SUMMER 2024

UAH Magazine

A PUBLICATION OF THE UNIVERSITY OF ALABAMA

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SEE YOU SOON, CHARGERS!

MARK YOUR CALENDARS

Join us for **Week of Welcome**!
August 16-24, 2024

The University of Alabama in Huntsville's Week of Welcome (WOW) is a campus-wide set of programs and activities designed to welcome new and returning students to the UAH campus. WOW takes place at the start of the fall semester and is packed with social, educational, and informational programs that allow you the opportunity to interact with other UAH students, faculty and staff. It's a great way to make new connections, find your way around campus, and receive free spirit items and Charger gear!

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- *This is Community*
- *Chargers After Dark*
- *Rock the Rec*
- *Charger Blue BBQ*
- *Service Saturday*

...and much more!

For the latest on 2024 WOW events, visit
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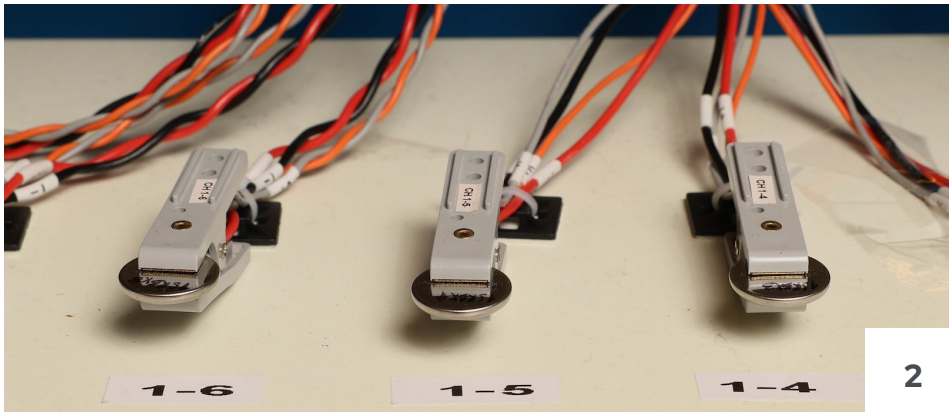

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UAHMagazine

UAH Magazine brings together our academic accomplishments, innovative research projects, extracurricular organizations and alumni into one engaging source for all things UAH.

If you would like to receive a hard copy of this issue of UAH Magazine or be added to our mailing list to receive future issues, please contact **omc@uah.edu**.

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ELECTRIFIED

UAH helps Alabama lead charge to meet surging battery needs

With the number of electric vehicles (EVs) in the United States projected to skyrocket to 26.4 million by 2030, the need is great for not only producing, but improving, the safety and efficiency of the batteries that power them, as well as cell phones, autonomous unmanned vehicles and smart electronics. UAH researchers are doing their part to ensure Alabama is leading the way to power this coming revolution.

Central Alabama boasts the largest continuous vein of graphite in the entire country, and the state is set to open the nation's first graphite processing facility, a 42,000-acre site in Coosa County that will process coated spherical graphite, the mineral that makes up roughly 50 percent of a lithium-ion battery. Set to open in late 2024, the plant will turn out 7,500 metric tons of graphite in its first year, ramping up to 40,000 tons by 2028. And when the batteries that use these raw materials come to the end of their lifespan, many will go to a Tuscaloosa recycling plant capable of processing up to 10,000 tons of lithium-ion batteries per year.

With the "cradle" and "grave" aspects of the battery life cycle covered to the south, UAH is fast helping to transform North Alabama into a national hub focusing on the heart of the battery technology timeline: making lithium-ion batteries safer and more efficient for users, both on land and at sea. University research initiatives recently garnered nearly $1.5 million in federal funding to bolster the vital middle prong of this burgeoning domestic industry.

Turning down the heat

News of sudden battery failures impacting EVs and airplanes, as well as smart electronics and utility-scale energy storage, drove Dr. Guangsheng Zhang to research a phenomenon called "thermal runaway," a condition where the lithium-ion cell enters an uncontrollable self-heating state, causing smoke, fire or even explosions. The researcher won a National Science Foundation Faculty Early Career Development (CAREER) Program award totaling $598,181 to support his research, slated to run through April 2028.

"I was shocked by news that lithium-ion batteries may suddenly fail energetically, all without warning," Zhang says. "What is most concerning is that, in some cases, the batteries caught fire when the devices or vehicles were not in use. Investigations have attributed many of those fires to thermal runaway caused by internal short circuit (ISC)."

Zhang focused his postdoctoral work on in situ studies of fuel cells to develop diagnostic methods to trigger and characterize ISC, a critical failure mechanism of lithium-ion cells. "There are still many unknowns," he notes. "What is the threshold of ISC causing thermal runaway? How does ISC form and slowly evolve to that threshold, in some cases after years of normal operation? How can ISC be prevented from reaching the threshold?"

Answering these questions is the goal of the current project. The researcher believes the insights gained will inspire engineers in battery-powered industries to derive innovative solutions to prevent thermal runaway. The project will also spark educational and outreach activities, such as seminars on energy storage, new courses on batteries and mentoring undergraduate research with hands-on workshops.

Building smart systems to battle 'range anxiety'

Another way to improve the function of lithium-ion batteries is by improving the onboard electronic battery management systems (BMS) that work to detect abnormal behavior. Dr. Avimanyu Sahoo, an expert in intelligent control systems, is collaborating with Sandia National Laboratories to develop control methods that emulate characteristics of human intelligence, such as adaptation and learning, to enhance the safety, efficiency and longevity of lithium-ion battery packs. Sahoo, who will act as principal investigator for the project, was awarded a National Science Foundation Established Program to Stimulate Competitive Research (EPSCoR) Fellowship totaling $279,105 to advance these goals.

"Given my background in intelligent control, I recognized the potential to improve battery management systems by incorporating advanced algorithms, enhancing the accuracy of operational decisions, ensuring the safety of the battery pack, the vehicle and its users," the researcher explains.

Intelligent systems can gather, analyze and respond to data they collect, making them especially applicable to improving BMS behavior. Developing a "smart" BMS capable of monitoring the smallest part of a battery pack in real time and learning abnormal behavior for future prediction could prove the key to addressing battery concerns.

"Our project is centered on crafting an AI-driven model aimed at achieving a more precise monitoring of individual cells within a battery pack," Sahoo notes. "Imagine having a highly intuitive system within electric vehicles that can keep a constant and detailed check on each battery cell's health and performance. This system would not only foresee potential internal issues and regulate temperature to prevent overheating, but also ensure each cell operates optimally."

> The ultimate goal is to create a more reliable and efficient battery.

The ultimate goal is to create a more reliable and efficient battery, charting a new frontier in energy management, as well as minimizing the risk of pack overheating, while addressing "range anxiety" drivers might experience due to long distances between charging stations.

Taking temps in the deep blue sea

Not to be outdone by advances on land, a UAH researcher is working on a battery initiative for the Office of Naval Research. Dr. George Nelson earned a Defense Established Program to Stimulate Competitive Research (DEPSCoR) award for $600,000 to study how high-energy-density lithium-ion batteries degrade over a range of temperatures, particularly relevant to unmanned underwater vehicles (UUVs), essential for work in environments that are inhospitable or inaccessible for humans, like mapping the ocean floor, inspecting undersea infrastructure—pipelines, cables, oil rigs or offshore wind installations—or searching for aircraft wreckage. The researcher is leading the three-year study in collaboration with Purdue University as part of the DEPSCoR Research Collaborations program.

"When it comes to studying temperature effects on batteries, we've focused on higher temperature operation, like leaving an EV in the sun on a hot day," Nelson says. "When I started discussing temperature ranges with my collaborator, Dr. Partha Mukherjee, the topic of operation at colder ocean temperatures, like those seen in UUVs, surfaced. We were not aware of studies that involved high-capacity materials at low temperatures, so it seemed natural to pursue that area."

Lithium-ion batteries contain a mixture of materials: the millions of particles that store the lithium, as well as substances that help move the electric charge through the battery and a binder that acts like a "glue" holding all these materials together.

"Changing how these materials are arranged changes how much and how fast energy can be stored or withdrawn from the battery," Nelson says. "Materials like silicon or tin can hold a lot of lithium, but that also means the particles swell and shrink a lot—by 300% or more—when the battery is charged and discharged. This makes the battery fall apart inside and fail prematurely. Ultimately, we want to understand how the materials inside the battery should be mixed to help them operate longer under demanding environmental conditions."

All in all, UAH minds working on projects like these are making a significant difference in helping America transition to its electric future. ■

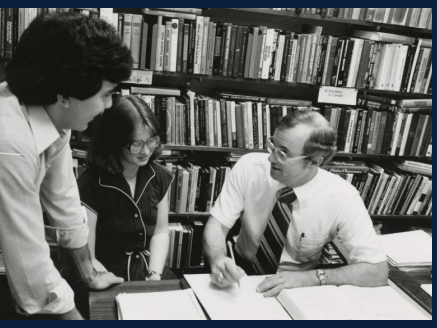
UNIVERSITY **ANNOUNCEMENTS**

David Moore, director of the Louis Salmon Library at UAH, has been promoted to librarian IV. He is the first UAH librarian to achieve this designation, which signifies a high level of professional achievement, leadership and commitment to the field of library science. "Our librarian ranking system reflects positively on the quality of the UAH Salmon Library by promoting professional growth, ensuring high standards, fostering leadership and enhancing user satisfaction within the library," Moore says. A graduate of The University of Alabama, he has worked at the Salmon Library for 26 years and served as director for the past 14 years.

Doctoral student Syed Raza was awarded a NASA Future Investigators in NASA Earth and Space Science and Technology (FINESST) fellowship to study space weather to improve predictive methods for coronal mass ejections from the sun. Forecasting the arrival time of these powerful events is vital to protecting against solar threats to satellites and near-Earth technology. FINESST awards are research grants for up to three years and $50,000 per year.

Dr. Jennifer English, associate dean of engineering for undergraduate education and associate professor of electrical and computer engineering, was selected by Business Alabama as one of Alabama's Top Women in Tech: 24 in '24. English was cited for "her visionary leadership and tireless efforts in establishing programs for academic success and career development for UAH engineering undergraduates, nurturing the next generation of tech talent."

UAH teamed with NASA's Marshall Space Flight Center and Downtown Huntsville Inc. for the annual celebration of NASA and the city of Huntsville, NASA in the Park. The event returned to Big Spring Park and featured more than 60 exhibits and demonstrations, including the College of Engineering and the UAH Propulsion Research Center, on hand to promote propulsion education to the community.



In Memoriam: Dr. Lee Cook came to UAH in 1967 as a part-time assistant professor of mathematics while working for NASA on the Saturn V. He joined the University full-time in the summer of 1969 and retired 28 years later in 1997. He served twice as chairman of the Mathematical Sciences Department, Assistant to the President, Associate Dean of Science and Director of the Institute for Science Education. Dr. Cook was a founding member of the UAH Retirees' Association and its first president.

At UAH, we are focused on sharing the real-world impacts of our discoveries with our community

Welcome to the Summer 2024 edition of UAH Magazine. Since the retirement of FOCUS: the UAH Research Magazine last year, we have made it our mission to incorporate more research-focused content into each of our publications on a regular basis. This edition is full of stories covering groundbreaking discoveries, from North Alabama to the cosmos.

In this edition, you can read more about recent natural phenomena—not only the cicadas, but the rare sighting of the northern lights—with explanations from UAH experts. From exploring the reasons for life expectancy inequities in Alabama, to studying cardiometabolic disease in the Deep South, to finding ways to make electric vehicle batteries safer and more efficient, UAH experts are innovating to improve the quality of life for our neighbors, community and the world at large.

Our researchers and alumni are not the only ones making headlines—we are very proud of the accomplishments of our students. From prestigious scholarships to grant awards and beyond, UAH students are making their mark in their respective fields. For instance, a team of students in the College of Engineering received a grant from the Environmental Protection Agency to develop a low-cost household water filter that will help make our drinking water safer. As a research university, we are focused on the real-world impacts of our work. It is gratifying to see that even our undergraduate students are able to take advantage of such hands-on learning opportunities.

We also had a near-record number of Academic All-Star student-athletes this spring. We are proud of the accomplishments of these students on the field, and even more impressed by their abilities to exemplify excellence in the classroom. Our goal here at UAH is to prepare our students for bright futures in their chosen profession, and it is clear that they are destined for great things.

Lastly, one of the things that makes UAH such a special place is our focus on real-world research opportunities. Not only does research support our academic goals and contribute to scientific literature, but it also promotes economic development in our community and across the nation. However, we would not be able to offer such robust research opportunities without our strong partnerships. Dr. Robert Lindquist and the entire team in the Office of Research and Economic Development remain committed to fostering partnerships with leaders in industry, government and academia to ensure cutting-edge research opportunities for our students. If you would like to learn more about our research projects for a potential partnership opportunity, please contact the UAH Office of Research and Economic Development.

Thank you for a great 2023-24 academic year. I can't wait to see what the new year brings. Go Chargers! ■

Charles L. Karr

SPRING'S SONG

Brood XIX cicadas impact our ears, ecosystem

Their droning chorus – is that a fleet of flying saucers? – seemed inescapable. When the cicadas of Brood XIX emerged across Alabama and elsewhere this spring, they made a large impression on the regular above-ground inhabitants.

The ringing in human ears may be gone, but the long-term consequences for other species could just be getting started. Expect a fluctuation in acorn production in 2025 and 2026, says Dr. Carrie Deans, an entomologist in the UAH College of Science.

Deans has been called on repeatedly to discuss the Brood XIX emergence for local media (WAAY-TV, Channel 31) and in person. She's appreciated the opportunity to share scientific insights about our natural world with a public rarely so focused on the ecosystem.

While cicadas are not her specialty – she studies agricultural pests such as the Japanese beetle – she's as fascinated by them as any layperson. She highlighted some other research that has looked at the ecological impacts of cicada emergences, including John Parker's work, published in Science (Vol. 382, Issue 6668, Oct. 19, 2023), on indirect effects of emergence on other insects and trees. The paper was frequently cited in news accounts of 2024's loudest natural phenomenon.

"Having all these cicadas around had a huge impact on something like 80 different bird species," Deans says. "Caterpillars that these birds are usually feeding on actually grow in number because they're not being predated upon as much as in a typical year."

And more caterpillars eat more leaves on more oak trees.

"This tends to have the effect where they produce fewer acorns the following year. But then the second year they actually produce a really big number of acorns. The caterpillars put a lot of pressure on the tree. Maybe there's some overcompensation for that, which is pretty common in plants."

Good news for oaks and other trees, Deans says, is a direct result of the cicada emergence.

"A lot of people wonder about the effect of cicadas on trees," she says, noting that cicadas feed on xylem, plant vascular tissue that carries water from the roots to all parts of the tree. "These nickel-size holes in the soil where cicadas crawl up actually help ecosystems with water infiltration. The cicadas are basically aerating the soil."

If there are any negative effects of cicadas feeding on trees, this benefit to the soil might counteract them, but Deans hasn't found specific research yet.

Perhaps that question can be answered when Brood XIX returns in 2037. ■

SUN SHOWER

Geomagnetic storm brings northern lights south

The National Oceanic and Atmospheric Administration issued a G4 solar storm watch on May 9, 2024, following a series of solar flares and coronal mass ejections (CMEs) issuing from a sunspot region known as 3664. Geomagnetic storms are disturbances in Earth's magnetosphere caused by an exchange of energy with the sun measured on a 1 - 5 scale, categorized as minor, moderate, strong, severe or extreme.

The G4 conditions were later upgraded to G5, marking the first extreme geomagnetic storm since October 2003, and on May 10-12, observers across Alabama were treated to a rare glimpse of the northern lights. The Earth was struck by energetic charged particle radiation from a series of X-class solar flares as well. The most powerful category of these energetic eruptions of relativistic particles and electromagnetic radiation resulted in reports of disturbances to power grids, communications systems and spacecraft operations.

"The aurora are a beautiful manifestation of some of the space research we do at UAH," says Dr. Gary Zank, director of UAH's Center for Space Plasma and Aeronomic Research (CSPAR) and the Aerojet Rocketdyne chair of the Department of Space Science. "When the heliosphere, the protective bubble that envelopes the solar system, enters a period of so-called solar maximum, the interplanetary environment becomes severely disturbed by large and frequent disturbances emanating from the surface and atmosphere of the sun.

"This is space weather in action and it is a major part of what the CSPAR and the Department of Space Science study. The exquisite aurora that we are witnessing as far south as Alabama are a direct consequence of energetic charged particles, particularly electrons, flooding the atmosphere where they collide with atoms causing them to radiate red and green colors. We have developed some of the most advanced physics-based models to describe how these energetic particles travel to the Earth from the sun. The recent eclipses and now the aurora have proved to be wonderful vehicles to bring the science of space and the sun to the attention of people throughout the state."

The historic storm marked the beginning of this solar cycle's solar maximum, with more active sunspot regions, solar flares, CMEs and geomagnetic storms likely in the coming months. ■

UAH CHEMISTRY: ONE GOAL, MANY PATHS

First-class programs, facilities and the faculty support to excel

Alabama is a national leader in chemical production, hosting over 200 international and U.S.-based companies that employ more than 10,000 workers. Chemical manufacturing contributes over $3 billion annually to the state GDP each year, and the industry ranks as Alabama's second largest exporter. Thanks to UAH's degree programs and local research opportunities in chemical engineering, the qualified workforce needed to support this booming industry is growing.

Three new degree programs launched

The UAH College of Science launched its chemistry Ph.D. program in fall 2023, offering three paths to success. The academic path leads graduate students to a traditional doctorate in chemistry, while the entrepreneur and executive paths combine a chemistry education with business, with the executive path offering a doctorate in chemistry and an embedded MBA as well.

UAH also provides a master's and doctorate in materials science, both highly regarded by industry professionals. Students in this interdisciplinary field explore the properties of matter and its applications to various areas of science and engineering, while the Ph.D. in materials science is a tri-campus offering from The University of Alabama, exploring everything from biomaterials to catalytic converters.

Lastly, the department boasts a Ph.D. in biotechnology science and engineering, where aspiring chemists can embrace this promising new avenue to hunt for innovative bioproducts and the exploitation of biological systems as technologies that benefit humankind in numerous ways.

To support this wide variety of hands-on degree programs, the department is committed to providing first-class instruction and mentoring and is equipped with exceptional facilities. For instance, the McMillian Nuclear Magnetic Resonance Facility is available to graduate students as well as industry partners.

Faculty presents an exciting array of chemical research

Dr. Bernhard Vogler, department chair, has expertise in structure elucidation of natural products by DNA mismatch repair. Structure elucidation is the process of determining the chemical structure of a compound. For organic compounds, it often involves the use of nuclear magnetic resonance spectroscopy as well as other characterization techniques, including mass spectrometry, infrared spectroscopy and X-ray crystallography.

Dr. James Baird focuses primarily on theory directed toward questions on the border between chemistry and materials science, working closely with students who are interested in experiments. All students are encouraged to analyze data and form conclusions based on their own findings. Recent research includes solid state diffusion, crystal growth and critical phenomena involving chemical reactions in binary liquid mixtures with a consolute point.

Dr. Sharifa Love-Rutledge researches diabetes and insulin resistance, focusing on two goals: identifying and characterizing early targetable signals related to the dysfunction of insulin-secreting beta cells and understanding the effect of these proteins on beta cells and insulin sensitive tissues such as liver, muscle and fat. Students work to identify disease pathways and isolate biomarkers for disease status during the onset of diabetes using biochemistry, analytical chemistry and molecular biology methodology.

Dr. Olaf Nachtigall heads the Nachtigall Lab, focusing on bioinorganic and laser chemistry. The goal of current bioinorganic projects is to mimic enzymes with rare earth metal cofactors for applications in catalysis and separation processes. In addition, Nachtigall and his students are developing new fundamental methods in synthetic chemistry involving high-energy laser beams to generate valuable organometallic compounds.

Dr. Carmen Scholz concentrates on the synthesis of biocompatible and biodegradable polymers, synthesizing block copolymers consisting of poly(ethylene) glycol and various poly(amino acid)s and investigates them for biomedically relevant applications, including developing gene delivery systems and surface modification of electrically active implants.

Dr. Jie Ling's interests include soft matter and quantum-confined materials design; synthesis and characterization of novel inorganic optical crystalline materials; development of metal-organic frameworks for removing radionuclides from nuclear waste streams, and discovering noncentrosymmetric materials of special interest in materials chemistry.

Dr. Ifedayo Victor Ogungbe has expertise in drug discovery for infectious diseases, cancer and crop protection; drug target identification; chemoproteomics, and lipidomics. His work in chemoproteomics entails a broad array of techniques used to identify and interrogate protein-small molecule interactions. Lipidomics usually refers to the analysis of lipids in bulk in an organic extract of a biological sample, including tissue, body fluids, plants or even processed food.

Dr. Jeffrey Weimer's primary research interests include surface science and technology and functionalizing solid surfaces to change their chemistry. Areas of application include changing the flow properties in channels for microfluidics as well as promoting adhesion of specific molecules to surfaces. He and his students create well-ordered films of quantum dots using Langmuir deposition methods with applications to enhance the opto-electrical or photo-optical properties of systems.

Dr. Pam Twigg has a research focus on the structural and biophysical characterization of proteins using methods such as X-ray crystallography, NMR spectroscopy, circular dichroism, calorimetry and fluorescence spectroscopy. She is particularly involved in the protein-protein interactions and function of proteins related to the pathology of Huntington's Disease.

Dr. Shanhu Lee pursues research in atmospheric chemistry, atmospheric new particle formation and advanced mass spectrometry instrumentation. Her research group has conducted both field observations and laboratory kinetics studies.

Dr. Marc Pusey's focus is investigating protein crystallization. Over the last decade he has complied a database of around 750 non-ionic liquid containing crystallization conditions for 25 different proteins. In another project he and his students are developing technology for X-ray crystallization studies at room, instead of cryogenic, temperatures. Crystallization studies are important in elucidating structure-function relationship.

UAH Chemistry undergraduate and graduate programs offer hands-on, cutting-edge research and mentoring with concentrations in biochemistry, pure chemistry, chemical business, chemical physics and environmental chemistry. Research areas of emphasis include biomedical materials and technologies; metabolomics and natural products; synthesis and characterization, and chemistry and our environment.

For more information or to apply, visit **https://www.uah.edu/science/departments/chemistry**. ■

BLUE GEMS MONTHLY GIVING SOCIETY

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WATER, WATER EVERYWHERE...

STUDENT TEAM WINS $100K EPA GRANT FOR SAFER DRINKING WATER RESEARCH

A student team won $99,998 in research grant funding from the United States Environmental Protection Agency (EPA) to develop a low-cost household water filter that removes per- and polyfluoroalkyl substances (PFAS) from drinking water. The project helps promote clean drinking water supplies, particularly in small, rural, Tribal and disadvantaged communities. The grant is part of the EPA's People, Prosperity and the Planet (P3) Program, a competition open to teams of university students working to design innovative solutions for a sustainable future.

The EPA P3 program advances innovative and sustainable technology-based projects through collaborations across STEM disciplines.

PFAS are a group of chemicals used to make fluoropolymer coatings found in many consumer products, including clothing, furniture, adhesives, food packaging, heat-resistant non-stick cooking surfaces and the insulation of electrical wire. Called "forever chemicals," they do not break down in the environment, can move through soils and contaminate drinking water sources and build up in fish and wildlife.

U.S.EPA P3 PEOPLE PROSPERITY PLANET

Dr. Tingting Wu, an associate professor of environmental engineering, is the principal investigator for the winning proposal, and team members include Sepideh Mansoori and Amir Ahmadi Zahrani, two Ph.D. students supervised by Wu.

"These students are leading the way when it comes to developing cutting-edge research to address PFAS, which is a top priority for our agency and country," says Chris Frey, assistant administrator for EPA's Office of Research and Development. "I'm excited to see how EPA's P3 funding can support this potential solution to help ensure clean drinking water, especially among our disadvantaged communities." ■

Caroline Bendickson, a chemistry and biology major at UAH, received a Goldwater Scholarship for her work in plant genomics. She analyzed the DNA sequences of Trillium, an important genus of plant species in southeastern U.S. forests.

Trillium photo courtesy of Caroline Bendickson

CRACKING THE CODE
CAROLINE BENDICKSON'S TRILLIUM ANALYSIS EARNS GOLDWATER SCHOLAR AWARD

Caroline Bendickson, a rising senior at UAH, has been selected as a Goldwater Scholar for her work in plant genomics. A double major in chemistry and biology with a minor in math, she is UAH's third Goldwater Scholar in the past four years.

The Goldwater Scholarship program "was designed to identify, encourage, and financially support outstanding undergraduates interested in pursuing research careers in the sciences, engineering and mathematics ... and is the preeminent undergraduate award of its type in these fields," according to the Goldwater website.

"I'm very interested in working with DNA, our genetic code," Bendickson says, "but instead of just taking short pieces of that DNA, I am interested in exploring the entire sequence that makes up whatever organism I'm studying."

For Goldwater consideration, she presented her work analyzing the DNA sequences of Trillium, an important genus of plant species in southeastern U.S. forests. Trillium "is a nationally recognized emblem of conservation concern with approximately 15 species presently ranked as high conservation priorities," she noted in her application.

As a member of Dr. Alex Harkess's lab for plant evolutionary genetics at the HudsonAlpha Institute for Biotechnology, Bendickson led the lab's project to explore the genetic relationships among Trillium species. Since Trillium genomes are almost 10 times as large as the human genome, her work yielded a significant amount of data.

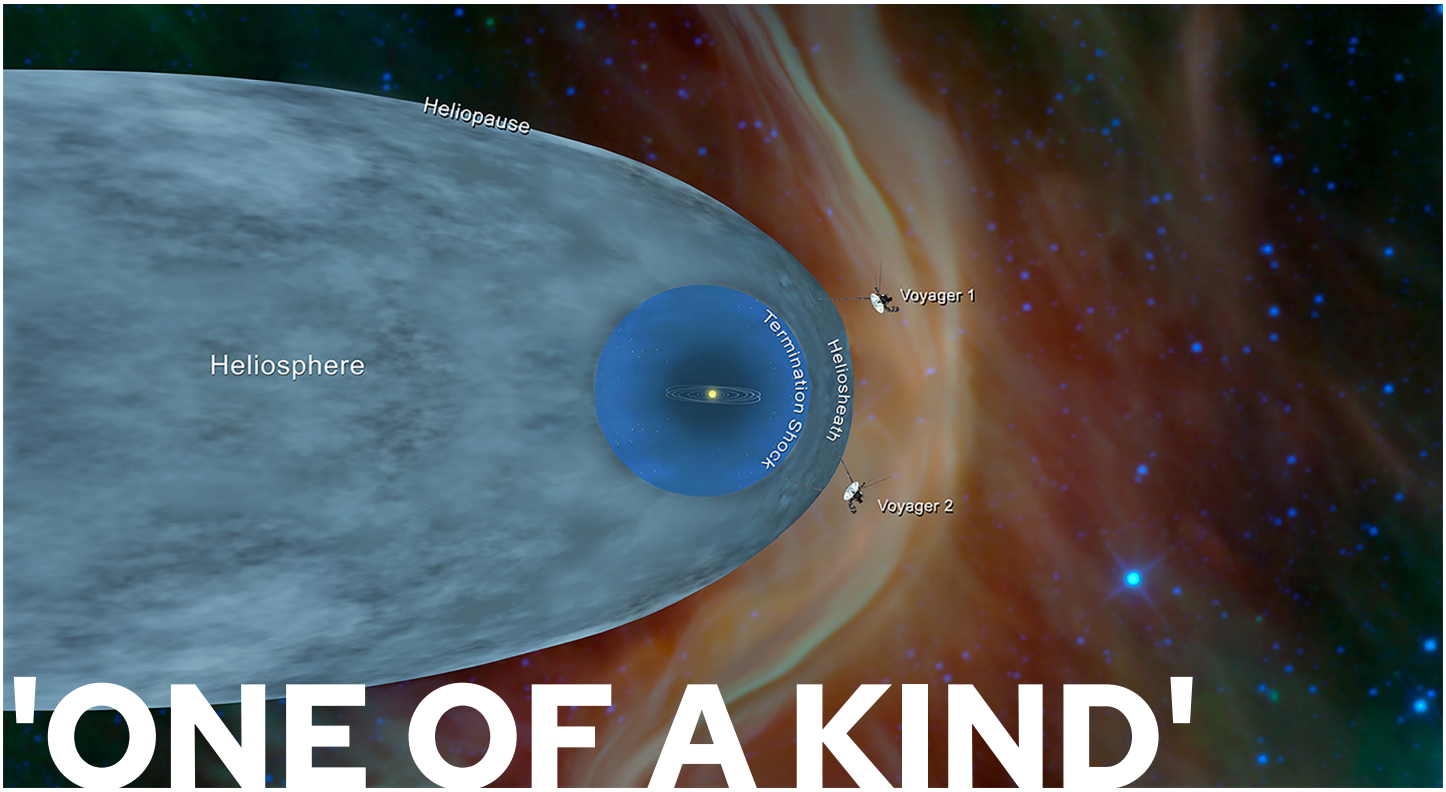
An important part of her professional goal involves developing publicly available genetic resources, such as her completed Trillium phylogeny, which can easily be used by other researchers. She is currently working on a manuscript to publish her Trillium phylogeny research.

Bendickson plans to pursue a Ph.D. in genomics and bioinformatics, an interdisciplinary field of science that develops methods and software tools for understanding biological data, especially when the data sets are large and complex – as with Trillium.

"We're generating large amounts of biological data with the (DNA) sequencing technologies that we've been able to develop in the past two to three decades," she says. "It's not possible for one scientist to manually process all that data anymore. So, we're using the techniques of computer science with applications toward biological questions."

Through bioinformatics, researchers like Bendickson can turn these large amounts of data into effective tools.

"A lot of what the current work is doing is developing these genomic resources which we can use in a wide range of studies, no matter what field of biology they're specifically used in. By having a larger volume of data, genomes are much more powerful as a resource."



'ONE OF A KIND'

MODEL OF HELIOSPHERE WINS $824K NASA HELIOPHYSICS GRANT

Dr. Federico Fraternale, a research scientist with the UAH Center for Space Plasma and Aeronomic Research (CSPAR), was awarded a $824,132 NASA heliophysics grant to develop new global models of the heliosphere that incorporate interstellar neutral atoms to help reveal the properties of space beyond the farthest reaches of the sun's influence. The initiative will support NASA's Interstellar Mapping and Acceleration Probe (IMAP) mission, scheduled for launch in 2025.

"Only a few space missions provide observations from the outer heliosphere, beyond 10 astronomical units from the sun," Fraternale explains. "New models are essential for interpreting these observations. Our model stands as one of a kind."

The heliosphere is the outermost atmospheric layer of the sun formed by the interaction of two magnetized flows: the solar wind – the flow of plasma from the sun – and particles and gases that make up the local interstellar medium (LISM), a gigantic region of space extending out 11.5 billion miles "upwind" of the sun.

"The heliosphere's shape resembles a comet, with a nose and a long tail," Fraternale says. "While the LISM plasma can't penetrate the heliosphere due to the presence of a magnetic field originating from the sun, interstellar neutral atoms can, because they do not interact with the magnetic field. In principle, one can detect the flow of such neutrals and use it to infer the properties of the unperturbed interstellar medium, such as its direction, temperature, etc."

The interstellar medium is made up of the matter and radiation existing between star systems in a galaxy and includes gases, as well as dust and cosmic rays. The challenge to investigating these regions is the mind-boggling distances from Earth. The UAH solution is modeling the flow of interstellar neutral atoms to bridge the gap.

"We are observing a system from its interior and wish to know what is outside," says Fraternale. Thanks to a "hydrogen wall" formed in front of the heliosphere, the atoms that eventually reach Earth represent only a fraction of the original particle population and are a mixture of the pristine, or unperturbed, population and the population of secondary atoms.

"This phenomenon is referred to as the 'filtration effect,'" Fraternale says. "Which emphasizes the necessity of accurate modeling to interpret spacecraft data. Our models and numerical software are considered state-of-the-art for global simulations of the heliosphere and regarded as the most advanced available by many researchers. Our models will aid in interpreting data from the Interstellar Boundary Explorer (IBEX) mission and future high-resolution data from IMAP." ■

HELP!

STUDY TAPS SOCIAL MEDIA AND AI TO SPEED ASSISTANCE DURING DISASTERS

Vishwa Vijay Kumar, a doctoral candidate of industrial & systems engineering and engineering management, published a study in the International Journal of Production Research investigating how social media platforms can be leveraged with artificial intelligence (AI) to connect victims of disaster to outside aid and support. Kumar teamed with fellow UAH co-researchers Dr. Avimanyu Sahoo and Dr. Sampson Gholston to support the initiative.

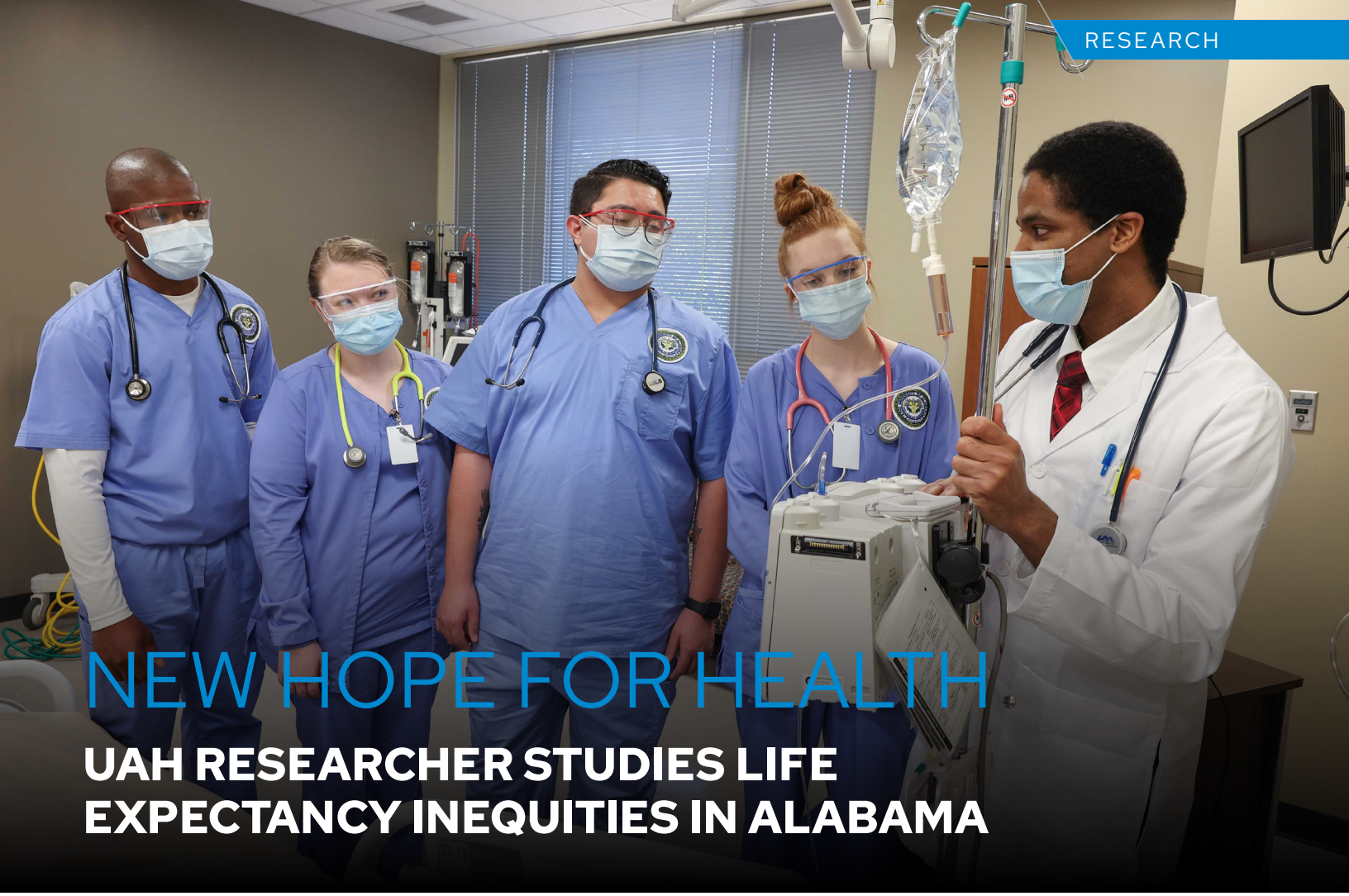
"I was born and raised in the countryside of India, in Sitamarhi, Bihar, near the Nepal border, where natural disasters such as floods from the Himalayan rivers are frequent," Kumar says to explain the initial spark driving his vision to help. "These floods can spread over miles, trapping thousands of people in their homes who need urgent help for health care and food, as well as rescue operations. From a young age, I was driven to develop a framework that would enable people in need to communicate their requirements to the world and relevant authorities so they could better assist disaster victims."

For the project, the team used data from X, formerly known as Twitter, from two six-week time periods and two countries during the COVID-19 pandemic: March–April 2020 in the United States when the pandemic broke out, and in India during the surge of the delta variant in May–June 2021. Disruptions in health care supply chains during these periods caused severe shortages of essential equipment ranging from face masks and medicines to ventilators for patients in intensive care.

"This situation reignited my early motivation to explore how social media and AI could be harnessed for faster disaster response and to mitigate health and supply challenges during crises," Kumar says.

The research developed algorithms to parse information from 3.9 million tweets to identify imperative information using AI and machine learning. Keywords within Twitter posts were identified to indicate which tweets included information relevant to pandemic supply chain disruptions and processed them for content analysis and modeling. The data analyzed also estimated the geographic location of tweets lacking geo-tag information to facilitate coordination of aid operations.

"We also plan to develop a platform/tool that will scan the social media posts from disaster events and generate real-time reports of demand and supply issues and people with their geo-locations who are requesting help," Kumar notes. ■



NEW HOPE FOR HEALTH

UAH RESEARCHER STUDIES LIFE EXPECTANCY INEQUITIES IN ALABAMA

Dr. Azita Amiri, an associate professor with the College of Nursing, was awarded a $25,000 Network of Practice Grant by the Bloomberg American Health Initiatives, Johns Hopkins Bloomberg School of Public Health, to examine life expectancy inequities in Alabama. The researcher is using findings from the project to develop a community-centric blueprint designed to address social environmental determinants of health in selected neighborhoods in the region.

"Evidence is convincing that social and built-environmental conditions affect health, including life expectancy, as much as genetics and other personal characteristics," Amiri says. "In the United States, life expectancy varies widely across geographical regions, neighborhoods, even city blocks. Equitable societies and built environments, such as access to health care centers or healthy food groceries, are essential for equal life expectancies."

Fifty-five out of 67 Alabama counties are considered rural, comprising 44% of the state's population, based on 2020 U.S. census data, and 58 of the counties are designated "medically underserved," the researcher notes. "Rural populations in Alabama suffer from an unequal distribution of resources, poverty, low literacy, environmental injustice and unequal disease burdens from cancer, diabetes, cardiovascular disease and all-cause mortality."

The study is using life expectancy data from the Centers for Disease Control's U.S. Small-area Life Expectancy Estimates Project to support the effort, as well as health data from the Agency for Healthcare Research and Quality within the U.S. Department of Health and Human Services. ■

▲ UAH College of Nursing students training through stations of patient care.

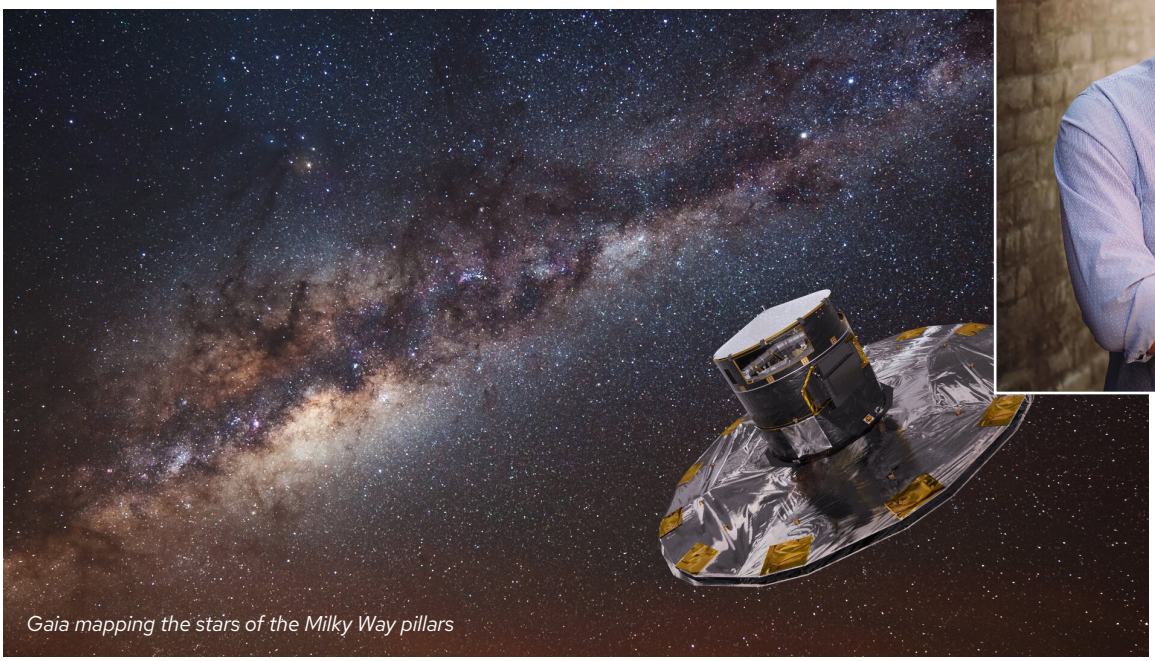
▲ Dr. Azita Amiri, associate professor, College of Nursing.

GALACTIC CRASH

Researcher demonstrates Milky Way's last major collision happened much more recently

◀ Milky Way "wrinkles" are more prominent than expected, leading researchers to determine the last major galactic collision occurred only three billion years ago.

Courtesy ESA/Gaia/DPAC



▲ Dr. Tom Donlon, postdoctoral researcher of physics and astronomy.

Courtesy Tom Donlon

Dr. Tom Donlon, a postdoctoral researcher, is the lead author of a paper published in the Monthly Notices of the Royal Astronomical Society that reveals the Milky Way Galaxy's last major collision occurred billions of years later than previously thought. Donlon concluded the Milky Way's last significant collision with another galaxy occurred no less than three billion years ago, rather than between eight and 11 billion years, as previously believed.

The data supporting these findings were collected via the European Space Agency's (ESA) Gaia spacecraft, a global space astrometry mission that is currently building the largest, most precise 3-D map of our galaxy ever attempted, surveying nearly two billion celestial objects throughout the Milky Way. Gaia monitors each of its target stars about 14 times per year, precisely charting their positions, distances, movements and changes in brightness. Donlon used these observations to focus on the galaxy's so-called "wrinkles," features formed when other galaxies collide with the Milky Way, to derive their conclusions.

"We get wrinklier as we age, but our work reveals that the opposite is true for the Milky Way," Donlon explains. The new study served as his doctoral thesis. "It's a sort of cosmic Benjamin Button, getting less wrinkly over time. By looking at how these wrinkles dissipate, we can trace when the Milky Way experienced its last big crash – and it turns out this happened billions of years later than we thought."

The researcher compared observations of the wrinkles with cosmological simulations to make the discovery. Scientists originally presumed the Milky Way's last major collision was the Gaia-Sausage-Enceladus merger, dated at between eight and 11 billion years ago. The new findings suggest instead that the most recent major encounter was actually the Virgo Radial Merger, which crashed through the center of the Milky Way less than three billion years ago, evidenced as well by a large number of stars with unusual orbits thought to have been generated by the collision.

"Gaia is a hugely productive mission that's transforming our view of the cosmos," says Dr. Timo Prusti, project scientist for Gaia at ESA. "Results like this are made possible due to incredible teamwork and collaboration between a huge number of scientists and engineers across Europe and beyond." ■

WARP FACTOR II, MR. SULU...

RESEARCHERS ENVISION WARP DRIVE THROUGH KNOWN PHYSICS

Alumni Dr. Jared Fuchs and Dr. Christopher Helmerich published a paper demonstrating for the first time that a subluminal warp drive is possible within the bounds of known physics without the use of exotic unknown forms of matter or energy. The Constant-Velocity Subluminal Warp Drive offers a new means of propulsion that allows it to operate at constant subluminal speeds, while still conforming to Einstein's theory of general relativity, with no need for "unphysical" forms of matter required by previous designs.

"Prior models required a matter-energy content that was 'unphysical,' meaning it had features we don't see in the regular universe, like negative energy," Fuchs explains. "Our approach was to avoid needing this exotic matter by adding positive energy to the solution while keeping as much of the warp effects as possible."

The team proposed something else that can be used to warp space-time: gravity. "Gravity means a certain kind of curvature that occurs in space which affects things around it," Fuchs notes. "Regular matter affects things far away from it in space-time, in contrast to most warp solutions, where the warp bubble doesn't affect things far away at all, only locally around the bubble. We are exploring the bounds of general relativity. Even if warp drives turn out to be impractical, our understanding could lead to new avenues we don't know yet." ■

Image courtesy of Marilyn Lands

READY TO LEAD

LANDS REPRESENTS MADISON COUNTY

UAH alumna Marilyn Lands won a special election on March 26 to fill Madison County's District 10 seat in the Alabama House of Representatives. Her margin of victory was 25 percentage points. Lands, a licensed professional counselor in private practice, graduated from UAH twice – in 1981 with a Bachelor of Science in Business Administration in marketing and again in 1987 with a Master of Science in administrative science. She worked for the Huntsville-Madison County Airport Authority and the Boeing Company before returning to school to earn her counseling degree from Alabama A&M University. Lands, who ran for office on a platform of improved health care, economic opportunities and education for all residents, wasted no time getting started in Montgomery. She introduced bipartisan legislation – the Maternal Healthcare Access Act, HB494 – that would extend presumptive Medicaid eligibility to pregnant women in Alabama. The bill had strong support but not enough time to make it through the legislative process. Lands plans to reintroduce the bill in the next session. ■

CARDIO BOOST

Nursing researcher charts cardiometabolic disease in Deep South

Dr. Jennifer Bail, an assistant professor in the College of Nursing at UAH, will be subcontract principal investigator.

Dr. Jennifer Bail, an assistant professor in the College of Nursing, was awarded a $179,000 subcontract to explore community-based strategies for reducing high-burden chronic disease like obesity, diabetes, heart disease and cancer in the Deep South. The grant is part of an overall initiative totaling $4.2 million funded by the National Institute on Minority Health and Health Disparities.

Nearly three out of four adults in the United States are overweight or living with obesity, with the highest rates among Black people, rural residents and lower socioeconomic groups. "Over the past decade, obesity trends have been generally stable for men, but have increased significantly among women," Bail notes. "This is particularly true among Black women who have an obesity prevalence of 57%, compared to 40% in white women. Black women living in rural settings also have higher rates of obesity compared to their same race/sex peers in urban settings."

Evidence-based interventions that promote weight loss, healthy diet and physical activity have been shown to be effective at slowing the conversion of pre-diabetes mellitus and hypertension to diabetes and heart failure, the researcher reports. However, Bail explains that "despite multiple large, well-designed randomized clinical trials, proven weight loss interventions have failed to reach populations at highest risk and often result in less weight loss among Black participants than other racial groups."

Residents of rural communities report greater environmental barriers to healthy eating and physical activity than their urban/suburban counterparts. Through a study named Stepping Into Lifestyle Changes (SILC), this research aims to reduce chronic disease burden and health disparities among Black women living in the rural Deep South by combining a weight loss intervention called Journey to Better Health with a mentored vegetable gardening intervention known as Harvest for Health.

To date, 248 Black women from 12 rural counties in Alabama have enrolled in the study. Seven local community members have been trained as Master Gardeners to support the SILC Study and after study completion will contribute their time and expertise as volunteers to various community projects. ■

uahchargers.com

UAH STUDENT-ATHLETES SHINE THIS SPRING WITH 11 ALL-ACADEMIC HONOREES

Student-athletes at UAH brought home numerous honors this spring as they continued their tradition of excellence.

Baseball

- **Merik Carter**: All-Gulf South Conference (GSC) First Team, National College Baseball Writers of America (NCBWA) All-South Region First Team, Division II Conference Commissioners Association (D2CCA) and American Baseball Coaches Association (ABCA) All-South Region First Team
- **Trey Wright**: Baseball GSC Academic All-District Team

Softball

- **Alexa Douthitt**: National Fastpitch Coaches Association (NFCA) All-American Second Team, GSC Co-Player of the Year, D2CCA All-South Region First Team, and NFCA All-South Region First Team, All-GSC First Team, and GSC Spring All-Academic honoree
- **Lawren Hayes**: NFCA Rawlings Gold Glove Award, NFCA All-South Region First Team, GSC Top Ten Award, D2CCA All-South Region First Team, All-GSC First Team, and GSC Spring All-Academic honoree
- **Jada Henderson**: D2CCA All-South Region First Team, All-GSC First Team, NFCA All-South Region Second Team, and GSC Spring All-Academic honoree
- **Katie Bracken**: All-GSC Second Team
- **Josie Thompson**: All-GSC Second Team

Women's lacrosse

- **Sarah Cole**: All-GSC First Team and GSC Spring All-Academic honoree
- **Isadora Springer**: All-GSC First Team and GSC Spring All-Academic honoree
- **Riley Kirby**: GSC Defensive Player of the Year, All-GSC First Team, Intercollegiate Women's Lacrosse Coaches Association (IWLCA) All-South Region First Team, and GSC Spring All-Academic honoree
- **Tory Ryan**: GSC Spring All-Academic honoree
- **Kourtney Bauroth**: All-GSC Second Team and GSC Co-Freshman of the Year
- **Sydney Schiavone**: All-GSC Second Team

Men's lacrosse

- **Brayden O'Neill**: Honorable Mention, United States Intercollegiate Lacrosse Association (USILA) All-American; Peach Belt Conference (PBC) Co-Defensive Player of the Year; USILA honorable mention for the All-South Region; and All-PBC First Team
- **Ian Arnt**: All-PBC Second Team
- **Pete Fabrizio**: All-PBC Second Team
- **Collin Galinski**: All-PBC Second Team
- **David Friend**: PBC Freshman of the Year
- In addition, the men's lacrosse team garnered 34 PBC academic honor roll recipients in 2024—an incredible feat. View **www.uahchargers.com** for details.

Men's track and field

- **Sam Wilhelm**: GSC Commissioner's Trophy men's award; First Team All-American (four All-American distinctions in cross country, indoor track and outdoor track); and GSC Spring All-Academic honoree
- **Wilson McClain**: First Team All-American and GSC Spring All-Academic honoree
- **Michael Gizzi**: First Team All-American
- **Tommy Rodriguez**: First Team All-American
- **Ke'Andre Campbell**: First Team All-American
- **Nathan Knox**: GSC Spring All-Academic honoree

Women's track and field

- **Emily McMurry**: GSC Spring All-Academic honoree

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