Groff is collecting should be able to show if a brood is present and sufficiently abundant, and thus indicate if the colony has a healthy, productive queen.

Groff said the winter months are the most dangerous time for a bee colony because there's no food to forage and it's cold, so the bees cluster together in the hive to stay warm. Using the sensors, he will be able to see a hot spot where they are clustering and determine if they are moving enough to get to their stored honey. Groff said the sensors might be valuable in alerting beekeepers if their bees are going to swarm. This is when a large number of the workers and queen fly away to find a new home once the hive becomes overcrowded.

"There's probably a temperature signature associated with that behavior. The pre-swarm activity involves bees doing things like clustering together near the hive entrance and not doing normal work. There could be an early warning signal that comes out of these types of data. If you know your bees are going to swarm, you can try to prevent it or capture the swarm to start a new colony."

Starting in the late 1990s, beekeepers noticed the honeybee populations were declining due to factors such as disease, parasites and pesticide use. Groff hopes the technology he's developing might prevent further decline.

"By monitoring the temperatures in a high resolution way, there should be signals that show a colony is weak, giving beekeepers a chance to intervene," Groff said. "Signs that a colony is getting weak include not putting enough honey away, not preparing stores for winter or a queen not doing a good job of laying eggs."

Groff expects students to benefit from working with the bees. He teaches a physical computing class that deals with building electronic sensor systems that can be embedded in an environment to collect data or manipulate that environment. Shepherd's new concentration in sustainable food production will also incorporate beekeeping, with a goal of establishing an apiary at the university's Tabler Farm for teaching and research. An environmental geomatics student is planning to do independent research in the fall that will involve streaming data from beehives into online maps.

"The first phase of this research project is to work out kinks in the prototype and build up to a situation where you have multiple frames in a single hive monitoring temperature so you can get a three-dimensional picture of what's going on," Groff said.

Groff hopes his work will eventually help advance our understanding of honeybee health and behavior.

"This is a new instrument, and every time there's a new instrument in science new discoveries are made, and often those are unexpected discoveries," Groff said. "Hopefully some unexpected things will come out of my data."

Photo: Shepherd University

West Virginia State University to honor Katherine Johnson with statue, scholarship

By **Jack Bailey**

West Virginia State University (WVSU) and the WVSU Foundation are honoring distinguished NASA mathematician and WVSU alumna Katherine Coleman Goble Johnson with the establishment of an endowed scholarship and the erection of a bronze statue on campus.

A dedication ceremony for the statue and scholarship is planned for Saturday, August 25, 2018, the day before Johnson's 100th birthday. The statue will be placed in WVSU's quad, the heart of campus, with accompanying seating and landscaping.

"Rarely are we presented an opportunity to attach ourselves to a historic moment. I believe this is one of those times," said WVSU President Anthony L. Jenkins. "Despite her numerous accomplishments, she never forgot WVSU, White Sulphur Springs, nor the state she loves so dear. Then, as throughout her life, Katherine has embodied the true essence of a West Virginian; strong values, unbreakable resolve, and a work ethic that is second to none."

The life-sized bronze statue depicting Johnson during her years as a mathematician at NASA will be created by West Virginia sculptor Frederick Hightower, a WVSU alumnus.

The endowed scholarship will build upon Johnson's legacy as a pioneer in mathematics and will benefit students majoring in Science, Technology, Engineering and Mathematics (STEM) with emphasis on assisting talented individuals who are underrepresented in those fields. The scholarship is endowed at $100,000.

Johnson received the Presidential Medal of Freedom in 2015 and has been widely recognized following publication of the book, "Hidden Figures," and by the movie of the same name.

West Libery biology department scores big wins at international conference held in Pittsburgh

By **Maureen Zambito**

Dr. Zachary Loughman and 11 College of Science students attended the 22nd International Association of Astacology (IAA) meeting in Pittsburgh recently and came home winners.

"This was the first international meeting I have taken students to, and I have to say, they were nothing but wonderful and represented us well! Every single grad student in attendance was offered the opportunity to pursue a doctoral degree with at least one of the PI's there. Several students were encouraged to apply for agency and conservation organizations. Astacologists came up to me and joked that the WLU students knew just as much if not more about astacology than they did," Loughman said.

The meeting took place July 9 – 13 at the Carnegie Museum of Natural History and included the Symposium on Freshwater Crayfish.

Every student presented at least a poster or an oral presentation. Two won big awards for their posters: Emmy Delekta, an ecology, evolution and organismal biology major from New Cumberland, W.Va. and Daniel Meyer, a graduate student from Glen Dale, W.Va. enrolled in the Master of Science in Biology degree program.

Only six student posters were selected out of 40 submitted for awards, making the students' win even more rewarding.

The IAA also presents two awards to professional astacologists at each conference, the Distinguished Astacologist Award and the Noble Crayfish Outreach Award.

Out of 10 professors nominated, Dr. Loughman was picked for the Noble Crayfish Outreach Award.

"The absolute best thing about this award is that it is student driven. Young scientists in the astacological community nominate a professional who has been encouraging and helpful and served as a mentor for them. In addition to teaching, the award honors an astacologist that serves as an advocate for crayfish via public outreach, teaching crayfish oriented classes," he explained. "I am proud to have received it."

The previous IAA meeting and symposium was held in Japan and next year's gathering is planned for the Czech Republic.

Above: (From left) Dan Meyer, Dr. Zachary Loughman and Emmy Delekta display their IAA awards.

Photo: West Liberty University

WVU geologist receives NASA grant to research environments similar to Mars

By **Kristin Uppercue**

Is there life on Mars? One West Virginia University (WVU) researcher is discovering ways to improve the search for life on the desert planet.

Kathleen Benison, professor in the Department of Geology and Geography at West Virginia University, has received a two-year grant from NASA's Astrobiology Program to study modern and fossil microorganisms trapped in halite and gypsum from acid salt lakes.

"The goal of my research program is to reconstruct detailed environmental conditions, including past lake water and groundwater depths, pH, past air temperatures and humidity and the history of continental sedimentary rocks," Benison said.

Benison's research will focus on saline lakes because salt minerals that form there trap fluid inclusions, tiny remnants of past lake waters, atmosphere and microorganisms. The acid salt-lake environments on Earth are similar to past environments on the surface of Mars. As a result, the research could inform scientists how to better search for life on Mars.

"Acid saline lake systems are important because they represent some of the most extreme environments on Earth and are close analogs to past environments on Mars," Benison said. "If we can understand relationships among rocks and minerals, waters, atmosphere and life in such environments, we can predict how desert environments will change in the future."

Most microbiological studies use traditional biological methods, including culturing and DNA metagenomics. Benison's research is different because she uses microscopy to visualize cells and other organics and spectroscopy to chemically characterize the microbes and organic compounds.

"These methods can yield important information about type abundances of microorganisms and can serve as a simpler, preliminary way to examine preserved microbiology prior to any future culturing or DNA metagenomics analyses," Benison said.

Benison

Benison will test samples of halite and gypsum salts she collected from modern acid saline lakes in western Australia and Chile. She will also examine ancient halite from Earth's subsurface taken from Kansas and Northern Ireland.

"One of the biggest questions of space science is does life exist, or has it ever existed, anywhere besides on Earth? Currently, the methods being used by rovers, landers and satellites to study Mars are methods that would not be able to detect microorganisms or organic compounds trapped in terrestrial halite and gypsum," Benison said. "So, if life exists within halite and gypsum on Mars, we do not yet have a way to detect it. Better refining methods for detection of life in terrestrial Mars-analogs, such as the acid lake halite and gypsum, could then be applied to future missions to Mars, as well as to any rocks returned from Mars in the future."

Two geology graduate students and one undergraduate student will also assist with the research.

Photo: West Virginia University

WVU Tech's Hatipoglu selected for DOE research program at Oak Ridge National Laboratory

By **Zac Carrier**

WVU Tech electrical engineering professor Dr. Kenan Hatipoglu has been selected to participate in the United States Department of Energy's Visiting Faculty Program at the prestigious Oak Ridge National Laboratory in Tennessee.

He'll spend the summer at the laboratory working on his project "Dynamic Voltage Stability Enhancement of a Distribution System with High Penetration of Distributed Energy Resources during Emergency, Hazard, and Disaster Events to Improve Grid Resiliency."

"This projects aims to keep electrical energy running with minimum interruption to people experiencing extreme conditions. It is targeting for uninterrupted power to people when it is needed the most," he said.

Hatipoglu grew up in Bursa, Turkey, where he caught the proverbial lightning bug at an early age.

"I started learning about electricity when I was at high school where I was trained to be an electrical technician. That was the starting point, and I decided to teach it at college level. It is a vibrant, evolving field that impacts everybody's life," he said.

He moved to the U.S. to continue his studies, earning his Ph.D. in electrical engineering with a specialization in electrical energy and power systems from Tennessee Technological University in Cookeville, Tennessee.

As a graduate student, he was well aware of the Oak Ridge National Laboratory, located just over an hour from the university. The lab is a bastion of research. It's where work began in earnest on the Manhattan Project. It's where the first medical isotopes were created and where the first successful bone marrow transplant was performed. Today, it's home to one of the fastest super computers in the world and a myriad other projects aimed at changing the face of everything from energy and national security to advanced materials and neutron science.

Now, he'll revisit the lab as a researcher.

Hatipoglu's project has been in the works for five years. While it's a complex idea, the goal is simple: use distributed energy resources (solar, wind, hydro, etc.) to create a more resilient power grid that minimizes power loss during an emergency.

Here's how it works: imagine a downtown area with a conventional power plant (think coal or natural gas-fired) to the east and distributed energy resources (solar panels and wind turbines) to the west.

Now imagine that a tornado hits that downtown area and creates a fault in the power system. Typically, customers on the west side of town would experience a loss in voltage or a complete blackout while many of the customers in the east would still be receiving power from the plant. That's because most of our current voltage-regulating solar or wind resources simply disconnect during emergency events.

Using Hatipoglu's system, these resources would instead support the grid during this disturbance and immediately begin to make up for the power loss in coordination with the conventional power plant. The customers on the west side of the fault would not experience the same loss of voltage because those wind or solar resources would continue to generate power instead of going offline.

"It's a coordination. We like to have each possible generation unit working together so the whole system can come back online in a shorter period of time," he said.

That impact would not only help more customers stay connected, but it would help to keep the power loss localized. It may even help the power company more quickly determine where the impacted areas are.

"If you detect and clear a fault as soon as possible, the damage will be minimized. Lots of things are depending on electricity in the United States. Less people might suffer," he said.

Hatipoglu will work on the project alongside ORNL faculty member Yaosuo "Sonny" Xue and present his research progress at the end of the ten-week program.

He said he's looking forward to the exchange of ideas and to making his research more competitive. He's also very interested in seeing ORNL's state-of-the-art labs.

"I am honored to be selected," he said. "This is a highly competitive program that will allow me to collaborate with some of the most talented scientists in the world. I hope to learn lots of things and bring them back here to share with my students and my colleagues, to get them excited and to accomplish even more."

Hatipoglu

Photo: West Virginia University Institute of Technology

Participating high school students at Glenville State College

Photo: Glenville State College

Students participate in summer research and outreach across state

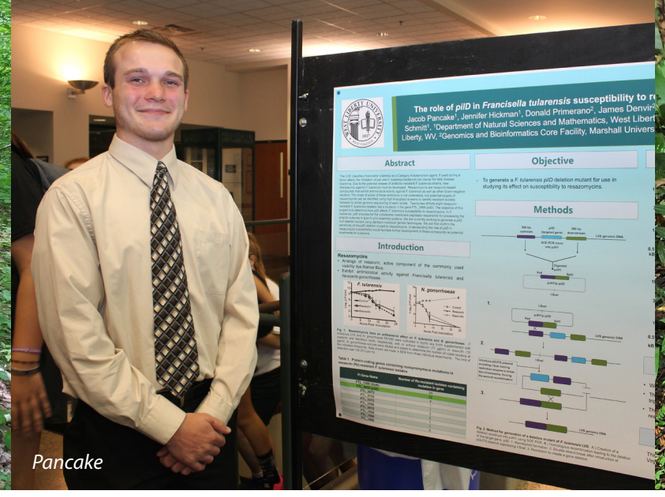
By **Angela Sundstrom, Maureen Zambito, Jack Bailey and Dr. Erica Harvey**

Underrepresented high school students learn STEM-based skills

The Health Sciences & Technology Academy (HSTA) is a mentoring program that helps participating high school students enter and succeed in STEM-based undergraduate and graduate degree programs. Their goals include increasing college attendance in West Virginia, improving STEM education in public schools, empowering communities through youth leadership development and increasing the number of health care providers and STEM educators in underserved communities.

This year's programs included forensics at Glenville State College, "Fun with Science" at Marshall University and both Senior Camp and Biomedical Camp at West Virginia University.

LaBella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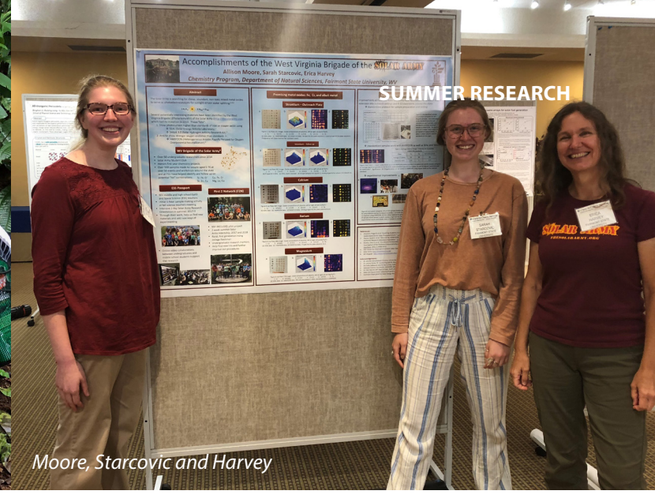
Barnett



Moore, Starcovic and Harvey

Photos: (left to right) West Virginia Wesleyan College and West Liberty University

Photos: (left to right) West Virginia State University and Fairmont State University

SURE grant research opportunity providing West Virginia Wesleyan's LaBella with valuable insights

Jessica LaBella is one of several West Virginia Wesleyan College students benefiting from a Summer Undergraduate Research Experience (SURE). The program is funded by West Virginia Science & Research, a division of the West Virginia Higher Education Policy Commission.

Labella, a junior from Bridgeport, received the SURE grant fellowship to work on the project entitled "Effect of Light Interception on Photosynthetic Capacity and Vegetative Reproduction of the Endangered Plant, Running Buffalo Clover" with Dr. Jordge LaFantasie, assistant professor of biology and director of the greenhouse, as mentor.

Running buffalo clover (*Trifolium repens, RBC*) is an endangered forest-edge/meadow species that requires filtered light to grow and reproduce. Historically, the plant was maintained by various disturbances, including bison trails, grazing and wallows, tree fall and fire.

The research experience has provided LaBella with several benefits, including a few that were unexpected.

"This project has provided the chance for me to gain a greater depth of knowledge on concepts discussed in classes, as well as learn proper lab techniques and gain hands-on field experience. It definitely has offered a challenge in the sense that research requires a higher level of thinking and of problem-solving skills."

Labella is one of ten Wesleyan students participating in a SURE Grant program. These students also worked with 5th-11th graders taking part in the West Virginia Wesleyan Summer Gifted Camp program in the Reemsnyder Science Center.

West Liberty student researchers share findings

West Liberty University's student researchers shared their summer work with campus on Friday, July 20 in Boyle Conference Center. In attendance were family, friends, faculty and the public.

"Our science majors gain great experience and hands-on education through the SURE program. It takes them out of the classroom and into the laboratory and field for work that is valuable as they apply for graduate school and prepare for professional fields," said Dr. Karen Kettler, interim dean of the College of Sciences.

After faculty mentors described the summer research of each student participating and shared video images of the action, the students took their places by their research papers and computers to describe the facts and conclusions of their projects.

Topics of study included things like neurosurgery and skulls, infections and antibiotics, water quality in streams, crayfish and snakes and vascular variations.

Summer Undergraduate Research Experiences (SURE) are funded with support from West Virginia Science & Research, a divison of the West Virginia Higher Education Policy Commission. Topper-SURE offers each student researcher a $3,000 stipend along with a valuable research experience for their resume. Eleven students particpated along with faculty mentors.

WLU's College of Sciences offers many opportunities for research in a variety of labs. Just last year one of its professors, Dr. Joseph Horzempa, was selected as West Virginia Professor of the Year by the Faculty Merit Foundation.

WVSU students selected for international research opportunities

Two West Virginia State University biology majors were selected to participate in international research opportunities this summer. Students traveled to Costa Rica and France to conduct hands-on research alongside accomplished scientists.

Edwina Barnett traveled to La Selva, Costa Rica, to study the effects different treatments have on seedling germination in legumes through the Research Experience for Undergraduates for U.S. Underrepresented Minority Students Summer Program.

Ky'Achia Atkins traveled to Toulouse, France, where she attended a research workshop and had the opportunity to shadow a French scientist.

"This is a great opportunity for an undergraduate student that I wouldn't have gotten the chance to attend without West Virginia State," Atkins said.

Added Barnett, "It truly takes a village, and the relationships I have created at WVSU can attest for my success thus far and in the future."

Both students believe these summer research opportunities will diversify their skills sets, help make them well-rounded scientists in their fields and ensure success.

The opportunities were provided through the Kentucky-West Virginia Louis Stokes Alliance for Minority Participation, a consortium of colleges and universities working to create, enhance and expand programs designed to broaden participation and increase the quality and quantity of students from underrepresented populations receiving degrees in science, technology, engineering, and mathematics (STEM) disciplines.

Fairmont State represented at California conference

Fairmont State University's Dr. Erica Harvey, professor of chemistry, and chemistry majors Sarah Starcovic and Allison Moore represented the WV Brigade of the Solar Army at the National Science Foundation Center for Chemical Innovation - Solar Fuels Capstone meeting July 8-12 in Ventura, California.

The students presented a poster on their research at the meeting, including work carried out in a two week internship with rural, first generation rising freshmen STEM majors earlier this summer. Dr. Harvey joined colleagues from around the country on a panel discussion about outreach the last night of the conference.

The Solar Army is a nationwide group of solar energy researchers and students. Fairmont State University is the headquarters of the WV Brigade. Hundreds of undergraduate and K-12 students, over a hundred teachers and numerous community members, aged 5-75, have participated in making and testing mixed metal oxide research samples as part of the WV Brigade during the past 5 years. The research goal is to find a photoelectrocatalyst to help sunlight split water into hydrogen and oxygen gases, thus storing solar energy in a renewable fuel.

"The conference made our research seem more real. It was super cool going to California and travelling across the country for the first time, especially being from a town of 100 people," Starcovic said.

Travel was supported by CCI Solar, the NASA WV Space Grant Consortium and College of Science and Technology at FSU, and the National Science Foundation INCLUDES pilot (Award No. 1649323), 2016-8.

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From the director: *universities leading the way in innovative environmental protection*

Taylor

We have only one world and the environment in which we live. That much is clear. What is less clear is the proper way to maintain our lands and waters to support not only humans but the natural communities that make our landscape so rich.

One of the pressing issues is that of water quality, while also advancing economic opportunity through industry. West Virginia holds the source water for much of the eastern United States, and it's important we protect it both environmentally and in the face of quantity issues that may arise from a warming planet. Higher education institutions and the research they produce can aid in this struggle.

Dr. Lian-Shin "Lance" Lin is at the forefront of environmental research, using his technical skills for creative problem solving with technology. He is using materials from acid mine drainage to help treat water coming from waste treatment plants. Lin is also involved in the Appalachian Freshwater Initiative (AFI), a statewide EPSCoR research team consisting of biologists, ecologists, environmental engineers and scientists, chemists and geologists focused on understanding and detecting the ecological and biological effects of contaminants in water under varying climate change scenarios.

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