AUBURN

RESEARCH

SPRING 2020

PULLING NO PUNCHES

WILL NANOMEDICINE TAKE CANCER DOWN FOR THE COUNT?

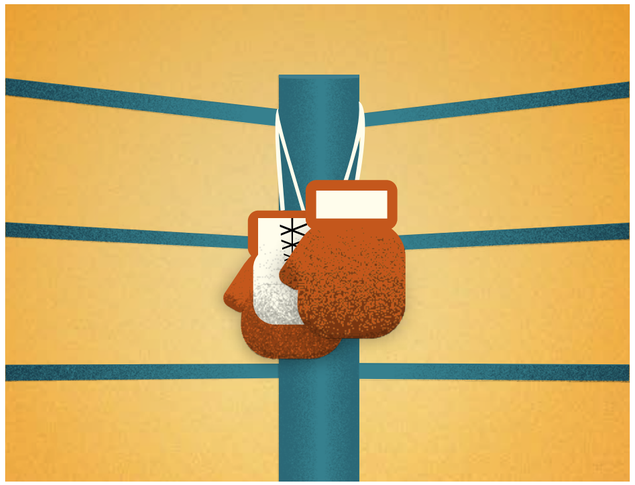
AUBURN UNIVERSITY

One of Auburn's beautiful native azealas in Samford Park.

Photo by Jeff Etheridge

CONTENTS

SYMPOSIUM SHOWCASE	5
CAT COST	5
GROWING THE FUTURE	6
POWER AND PRESTIGE OF HISTORICAL HOSPITALS	10
HELPING THOSE BEHIND PRISON WALLS	12
C-SUITE SHAKEUP	15
PRACTICAL SOLUTIONS	16
A MEETING OF MUSIC AND THE MIND	18
BEST DEFENSE	20
FACULTY ACHIEVEMENT HIGHLIGHTS	22
ATTACKING CANCER	23
PULLING NO PUNCHES	24
RESEARCH AWARD-WINNING FACULTY	30
MINDING HER SPACE	34
ALL AN "ACT"?	35
CHANGING LANDSCAPE	36
CUTTING OUT THE NOISE	38
SCULPTING A VISION INTO REALITY	40
AUBURN'S BIG FOUR	42
2019 YEAR-END METRICS	44
CLOSING THOUGHTS FROM THE VICE PRESIDENT	46



24 PULLING NO PUNCHES

Credits
Dr. James Weyhenmeyer
Vice President for Research & Economic Development

Publication Team:
Jonathan Cullum
Editor

Megan Burmester
Copy Editor

Lucy LaMar
Project Manager

Jennie Carson Hill
Design and Production

Jeff Etheridge
Leslie Chapman
Mitch Emmons
Penny Fant
Philip Smith
Photography

Contributors
Chris Anthony
Latha Bhavnani
Matt Crouch
Jonathan Cullum
Mitch Emmons
Maria Gebhardt
Jeremy Henderson
Paul Hollis
George Littleton
Charles Martin
Joe McAdory
Austin Phillips
Vicky Santos
John Seitz
Charlotte Tuggle

Auburn Research is published biannually as a collaboration between the Office of the Vice President for Research & Economic Development and the Office of Communications and Marketing.

Inquiries, suggestions and news items concerning Auburn Research magazine should be directed to:
Jonathan Cullum
202 Samford Hall
Auburn, AL 36849
jonathan.cullum@auburn.edu

On the cover:
Nanomedicine aims to knock out cancer. Custom artwork by Jennie Carson Hill.

SYMPOSIUM SHOWCASES BRIGHT MINDS

By Charles Martin

Auburn University faculty gathered for the 2019 Auburn Research Faculty Symposium, during which they discussed and gave presentations on their groundbreaking research, from neuroscience to rural housing design to additive manufacturing and more.

The annual event provides Auburn and Auburn University at Montgomery faculty an opportunity to share their discoveries university-wide and with the community.

"Auburn researchers are working every day to solve real-world problems for the benefit of citizens in Alabama and beyond," said Dr. James Weyhenmeyer, Auburn University vice president for research and economic development. "The annual faculty symposium is a great chance for everyone to see this innovative research and scholarship firsthand."

In addition to roundtable discussions designed to help faculty achieve external funding for research projects, a series of Auburn Talks highlighted the following:

• Dr. Allan David, the John W. Brown Associate Professor of chemical engineering, Samuel Ginn College of Engineering: "Nanoparticles for Cancer Diagnosis and Therapy"

• Dr. Sarah Zohdy, assistant professor of disease ecology, School of Forestry and Wildlife Sciences: "What's the Buzz? Disease Emergence in a Changing World"

• Dr. Mollie Mathis, assistant professor of accounting, Harbert College of Business: "U.S. Taxation of Foreign Earnings: Tax Cuts and Jobs Act" (See page 35 for more on Mathis's research.)

• Dr. Steve Brown, professor of political science, College of Liberal Arts: "Alabama Justice: The Cases and Faces That Changed a Nation"

Following the Auburn Talks, more than 90 researchers gave poster presentations of their recent work, and collaborative teams that received the Presidential Awards for Interdisciplinary Research discussed their projects on topics ranging from housing affordability to advanced manufacturing of medical implants. Other projects featured included rural health disparities in poverty-stricken areas, treating the hallmarks of Alzheimer's disease, neuroscience research and graduate education, reducing carbon dioxide emissions or using them for other means, and other critical areas of human and environmental health.

UNDERGRADUATE RESEARCH PROFILE:

CAT COST

By Mitch Emmons

Two Auburn pre-veterinary medicine/wildlife sciences students are collaborating with Auburn University's Undergraduate Research Fellowship Program in a project aimed at helping pet owners to be better informed about the long-term considerations and costs associated with pet ownership, before they take on that commitment.

Allison Gary

Abby Hagelskamp and Allison Gary of the School of Forestry and Wildlife Sciences—under the faculty mentorship of Dr. Christopher Lepczyk, a professor of wildlife biology and conservation—are compiling a survey involving veterinarians in the states of Alabama, Georgia and Florida. They are focused on cats in their project titled "Creating a Social Survey to Analyze Differential Veterinary Care Cost for Indoor Versus Outdoor House Cat (Felis Catus) in the Southeastern Region." The electronic data source is intended to become a model that provides a wealth of information about the economic considerations of owning a pet and properly caring for it.

Abby Hagelskamp

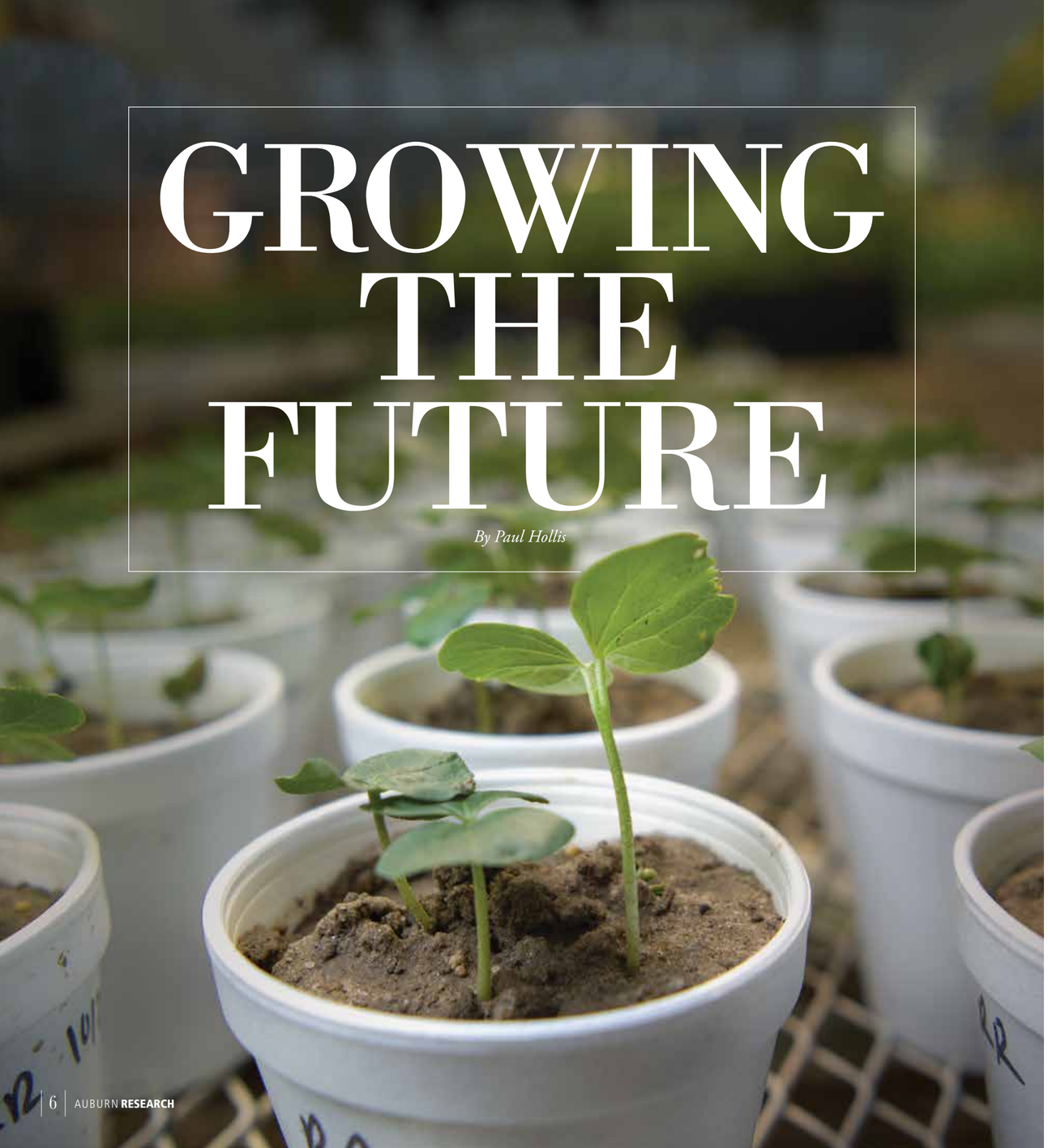
Veterinary care costs vary among cats that are kept indoors versus those that live outdoors. This project has the potential to better inform pet owners about what the total lifetime cost of owning a cat may be and how choosing to keep it as an outdoor or indoor cat may affect those costs. It also provides a more complete picture of the cost of veterinary care as a whole and as an economic market. Ultimately, this project may help to reduce the number who take on the responsibility of an animal but later must surrender it due to being unable to afford it or to provide the proper veterinary care.

The data will be analyzed and compiled in the School of Forestry and Wildlife Sciences, and their results will be presented in late spring. Both students plan to pursue veterinary medicine degrees following their undergraduate studies.

The Undergraduate Research Fellowship Program is administered by the Office of Undergraduate Research under the auspices of the Office of Undergraduate Studies and the Office of the Vice President for Research and Economic Development. Students interested in the program must have a faculty mentor, and applications are open annually. For more information, visit: our.auburn.edu.

GROWING THE FUTURE

By Paul Hollis



PGPR discovery becomes accepted practice in agriculture

Like a lot of great discoveries, PGPR, or plant growth-promoting rhizobacteria, came about when someone wasn't particularly looking for it.

"I coined the term PGPR in a publication from my Ph.D. research in 1978," said Dr. Joe Kloepper, Alumni Professor in the College of Agriculture's Department of Entomology and Plant Pathology. "My research assistantship in Berkeley was to work on biological control of potato diseases. While I was testing rhizosphere bacteria for this, I found that some strains had no biological control capacity, but they did promote growth of the potato plants."

This "unintentional" discovery has evolved into a technology that is becoming a standard input in crop production and has spawned numerous other groundbreaking research projects across several disciplines.

Kloepper's research primarily focuses on using beneficial bacteria for promoting plant growth, plant health and nutrient uptake.

The emphasis is on various species and strains of the spore-forming bacilli because spores of these PGPR remain viable as seed treatments for a long period of time, thereby increasing the opportunities for integrating PGPR into current agricultural practices.

"Many of the agricultural chemical companies have added biological components to their products, and this has enabled Auburn University to have license agreements with major companies such as Bayer," Kloepper said.

There is a growing acceptance, he said, for using these kind of bacteria as a standard practice in agriculture.

"This is especially true for seed treatments in production agriculture, which is the biggest use of this technology now," Kloepper said. "These seed treatments are being used for all traditional row crops, including corn, soybeans and others."

The first applications of these bacteria were made on vegetable crops, with the PGPR put into the irrigation water on specialty crops in Florida and California.

Dr. Joe Kloepper

"But now, with the seed treatments, it has expanded so there's a lot more acreage being treated," he said. "Farmers buy seeds, and seeds have various components placed on them, including chemicals, fungicides and insecticides. We're seeing that more of the companies want to sell farmers seed that have biologicals on them, and that's where the PGPR comes in."

The benefits of PGPR fall into two categories, Kloepper said.

"One is that there's increased growth promotion. If farmers use these in cold soils, there will be quicker establishment of the plant, better root systems and better overall growth."

Another area of interest for the use of PGPR is in helping with nutrient uptake, or fertilizer use efficiency, Kloepper said.

"Farmers have to spend a lot of money for fertilizer, but a certain percentage of the fertilizer that is applied is not taken up by the plant," he said. "Several researchers have found that PGPR

"Farmers buy seeds, and seeds have various components placed on them, including chemicals, fungicides and insecticides. We're seeing that more of the companies want to sell farmers seed that have biologicals on them, and that's where the PGPR comes in."

– Dr. Joe Kloepper

Pictured from the left: Dr. Mark Liles, Dr. Russell Muntifering, Dr. Henry Fadamiro, Dr. David Held, Dr. Kathy Lawrence and Dr. Leanne Dillard

can increase the amount of fertilizer taken up by the plant. This also has the spinoff of less environmental pollution."

One PGPR strain has been licensed for use as a biofertilizer and biopesticide in numerous seed and soil applications, and another license is under negotiation with a different company for additional applications.

Kloepper and his colleagues have also developed additional bacterial libraries of strains from long-term crop rotations and other sources. Auburn currently has one of the richest collections of PGPR strains in the world.

PGPR have also shown promise by increasing tolerance to drought, attracting beneficial insects, repelling destructive insects and combating other pests or disease-causing agents, such as nematodes, bacteria and fungi.

Modes of action are being studied and effects on plant growth, plant pathogens and plant-damaging insects are being evaluated in collaborations with other faculty in the College of Agriculture, College of Sciences and Mathematics, School of Forestry and Wildlife Sciences and the USDA Soil Dynamics Lab in Auburn.

Dr. Henry Fadamiro's laboratory in the Department of Entomology and Plant Pathology is focusing on investigating the effects of PGPR in mediating plant-insect interactions.

"Specifically, we are interested in how treating plants with PGPR affects the biology and behavior of insect pests of important row and vegetable crops and their natural enemies," said Fadamiro, associate dean for research for the College of Agriculture and associate director of the Alabama Agricultural Experiment Station.

A related project in the laboratory of entomology professor Dr. David Held is focused on the use of PGPR treatments to manage pests of turfgrass and ornamental plants.

Researchers are also studying the chemical, biochemical and molecular mechanisms by which PGPR affect plant-insect interactions.

"Our research has helped to establish that the treatment of plants with specific PGPR strains can result in chemical and molecular changes that will make the plants less attractive to insect pests but highly attractive to [the pests'] natural enemies," Fadamiro said.

This research has attracted significant industry funding, supported the training of many graduate students and postdoctoral researchers, and resulted in several high-impact publications and patents, he said.

"In addition, our research team has identified specific PGPR strains with insecticidal activity, which can be used to control certain insect pests and reduce plant damage," Fadamiro said. "Knowledge of the effects of PGPR on plant-insect interactions has contributed to the increased adoption of PGPR products and development of better products, while mitigating against potential negative impacts of these products."

Dr. Kathy Lawrence, a professor in the Department of Entomology and Plant Pathology, has worked with Kloepper and his PGPR collection for 20 years.

"We have screened 700 of his isolates to look for plant growth promotion and nematicidal activity with the three most damaging nematodes in Alabama crops," Lawrence said.

Many of these isolates from Kloepper's collection were identified to have activity toward the root knot nematode and enhanced cotton yields.

Professor Dr. Mark Liles's laboratory in the Department of Biological Sciences has been working for many years on the use of PGPR for preventing disease in fish.

"In an initial study, we evaluated a large collection of bacterial isolates from plant rhizospheres—from Kloepper's collection—to identify those that inhibited the growth of major fish pathogens," Liles said. "We found that our best-performing probiotic strain is effective at reducing mortality due to multiple fish pathogens."

After these studies, a pond study in which fish were fed with control feed versus spores of Kloepper's PGPR strain showed that coating feed with the probiotic significantly enhanced catfish growth and reduced nitrogen and phosphorus in pond water.

"Now that we have seen such promising results for specific probiotic strains in fish, we are working on understanding the mechanisms by which these probiotics protect fish from pathogens and improve fish growth performance, as well as ways to enhance their efficacy," Liles said.

"For example, we know this PGPR strain makes the antibiotic difficidin, and that this antibiotic is responsible for the direct inhibition of multiple aquaculture pathogens. But we also have evidence that the probiotic has other beneficial effects on fish besides production of the antibiotic, so we want to understand these other mechanisms so we can better use this probiotic for aquaculture applications," Liles said.

Interestingly, this same Kloepper strain has also been effective in biocontrol of the bacteria that causes citrus canker in tomato.

"It was in this study that we discovered that PGPR strains can use plant-derived pectin as a growth substrate," Liles said. "Importantly, this implied that we could improve how well the probiotic survives and grows when applied to the seed of a plant or introduced into the gut of a fish.

"Also, in collaboration with Kloepper, we recently published that the combination of Bacillus velezensis spores together with a pectin-rich agricultural waste (orange peels) can enhance the probiotic effects in soybean and resulted in dramatically enhanced soybean nodulation. We are now evaluating whether this symbiotic approach—prebiotic and probiotic—can enhance catfish growth, while using strains singly or in combination."

Working with Liles are professors Dr. Allen Davis, Dr. Eric Peatman and Dr. Jeff Terhune from the School of Fisheries, Aquaculture and Aquatic Sciences, and Dr. Ben Beck of the USDA Agricultural Research Service.

Researchers and extension specialists in Auburn's College of Agriculture are joining forces on a project that could provide a fertilizer alternative to Alabama livestock producers currently using synthetic nitrogen on bermudgrass.

Preliminary data indicate that PGPR may hold promise as an alternative to synthetic nitrogen fertilizer for biofertilization and forage quality enhancement of bermudagrass for livestock.

"We are altering the diet of the soil," said Dr. Leanne Dillard, a member of the project team and an assistant professor and extension specialist in the Department of Animal Science. "We're not adding something new. These PGPR are already in the soil. All we've done is concentrate them so that their small effect becomes a large effect."

Other members of the team include Held and Dr. Russ Muntifering, a professor and graduate program officer in the Department of Animal Sciences.

THE POWER AND PRESTIGE OF HISTORICAL HOSPITALS

How medieval medical facilities in Rome played a key role in sovereignty, politics and urban development

By Mitch Emmons

Hospitals today are recognized as healthcare institutions that provide patient treatment with specialized medical and nursing staff and medical equipment; some have teaching functions; some are specialty centers. However, in medieval times, they served a very different purpose and function, according to Dr. Carla Keyvanian, a professor in Auburn University's College of Architecture, Design and Construction.

In her book, "Hospitals and Urbanism in Rome, 1200-1500," Keyvanian argues that those early hospitals played a key role in establishing the power and prestige of the administrative ruler and that their establishment, opulence and locations were strategically conceived for manifesting those purposes.

Keyvanian earned her Doctor of Philosophy degree in architectural history from the Massachusetts Institute of Technology. She also studied in Venice, Italy, and became interested in the urban development of early Rome while seeking her dissertation topic.

"Studying architectural history does not make us as architects to be better designers," Keyvanian says, "but it helps us to understand what has been achieved in the past; how problems were solved; and that form did not emerge out of purely esthetic reasons, but from structural needs, materials availability and often political considerations."

Keyvanian became interested in medieval hospitals in Rome because of their prominence as architectural symbols around which Rome and other urban centers developed throughout the Mediterranean region. Moreover, her book argues that those hospitals were constructed as expressions of sovereignty by those in administrative and political positions of power, particularly the clergy and kings.

Monumental urban hospitals appeared in western Europe during the 12th century Renaissance—a period marked by a booming economy, a demographic increase that almost doubled the population and administrative change, Keyvanian notes. These late medieval hospitals were not like our modern hospitals but served as religious centers and social, charitable institutions offering temporary shelter, medical treatment to the destitute and to travelers, safe housing, banking and financial services.

The rulers of the time were expected to be benevolent, Keyvanian said. As a high-profile means for portraying those qualities and characteristics, the rulers constructed large, monumental structures as hospitals that were charitable institutions for the poor and destitute. But although they played a charitable role, they were not designed to be long-term refuge institutions. These hospitals represented for the ruler his piety and celestial reward.

"They were political institutions—halls of state—and they were built by the most prominent architects and in the post prominent locations of the city, because they had display value," Keyvanian said. "They stood for how charitable and compassionate the ruler was. My research helped me to understand how charitable aspects played such a crucial role in legitimizing a ruling official's authority.

When Christianity began to replace the Roman pagan faith, one of its most powerful tools of persuasion was its appeal to the poor, sick and lame, who were promised the miraculous healing powers of Christ.

"The medieval kings of France and England as well as the pope were believed to have divine, magical properties to heal the sick. They were considered to be appointed by the divinity and were upheld as being semi gods. Disease and sickness was the greatest source of fear among the population, and so the more prominently the ruler presented his capacity to heal, the more powerful his influence over his kingdom. The construction of a massive hospital was a clear demonstration of the ruler's capacity to heal and a symbol of his charity—which legitimized their 'divinely ordained' position of leadership."

History notes that a very large segment of the population was poor, Keyvanian adds. Hospitals play a role managing that segment of the population.

"Take someone off the streets who is sick from hunger and give them three days of food and bed rest, and their recovery would seem miraculous," Keyvanian said. "In return for their benevolence, the ruler campaigned for support of his hospital and charity through donations from the faithful. Thus, the church-supported hospital prospered."

The hospital of medieval times also served an important purpose in caring for the sick and wounded during the Crusades, Keyvanian writes. As the prestige and power of the ruling sovereign grew, these hospitals flourished and their importance to the urbanization of the region also grew. Many still serve an important function in modern Rome, and their opulent architecture serves as a reminder of their former purpose and function, as well as a record of how cultural expansion in the region spread ideas and influence.

Keyvanian studied a variety of sources as she conducted the research for her book.

"There aren't many writings available from the earliest part of this period," she said.

But Keyvanian had access to numerous illustrations and paintings, architectural documents and relics, the architecture itself and rituals observed from the time.

"By studying this history and the establishment of these hospitals, I was able to debunk some myths associated with the purpose and reasons for their construction," Keyvanian said.

"One, they were not established totally as an emergence of more compassionate attitudes toward the poor. They were not built out of Christian charity, but as a means for manifesting the sovereignty of the administration. Another, they were not built to respond to social needs, but placed in highly visible locations that supported the rulers' interest and intent for developing a specific area."

Dr. Carla Keyvanian

By studying the rise and development, as well as the decline, of the hospitals of the time between 1200-1500, Keyvanian says one can learn much about the urban development of Rome, Europe and the Mediterranean area over this seminal 300-year span. She has begun work on a second book.

"The next book will focus on a single hospital and its architect and will show how to use architectural form as historical evidence to make the connections that put together the story of a culture, its interactions and its development."

Helping those behind

PRISON WALLS

By George Littleton

Researchers from the Auburn University College of Education are collaborating with faculty from the University of Alabama to ensure the protection and post-prison success of inmates at Julia Tutwiler Prison for Women. They are engaged in research as a result of an agreement between the Civil Rights Division of the United States Department of Justice (DOJ) and the Alabama Department of Corrections (ADOC). The DOJ entered the agreement with the goal of guaranteeing inmates at Tutwiler are provided with constitutional conditions that protect them from sexual abuse and harassment, and that their future behavior risks are properly assessed.

"Our work is addressing two separate but related situations for the women at Tutwiler," said Dr. Peggy Shippen, a professor in the college's Department of Special Education, Rehabilitation, and Counseling (SERC). "One is to assess the provisions of training and implementation at Tutwiler of the Prison Rape Elimination Act, or PREA, as it is widely known. PREA is a federal statute focused on sexual assault and victimization. The goal of PREA is to prevent, detect and respond to sexual abuse in detention and correctional facilities. A second area of focus is to assess the risk of different types of behavior by the inmates associated with future misconduct and recidivism."

This second project involves a collaboration that has Auburn faculty providing expertise in data evaluation, mental health and disabilities, while faculty from Alabama bring expertise on the criminology and social science work components. The Auburn faculty members became involved through a competitive request for proposals process, and have worked with Dr. Wendy Williams, deputy commissioner of Women's Services in the ADOC, to respond to the Women's Risk Needs Assessment (WRNA) validation.

"Dr. Shippen and I had been doing volunteer work in the women's prison and Dr. Williams asked us to collaborate with them on how to comply with some of the specific

provisions in the DOJ settlement and make the institution better," said Dr. Nick Derzis, a SERC professor who has long had a research interest in incarcerated populations and the world of work. "We began quarterly polling at Tutwiler in 2016 and two years later added women's prisons in Montgomery and Birmingham. The questions related to sexual safety and harassment, institutional conditions, inmate-on-inmate violence and staff-on-inmate violence."

Participation by the inmates is voluntary, and all inmates are allowed to participate. The participation rate was outstanding, with 50% of the 751 invited inmates taking part. The project is approved by the Institutional Review Board (IRB), and the responses to the 76 questions are entered in a secure, private setting on iPads. The ADOC collects and sends the anonymous raw data to the Auburn research team, who analyze it and produce quarterly and annual reports. The reports are then shared with the DOJ by the ADOC. Based on feedback from Dr. Williams and the Tutwiler court-appointed monitor, in the coming year the iPad polling will be supplemented with structured interviews. These will be conducted by Dr. Rebecca Curtis, a SERC professor who is an expert in qualitative interviewing. Drs. Angie Hall and Sharon Weaver also work in research support roles on these projects.

"So far our data have shown that staff-on-inmate violence has decreased, but conflict among inmates remains a problem," Shippen said. "The PREA can be misused by inmates filing false reports against other inmates or staff. We also concluded that a full 90 percent of the inmates have no visitors, so they must build their own family structures with other inmates."

Presently there are about 1,000 women in Tutwiler, with county jails holding future inmates.

A separate contract was awarded to the Auburn team to conduct and validate the Women's Risk Needs Assessment (WRNA).

"This is part of the gender responsive approach now being used in women's prisons," Derzis said. "We will validate the use of three separate assessments: at intake, after at least six months and then just before their release. The goal here is to literally assess their risks. Are they likely to be involved in substance abuse? Violence? Trauma? It is also determined whether they might benefit from counseling or anger management. A goal is to reduce recidivism, and give the women stability when they are back in the free world. How we rehabilitate people speaks volumes about our culture and society."

An important part of the work is not only to evaluate and validate the WRNA instrument but also to assure the fidelity of the instrument's administration. For example, two raters may see the inmate's risks in the same way, but a third person might interpret the risks differently.

"It is critical to ensure the ratings are done fairly and equitably," Shippen said. "We're just getting started with this, but our approach is to have a second party watch a video of the evaluation and then make their own WRNA assessment. It's a process called inter-rater reliability."

There are many reasons for this focus on reliability.

"The welfare of both our society and the individual being assessed is the goal of the WRNA," Derzis said. "Proper risk assessment not only serves the citizens of our state but also helps the ADOC classify people correctly. Could this person serve in work release, or should she be sent to maximum security? Solid assessments can provide that insight and better predict who might be successful in the free world and who may need more levels of support."

Shippen said part of the risk assessment is evaluating the inmates' mental health. The Auburn researchers stated it is widely known that a large percentage of incarcerated individuals have mental health issues and substance abuse challenges.

"This work provides other opportunities as well," she said. "Auburn is sending its doctoral-level mental health counselors into the prisons. Two of our graduates just completed their dissertations on women's prison issues. So we are seeing the full circle of research to practice and seeing all kinds of good services available that were not there before."

50% of the 751 invited inmates are participating in the study

In the WRNA activities, Auburn's researchers do not interact directly with the women but focus on the data collection instrument and how it is administered. The PREA portion of their work is much more face-to-face.

"When we give inmates feedback, they see that someone is actually listening, that someone actually cares," Shippen said. "It's a difficult situation in the women's prison. Not many people want to do this, but someone must."

Shippen concluded by explaining that successful research in this field takes time.

"Social science research is about relationships. People must trust you. They see that we are objective and that we are honest. That's really all they want."

C-SUITE SHAKEUP

Female CEOs lead the way in patient-centered hospital management

By Vicky Santos

Dr. Geoff Silvera, assistant professor in the Department of Political Science (Health Services Administration Program), recently co-authored a paper about the influence of chief executive officers on patient care experiences, and it turns out that patients benefitted most where women were the chief executive officers.

The article, "Women at the helm: Chief executive officer gender and patient experience in the hospital industry," was published in Health Care Management Review.

> **"We need more female CEOs. That would be the first implication. In health care specifically, we know now we're trying to build a patient-centered health care system."**
>
> *– Dr. Geoff Silvera*

As a health care management scholar, Silvera conducts research on the ability of executives, especially chief executive officers, to positively influence care quality, patient experience and patient safety, as well as the influence of management on those outcomes. Silvera said research in those areas tends to focus on the influence of frontline clinicians, typically either nurses or physicians.

"In my experience as both an administrator and as a patient, so much of the experience and outcome is influenced directly by management. 'How much time do I have with the patient, what resources do I have available?' All those things are management decisions. And so, that's where my focus is looking at the link between management and patient outcomes."

Silvera's research found evidence that female CEOs improve the interpersonal care experience faster than male CEOs, particularly in the most complex executive job environments, that is, in the most populous urban environments, and in the largest hospital facilities.

"Our results not only support the notion that executives tend to rely on personal values and preferences but also that women have an apparent propensity for transforming health care organizations in the direction of patient centeredness, particularly in the most demanding circumstances," Silvera states in the article.

The practical implications, according to Silvera, are that hospital boards seeking to improve the patient experience should give careful attention to promoting women to the role of CEO and consider how their own policies may be constraining both the promotion of female executives and the creation of more patient-centered health care organizations.

"We need more female CEOs. That would be the first implication. In health care specifically, we know now we're trying to build a patient-centered health care system. That's been a goal for going on two decades now. And this finding shows that female CEOs improve patient experiences. So we need more female hospital CEOs if we want to have a patient-centered health care system," Silvera said.

PRACTICAL SOLUTIONS

College of Human Sciences researchers work to improve quality of life for all

By Charlotte Tuggle

Life-threatening metabolic disease. Emerging technology with hidden health risks. Wasting apparel in the world's landfills. For the issues that affect well-being at home and around the world, human scientists are researching practical solutions to solve these problems and more.

In the College of Human Sciences, the studies of global issues, consumer and design science, human development, family, hospitality and nutrition all work toward the same mission: to improve quality of life for all.

Unlocking the Mysteries of Alzheimer's with Nutrition

Alzheimer's disease disrupts millions of lives around the world every year, according to the 2018 World Alzheimer's Report, but both the cause and cure to the disease remain a mystery to the medical field.

A promising avenue of research is the topic of meal-timing, which nutrition doctoral student Lauren Woodie studies in the lab of associate professor of nutrition Dr. Mike Greene. The meal-timing principle explains how the time of day in which people consume food affects their metabolism. For example, eating very late at night may slow your nutrient uptake and lead to negative health effects.

Circadian rhythm is the schedule by which the body's internal clock is set. This rhythm keeps the pace in organs such as the liver, where the genes of the internal clock are regulated by nutrients and synchronized by the central clock in the brain. Researchers were surprised to find the hippocampus, the brain's center of memory, behaves in a similar fashion. So, the same principle applies—an irregular eating schedule or poor diet may have serious, lasting effects on memory.

"When those two clocks are not working together, metabolic disruptions will happen. One clock remains set to the light, the other becomes set to food. A high-fat diet will disrupt the food regulated clock, and then you have this desynchronization, which is part of the development of metabolic diseases," Woodie said. "Given the fact that the diet has such a big impact on the hippocampus and that circadian disruptions are a big part of Alzheimer's disease, looking to see if Western diet-induced circadian disruptions can modulate some of the Alzheimer's disease risk genes is a major addition to the field."

With her results, further research will reveal more about the probability of when you eat as a possible treatment of Alzheimer's.

Investigating the Health Risks of Vaping

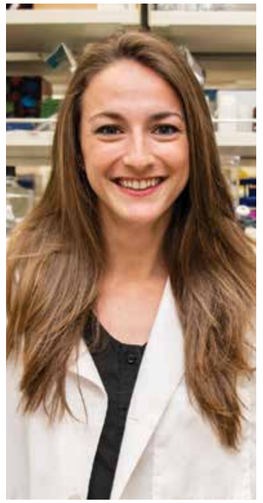
Vaping and e-cigarette technology are growing in popularity among students and the general public. Human Development and Family Studies associate professor and Alabama Extension specialist Dr. Adrienne Duke said there's a broad misunderstanding about the health risks these vapor-based nicotine delivery systems pose.

Duke and Dr. Linda Gibson-Young in the School of Nursing examine adolescent and college-aged students' vaping use, beliefs, behaviors and health outcomes. Duke said not only are higher rates of college students vaping than previously thought, but a majority believe that electronic nicotine delivery devices are relatively harmless.

"Teens and young adults often don't understand what nicotine can do to the body and brain. If youth understood better that they are breathing in an aerosol of nicotine, ultra-fine particles, volatile organic compounds and other toxins, they would be less likely to say that it's harmless," Duke said. "Addiction to nicotine at an early age has effects on brain development and can lead to lung damage and respiratory illnesses."

The scientific community recently named this infection EVALI, or e-cigarette or vaping product use associated lung injury. As this pool of research grows, it will serve to inform policy-makers and federal regulation offices about how to restrict the use of these relatively new products.

As an Alabama Extension specialist, Duke is evaluating a vaping prevention program called Escape Vapes, led by Extension's Family and Child Development educators across the state of Alabama. This prevention program is targeted toward middle and high school students, and assesses the changes in attitude about vaping. Duke said this type of education will reduce the number of people smoking, as well as those who try it for the first time.



Lauren Woodie

Dr. Adrienne Duke

Dr. Young-A Lee

Creating Sustainable Apparel

Today's dress shoes are most commonly made from a variety of rubber, leather and synthetic materials that contribute to environmental deterioration and have negative effects on industry workers' health. In response to this problem, Auburn University consumer and design sciences associate professor Dr. Young-A Lee and her research team developed a promising biodegradable material alternative to leather using the byproducts of fermented green tea through an Environmental Protection Agency-funded grant.

In her research at Iowa State University, Lee found that a green tea-based cellulosic material behaved the same way as leather, without the same negative environmental side effects. When the researchers combined an outer shell of cellulosic material with a hemp-based fabric on the inside, then used recycled denim to bond the two together, the result was an eco-friendly product comparable to the style and durability of a leather dress shoe.

The study concluded that the multilayered, biodegradable material presented great potential as a substitute to leather. These findings will inform future explorations into sustainable apparel and footwear practices in the industry.

"Fashion, to most people, is an ephemeral expression of culture, art and technology manifesting itself in form," Lee said. "Fashion companies keep producing new materials and clothing, from season to season, year to year, to fulfill consumers' desire and needs. This is really the time to think about where these items eventually go. We really need to think about new ways of creating sustainable materials and products made out of those materials, which contributes to the betterment of people, the planet and our society."

A MEETING OF MUSIC AND THE MIND

Blending the arts with education and research is central to GPAC's mission and programming

By Mitch Emmons

A few short months ago, the new Jay and Susie Gouge Performing Arts Center at Auburn University lit the spotlight and raised the curtain on its first stage performance, and from the start, its programming has blended the arts with education and research for the betterment of the community.

Virtually every performance to date in this inaugural season has included a separate event involving the artists engaged with the community at large as well as Auburn's academic and research faculty. Perhaps none, though, has more clearly demonstrated this purpose than the performance Sept. 23 by renowned opera soprano, Renée Fleming.

Fleming is a recipient of the National Medal of Arts—the highest honor the United States can bestow on an artist. She has many other accolades as a performer, but she also is passionate about her belief in the effect music and the arts can have on our society, especially the brain itself.

Fleming spearheads a collaboration with the National Institutes of Health. Her Sound Health initiative, in association with the National Endowment for the Arts, explores and brings attention to research and practice at the intersection of music, health and neuroscience. This initiative has also led the NIH recently to award $20 million in funding for music and neuroscience research over five years.

Fleming's program, Music and the Mind, explores the power of music as it relates to health and the brain. It focuses on such topics as childhood development, cognitive neuroscience, evolution, music therapy and the impact on health care, the impact of music education, music and social cohesion, and the future of music in medicine.

Fleming invites experts to present their research and discuss their experience as part of her presentations. She also investigates the evolutionary role music may have played in creating community, as well as case studies and individual stories of how music has changed lives. In each location where she performs, she collaborates with leading local neuroscientists, researchers, physicians, music therapists, educators and universities. Her goal is to bring this information to her audience and amplify the amazing work happening at the intersection of music, health and neuroscience.

"The Music and the Mind program was the perfect blend of research and outreach," said Dr. Jeff Katz, Alumni Professor in the Department of Psychology in the College of Liberal Arts, and principal investigator with the Comparative Cognition Laboratory. "The program showcased a unique mixture of active research areas at Auburn related to how the arts, music and observational drawing, can heal the mind and brain. The open discussion between Renée Fleming, the Auburn faculty and the audience further provided an excellent opportunity to educate the general public."

Dr. Nancy Haak, an associate professor in the Department of Communication Disorders, teaches graduate courses in neurogenic communication disorders. She shared a similar view: "Research, linking our memories to the music that 'speaks' to us, holds much promise for those facing a devastating diagnosis of dementia," Haak said. "To be able to offer a means of maintaining connection/communication with loved ones, via the music of their life, seems most encouraging in a future fraught with loss."

"I loved the opportunity to share the work my lab has been conducting related to music and listening skills with the audience," added Dr. Aurora Juliet Weaver, an assistant professor in the Department of Communication Disorders and lead researcher in the Auditory and Music Perception Lab.

"It was a privilege to have our NEA-funded study that investigates the impact that drawing has on the brain included," said Barb Bondy, the Jane Dickinson Lanier Professor in the Department of Art and History. "It is widely understood that communities thrive where the arts flourish. Over the last decade we have seen scientific evidence of the profound impact that the arts have on the brain and the power of the arts to help individuals think creatively, thrive and heal."

The Jay and Susie Gogue Performing Arts Center at Auburn University is East Alabama's premier performing arts venue, presenting touring Broadway productions, opera, dance, chamber arts, popular musical performances

Renée Fleming

and student and faculty music and theater performances. The Gogue Center is home to both the 1,202-seat Woltosz Theatre and 3,500-capacity amphitheatre at the City of Auburn Lawn and Porch, with 17,000 square feet of open space for outdoor performances, community festivals and events. Located at 910 South College Street, directly opposite the Jule Collins Smith Museum of Fine Art, the Gogue Center serves as a twin pillar of Auburn's bourgeoning arts district, a cultural hub for the university, community and region. More information and a full slate of upcoming performances can be found on its website: goguecenter.auburn.edu/

BEST DEFENSE

Elite national training program leads veterinary medicine graduate researchers into biodefense workforce

By Mitch Emmons

Dr. Constantinos Kyriakis and Virginia Aida

Protection of the American public against infectious diseases and developing vaccines to counteract biological threats and cure the spread of contagious pathogens is not only a medical concern, but also one of national security significance. Biodefense is such a priority in the United States that the U.S. Department of Agriculture has multiple agencies involved in this mission.

At the top of the list is the construction, opening and staffing of the nation's forthcoming National Bio- and Agro-Defense Facility (NBAF) and training of the scientists and veterinary medical officers who will operate it.

Perhaps nowhere is that training presence stronger than at the Auburn University College of Veterinary Medicine, where two of its graduate student researchers and their faculty mentors are participating in the NBAF Scientist Training Program (NSTP), sponsored by the USDA Animal and Plant Health Inspection Service (APHIS), and the related Veterinary Medical Officer (VMO) training program, sponsored by the USDA Agricultural Research Service (ARS). Both programs are designed to build the NBAF workforce.

Two graduate trainees and their Auburn faculty mentors are working with subject matter experts affiliated with APHIS, through the foreign animal disease and diagnostic laboratory, the ARS, and the National Institute of Allergy and Infectious Diseases (NIAID) Centers of Excellence for Influenza Research and Surveillance (CEIRS).

Virginia Aida, a third-year veterinary student, was awarded an NSTP fellowship in 2018. The Huntsville native came to Auburn after earning a bachelor's degree in biology with a minor in chemistry and a Master of Science in neuroscience from the University of Alabama at Birmingham. She has since been as an NSTP fellow in a dual D.V.M./Ph.D. degree program. Aida is mentored in research by Dr. Constantinos Kyriakis, an assistant professor in the Department of Pathobiology, whose Centers of Excellence for Influenza Research and Surveillance (CEIRS) NIH-funded research focuses on investigating immune responses and novel vaccine platforms against influenza A viruses in swine.

Dr. Shari Kennedy, a veterinary resident in large animal internal medicine who completed her DVM degree at Kansas State University, was supported by the ARS for her research by Dr. Thomas Passler, an associate professor in the Department of Clinical Sciences, whose research focuses on the infectious pathogen Bovine viral diarrhea virus (BVDV). Kennedy is pursuing the Ph.D. degree as she completes her residency.

Both Aida and Kennedy use the porcine model in their research.

"We use pigs in our research because they are a natural host of influenza and they have a very similar pathogenesis and immune response to infection with humans," said Aida's faculty mentor, Dr. Kyriakis.

As part of one of the CEIRS research projects, Kyriakis collaborates in a novel vaccine development study underway at the University of Georgia.

"We study the efficacy of a new generation vaccine that could offer protection against several strains of influenza," Kyriakis said. "Unlike measles virus, which remains fairly stable and once we are vaccinated as kids we are protected for life, influenza viruses have multiple strains, which change significantly over time. This is why we need to frequently replace our vaccine strains and get the flu shot every single year. Vaccines that provide long-lasting and broad protection must be developed against ever-changing influenza virus. Here at Auburn, Virginia is testing these vaccines."

Under the umbrella of the Animal Health Research Program at the College of Veterinary Medicine, Kennedy was already involved in research that the USDA was interested in before she was awarded support through the USDA-ARS VMO program.

BVD is a significant medical infection among livestock. It is highly contagious among various livestock species and is transmitted a number of ways. The USDA is interested in the development of vaccines that can control this pathogen.

"What we have learned is that some pigs infected either at birth or later with BVD are able to reproduce an immunity or cure," Dr. Passler said. "We think this is due to a mutation of the virus that develops in the pig's immune system. Shari is doing research to shed light on how this occurs."

Aida and Kennedy are the first Auburn participants to be awarded USDA NSTP and ARS support as part of the NBAF workforce development effort. The opportunity was cultivated in part through the work of Dr. Frank "Skip" Bartol, associate dean of research and graduate studies in the College of Veterinary Medicine.

"The NSTP fellowship program was established to build the workforce of doctoral-level scientists required to support the NBAF mission, and the ARS-VMO program evolved to ensure that state-of-the-art clinical expertise would be available to support this mission" said Bartol "Having two of our students supported by these programs speaks very highly of the quality and caliber of our students, our faculty and our research programs here at the College of Veterinary Medicine."

Upon completion of her five-year NSTP fellowship, Aida will begin her career as a scientist through a seven-year career appointment with the USDA APHIS in its foreign animal disease diagnostic laboratory at the new NBAF in Manhattan, Kansas.

While Kennedy's participation through the USDA-ARS program does not contain the same service commitment, she says she also hopes to return to her home state and continue her career as a clinician-scientist at the NBAF facility there.

The mission of APHIS is to mitigate the influx and spread of foreign and serious plant and animal diseases into the United States. Its foreign animal disease diagnostic laboratory studies these diseases in highly bio-secure conditions. One of the primary goals is to test and validate vaccines to combat and treat those diseases in addition to serving as a national diagnostic laboratory.

The new NBAF is under construction on the Kansas State University campus in Manhattan, Kansas. The $1.25 billion facility includes a biosafety level-4 laboratory and will replace the aging Plum Island Animal Disease Center in New York. The NBAF is expected to be operational by 2022-2023.

Dr. Shari Kennedy and Dr. Thomas Passler

FACULTY ACHIEVEMENT **HIGHLIGHTS**

Dr. Marilyn Strutchens, Emily and Gerald Leischuck Endowed Professor & Mildred Chesire Fraley Distinguished Professor in the College of Education's Department of Curriculum and Teaching, has been named chair of the advisory committee for the National Science Foundation's Directorate for Education and Human Resources (EHR). The advisory committee membership includes about two dozen STEM education experts, and the group provides guidance and oversight for the NSF's programs for education and human resource development.

Dr. Alice Smith, the Joe W. Forehand/Accenture Distinguished Professor of industrial and systems engineering and joint appointment professor of computer science and software engineering, is the editor of a new book celebrating women who have contributed to the field of industrial and systems engineering. The book, titled "Women in Industrial and Systems Engineering," was published by Springer and covers real-world applicable topics, including analytics, education, health, logistics and production. With 25 chapters and over 60 authors and collaborators from around the globe, the book covers the span of women's impact on this field of engineering.

Dr. Daniel Tauritz, associate professor in Auburn's Department of Computer Science and Software Engineering and an expert in artificial intelligence, has been appointed as a guest scientist with the Los Alamos National Laboratory (LANL). In this role, Tauritz will develop Auburn research programs to help solve the national security issues that LANL addresses and will also work with undergraduate and graduate students and other Auburn University faculty and LANL scientists on both research and workforce development.

Dr. Ryan Comes is the first recipient from Auburn University selected for the Air Force's Young Investigator Research Program Award. Comes joins a cohort of only 40 researchers in 2019 given this prestigious honor as one of the most promising scientists and engineers who received a doctoral degree during the last seven years and demonstrated exceptional capabilities for conducting research that can advance military interests.

The award of $450,000 in funding over the next three years will support the project titled "Metastable Oxides for High-Mobility and Spin-Orbit 2D Electronics." The grant will also provide funding for graduate student and postdoctoral researchers in the Films, Interfaces and Nanostructures of Oxides (FINO) Lab in the Auburn physics department.

A new book by **Dr. Sunny Stalter-Pace**, the Hargis Associate Professor of American Literature and director of graduate studies in the Department of English, is slated for release on May 15, 2020. Imitation Artist: Gertrude Hoffman and American Popular Performance, published by Northwestern University Press, explores the dancer and choreographer's work of popularizing European performances among early 20th century American audiences. Stalter-Pace received her Ph.D. from Rutgers University and specializes in the interdisciplinary study of modernist performance, literature and urban space.

In fall 2019, Auburn University Culinary Science Director **Dr. Mark Traynor** showcased American cuisine in an immersive international program for the greater good of culinary education and the industry's economic impact. Through a U.S. Department of Agriculture Cochran Fellowship for Gastronomy Education and Promoting U.S. Cuisine for Ukraine, Traynor led five fellows representing leaders of the Ukrainian culinary world with a focus on the diverse gastronomy of the southeastern U.S.

Traynor, as principal investigator of the first program to feature contemporary American cuisine in the Southeast designed to increase U.S. exports in areas of the world that would benefit from American products, crafted an experience that showcased the diversity, creativity and quality of U.S. cuisine. The fellows on the program learned about restaurant functions, culinary trends, cooking techniques, innovative marketing, food production, U.S. food products, food and drink pairings, crop seasons and U.S. food quality standards.

Three Auburn faculty members and their international co-researchers have received a major National Science Foundation (NSF) grant to lead a study on climate and global changes that will affect the sustainability of food, energy and water, or FEW, resources for the rapidly growing populations in the United States, China and beyond.

Professors **Dr. Hanqin Tian** and **Dr. Shufen "Susan" Pan** of the School of Forestry and Wildlife Sciences and **Dr. Ruiqing Miao** of the Department of Agricultural Economics and Rural Sociology in the College of Agriculture, along with their fellow researchers in China, received a $1 million grant, jointly funded by the NSF and the National Natural Science Foundation of China. The group will conduct research on both the Mississippi River Basin and China's Yellow River Basin.

ATTACKING CANCER

By Matt Crouch

Treating any kind of cancer can be a difficult task. Along with identifying the right drug or therapy for a particular cancer, the problem gets even more complicated when attempting to determine the proper mode of delivering the drug while also factoring in the patient's biologic or genetic makeup, side effects and the potential success rate.

Tackling all the moving pieces can be a challenge, but it is one that investigators at Auburn University's Harrison School of Pharmacy are taking on every day in their labs. From developing new drugs, to genetic testing, to dosing and delivery, and to mitigating chemotherapy side effects, faculty members are taking a holistic approach towards learning more about cancer and how it affects us.

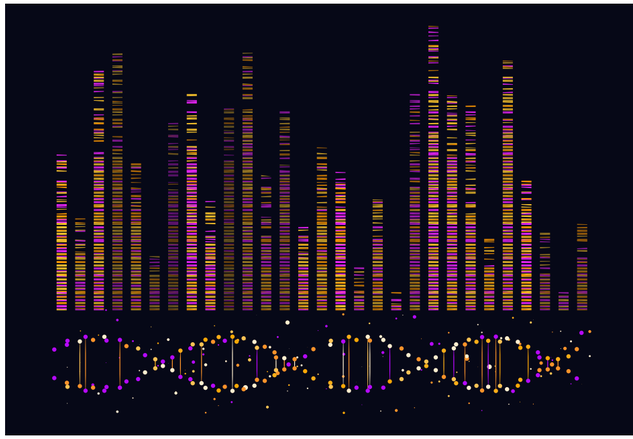
"Most people might ascribe cancer research being conducted in a school or college of pharmacy as developing and testing new drugs, and this would be correct," said Dr. Tim Moore, associate dean for research at the Harrison School of Pharmacy (HSOP). "However, our researchers are also engaged in multi-faceted work that includes testing new applications of currently available drugs to treat different types of cancers, developing new dosing regimens for chemotherapies, designing new ways to target cancer at the cellular and molecular level, identifying new genetic mutations responsible for cancer development, testing the effects of diets and nutritional supplements on affecting cancer drug effectiveness and looking for ways to minimalize side effects associated with cancer treatments."

A relatively new tool in this work is the Center for Pharmacogenomics and Integrated Omics Initiative (AUPharmGx), headed up by Dr. Amit Mitra. The first of its kind in Alabama, the program combines the science of drugs and pharmacology with genomics, the study of genes and their functions. This type of specialized or personalized medicine allows experts to better understand variations within a person and whether a particular drug treatment could be effective.

"Modern cancer research must consider genetic–influenced molecular pathways that cause the disease," said Moore. "The work of Dr. Mitra and his team will allow us to identify multiple genetic mutations for a wide number of different cancer types all the way down to determining a mutation in a single cell that might lead to cancer development. Knowing this will enable precision cancer drug discovery and development."

That drug discovery and development covers a variety of areas, including solid tumors, melanoma, multiple myeloma, prostate and breast cancers. Faculty take on cancer by developing new molecular therapies or new drugs, while also searching for ways to repurpose existing molecular therapies.

HSOP faculty also work to develop drug delivery systems. In particular, investigators develop novel lipid nanoparticles as drug carriers and diagnostic agents for the treatment of cancers. Nanoparticles are developed with consideration of how a tumor's microenvironment alters the distribution and rate-extent of drug release, allowing scientists to engineer formulations that provide optimal drug exposure.

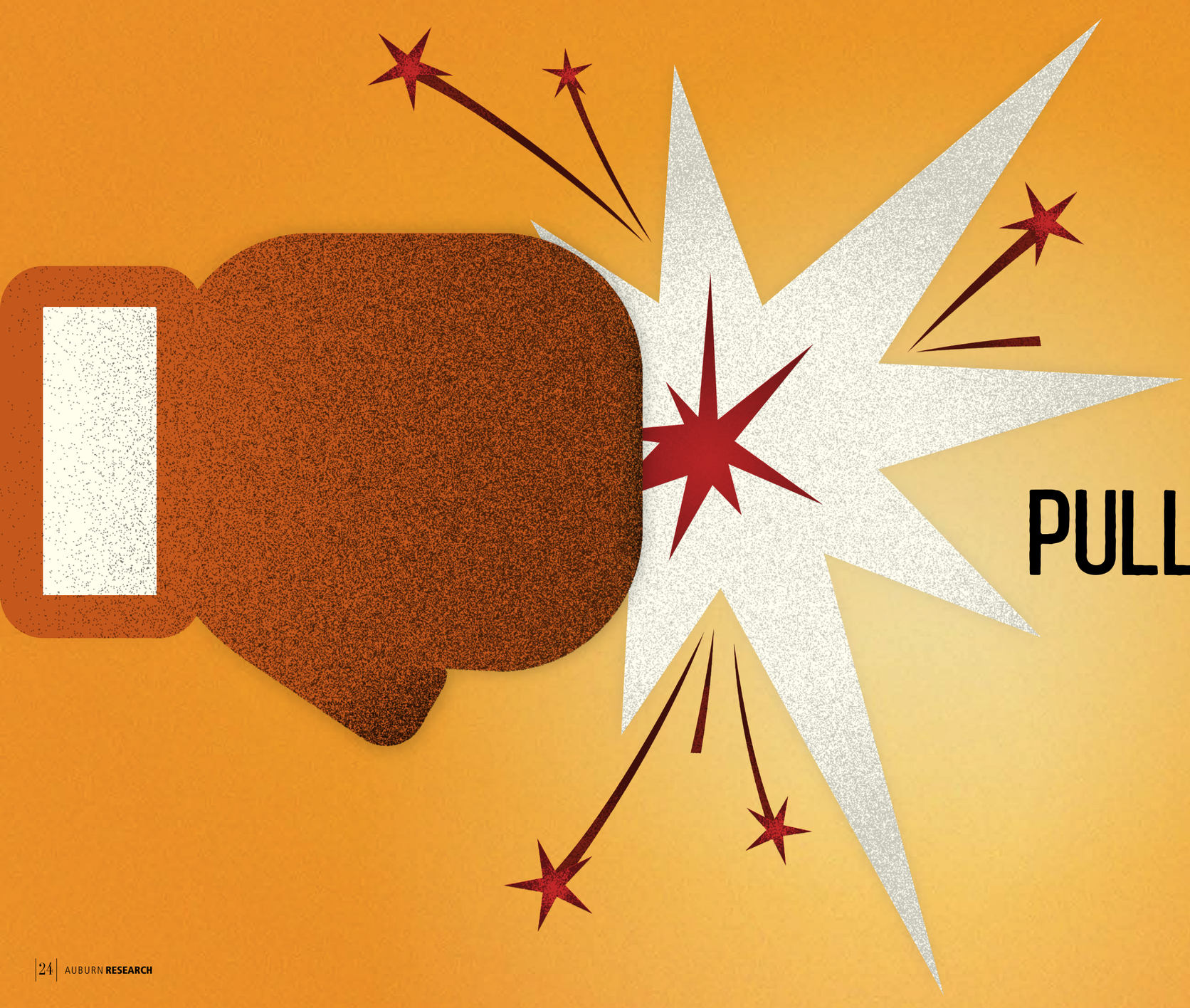


> **"Modern cancer research must consider genetic–influenced molecular pathways that cause the disease."**
>
> *- Dr. Tim Moore*

"The concept of drug delivery systems for treating cancer goes beyond just traditional modes of thinking about how drugs are administered to the body, which typically include oral, intravenous, inhalational or transdermal routes," said Moore.

Work on new drug therapies, delivery systems, testing and research are benefitted by on-campus relationships with the Auburn University Research Initiative in Cancer (AURIC), College of Veterinary Medicine and the Samuel Ginn College of Engineering. Additionally, faculty members are actively engaged with collaborators at the University of Alabama at Birmingham College of Medicine.

"Better diagnosing, treating and ultimately curing cancers requires a multidisciplinary research approach," said Moore. "Without bioengineering professionals, medical health professionals would not be able to advance effective chemotherapeutic delivery systems into clinical application."



PULLING NO PUNCHES

Will nanomedicine and other tech advances knock out devastating diseases?

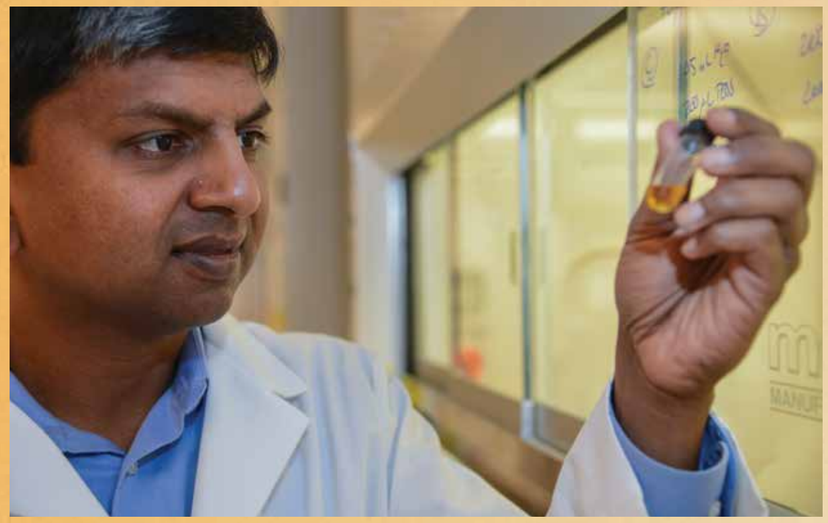
by Austin Phillips, Chris Anthony and Jeremy Henderson

When it comes to biomedical engineering research and instruction, Auburn University's Samuel Ginn College of Engineering is emerging as a leader on the forefront of finding solutions and cures to some of the world's most serious human health issues. Auburn Engineering faculty members are collaborating across campus and disciplines in this effort, uncovering and discovering many diagnostic and delivery systems that will change the way we look at once grim diagnoses.

Fighting cancer

Cancer. It affects almost all of us. Whether it's you personally, a family member or a friend, cancer is ravaging our country at an astounding rate. According to the American Cancer Society, more than 1.8 million new cases will be diagnosed in 2020, and more than 600,000 people will lose their battle with the disease this year.

This terrible trend must stop.



Dr. Allan David

MORE THAN
1.8 MILLION
NEW CASES OF CANCER WILL BE DIAGNOSED IN THE UNITED STATES IN 2020.

Here at Auburn University we are engineering a cure. Not only is our cutting-edge research attacking cancer at the source, but it's also helping to diagnose and better treat the debilitating effects of this disease.

Through collaborative efforts from Samuel Ginn College of Engineering professors Dr. Allan David and Dr. Elizabeth Lipke, along with researchers in the College of Veterinary Medicine, the Harrison School of Pharmacy and the Department of Nutrition, Dietetics and Hospitality Management, the race for a cure is taking place right here at Auburn.

David, a faculty member in the Department of Chemical Engineering, oversees a nanoparticle and nanocomposite lab that is focused on highly selective drug targeting to enhance cancer therapy.

Part of David's research targets cancer cells in a highly selective way so that the therapy goes to the diseased site and does not interfere with healthy cells in the rest of the body. For example, achieving a therapeutic concentration in a tumor could require gram-level doses of a drug that distributes through the entire body.

The "smart nano" approach places the drugs where they can be effective. They are contained within nanoparticles and nanocomposites that target and stick to the cells that need to be treated. It's an approach that will allow for much greater treatment efficacy at lower delivery doses and a resulting reduction in side effects.

David's research also holds great promise for insulin therapies in diabetics, since insulin cannot be delivered orally and must, therefore, be injected.

The benefits of nanotechnology will ultimately lead to what is called personalized medicine—targeted therapies that reduce dosage amounts and frequency, which results in better treatment at lower cost. It is also anticipated that patients treated in this way will recover more quickly, and become productive again in a shorter amount of time.

Lipke, a faculty member in the Department of Chemical Engineering, and her team are developing 3D in vitro cancer models for use in drug-testing applications. Employing a range of metastatic and non-metastatic cancer cell lines, they are encapsulating the cells in hydrogel materials to create tissue-engineered "tumor microspheres" and "tumor millibeads."

Using 2D monolayer cultures and self-aggregated 3D tumor models, researchers and scientists are unable to capture key features of the complex in vivo tumor, severely limiting their ability to obtain clinically-relevant data in cancer drug-testing applications. In addition, the information acquired from these models, including identification of new cancer drug candidates, does not reflect the actual response seen in animal testing and human trials.

By using novel fabrication techniques, the tissue-engineered tumor models developed by Lipke and research team members reproduce native tumor characteristics not emulated by traditional models. Importantly, these techniques can be used to form engineered tumors with multiple contributing cell types or from non-self-aggregating metastatic cancer cells. Models are formed through the encapsulation of cancer cells within poly(ethylene glycol)-fibrinogen (PEG-Fb) hydrogels. The tumor microspheres support long-term 3D culture of the cancer cells and, by more accurately mimicking the properties of tumors within cancer patients, results could provide a platform for identifying more effective candidate drugs for animal and clinical testing. The model will not only help medical experts more carefully examine the tumor microenvironment, which is known to play a significant role in the malignant progression of cancer, but will also aid in the study of tumor growth for breast, prostate and colon cancer.

Rapid Response

In the fight against cancer and autoimmune diseases, time is often a clinician's worst enemy.

Having real-time data on the health and function of a patient's immune system is critical to treating these diseases. However, one of the main diagnostic tools in use today, the enzyme-linked immunosorbent assay, must be sent to a lab and will take hours to days for results to return.

By then, the dynamics of the immune system may have completely changed, leaving the clinician to make treatment decisions based on outdated information.

Dr. Pengyu Chen, assistant professor of materials engineering, is aiming to change that by developing optofluidic nanoplasmonic biosensors for rapid analysis of the immune system. The research, supported by a $1.9 million National Institutes of Health grant, seeks to better understand and measure cytokines—tiny proteins vital to signaling between cells—for rapid diagnostics.

"The ultimate goal is to develop a biomedical device based on nanoparticles that we can use to take one droplet of the patient's blood, and in a short period of time, we can accurately tell if the patient's immune system is healthy or not," Chen said.

The research project has three primary goals: to integrate nanoplasmonic structures into biosensors for higher performance and faster response times; to fabricate microfluidic devices for target cell isolation and on-chip measurements and analysis; and to develop nanoplasmonic ruler biosensors—two nanoparticles linked with one DNA—to visualize cytokines secreted from a single immune cell and eventually map out its secretion profile. Previous research suggests that measuring cytokine-based immune fingerprints provides useful information related to infectious diseases, cancer and other diseases.

"We are trying to provide real-time feedback of the immune system for personalized immunomodulatory therapies," Chen said. "Currently, there is no technology that can serve as a real-time diagnostic tool to tell if the dosage of a therapy is good or not. Our hope is that we can develop a technology that can be used at bedside or a point-of-care device so that physicians can make decisions based on these measurements more quickly and accurately and then potentially change the outcome of the therapeutics."

Resonance of Research

It was a big deal when Auburn got only the nation's third actively shielded whole-body 7 Tesla MRI in 2012, figuratively and literally. Workers had to lift it out of the crate with a crane. It took a little while.

Dr. Tom Denney, professor in electrical and computer engineering and director of the Auburn University MRI Research Center, didn't mind.

Still just one of just three 7 T machines in the South, the $8.5 million investment allowed Denney's team and others game-changing access to dimensions of detail once unimaginable in brain imaging. Its installation was the final step in implementing the $24-million research center's mission: saving lives.

"This is not engineering for engineering's sake," Auburn University trustee and former CEO of Alabama Power Company Charles D. McCrary, '73 mechanical engineering, told reporters at the 2010 groundbreaking for the 45,000-square-foot facility.

Turns out, it was for JoJo's sake.

Though intended primarily for cognitive neuroscience, the 7 T's most recent, high-profile success story may be a breakthrough treatment for GM1 gangliosidosis, a devastating genetic nerve disease that affects around one in 100,000 children. But for one of those children, it may no longer be a death sentence.

In May, 10-year-old JoJo, who needs help to stand and even speak, began the first in-human GM1 gangliosidosis gene therapy trial, developed in large part through a collaboration between the MRI Research Center and the College of Veterinary Medicine's Scott-Ritchey Research Center.

The results have so far put smiles on the faces of everyone involved.

"She's actually gotten slightly better," said Dr. Doug Martin, a professor in the Scott-Ritchey Research Center. "It was thought that once the disease reached a certain point, you wouldn't be able to recover any function, but she has. Of course, that could all end tomorrow, but right now she's doing well."

For several decades, Martin has studied feline GM1 gangliosidosis in cats, which manifests identically as the human variety of the disease. If ever a potential gene therapy could be developed, he suspected a cat would be the perfect model.

> **"THIS IS NOT ENGINEERING FOR ENGINEERING'S SAKE."**
>
> *– Charles D. McCrary, '73, Auburn University trustee and former CEO of Alabama Power Company*

So did Dr. Cyndi Tifft, a geneticist at the National Human Genome Research Institute in Bethesda, Maryland, who in 2006 began a natural history study of 35 children with GM1 gangliosidosis.

"She was doing cutting-edge research on biomarkers of disease progression in human patients with gangliosidosis, and she wanted to test the same biomarkers in cats," Martin said.

The two joined forces 15 years ago. But in 2012, now with access to one of only a handful of 7 T MRIs in the country, the magnitude of their research increased exponentially.

"I almost couldn't believe we'd made the investment," Martin said. "It was such a tremendous step forward for all of our research on animal models and human patients. It was really amazing because Auburn had not traditionally put a lot of emphasis on biomedical research, and then the 7 T showed up.

"We can watch the progression of gangliosidosis and the progression of the therapeutic results in a live animal without having to euthanize the animal and take a sample post-mortem. I think there's only one or two other vet schools with access to a 7 T."

Denney, who has helped train Martin's laboratory team on how to use the center's crown jewel, said the increase in insight into brain chemistry allowed by 7 T technology can't be overstated.

"The strength of the magnet provides a much, much higher resolution," he said. "We can see things in the brain now that we could never see before. We use it to measure different metabolites in the brain, which are indicators of the response to therapy or disease progression. It gives us much clearer, more accurate data that we can trust much more."

The U.S. Food and Drug Administration trusted it, too, greenlighting clinical trials—and JoJo's chance for a future—thanks directly to the gene therapy vector Martin and colleagues helped develop and test with the 7 T.

"We probably have used the 7 T more than any other outside group," Martin said. "That kind of tells you how important it is to what we're doing. It's a big part."

FINAL ROUND

RESEARCH AWARD-WINNING FACULTY

Creative Research and Scholarship Award

Selected annually by a panel of previous recipients and other faculty, the Creative Research and Scholarship Award is an Auburn University Faculty Award recognizing faculty who have distinguished themselves through research, scholarly works and creative contributions among the categories of fine arts, liberal arts, architecture and design, business, social/human sciences biomedical sciences, engineering and agriculture.

Dr. Hareesh Tippur, the McWayne Professor in the Department of Mechanical Engineering in the Samuel Ginn College of Engineering, has taught at Auburn for 29 years. He is recognized for his research in the area of solid mechanics and novel/non-traditional materials as well as optical sensors used in studying material fractures. Tippur received his doctoral degree at the State University of New York, Stony Brook and did post-doctoral research at the California Institute of Technology in Pasadena. Tippur is passionate about his research and his teaching and mentoring of students. He says that the next generation of engineers faces a fast-paced, globalized and highly competitive career environment that requires life-long learning and rapid adaptation. Presently, he is working on two funded research projects for the Army Research Office in dynamic failure mechanics of layered architectures using novel full-field optical methods and non-contact optical metrology instrumentation for failure characterization of transparent armor materials.

COLLEGE/SCHOOL

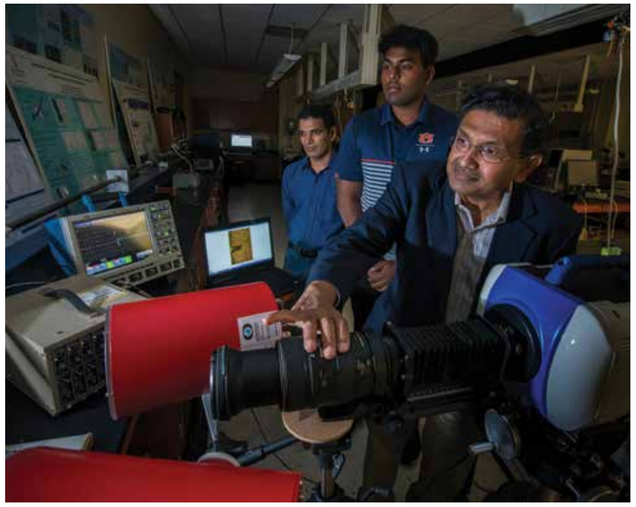
Samuel Ginn College of Engineering

YEARS WITH AUBURN

29 years

RESEARCH AREA

Solid mechanics and novel/ non-traditional materials as well as optical sensors used in studying material fractures



Rusty Smith is the associate director of the Auburn University Rural Studio and has taught at Auburn for 21 years. He is recognized for his leadership and involvement in this internationally recognized design-build architecture program, focused on providing affordable housing to underserved individuals in underdeveloped areas. Smith was educated first at Auburn University and then at The School of the Art Institute of Chicago. He is a nationally recognized teacher and scholar who prescribes to the philosophy that the best way to learn how to do something is to actually do it. He says that the opportunity to contribute to the work of Rural Studio is truly humbling. Through context-intensive work, students come to understand that design has profound social consequences. Development of know-how (the embodiment of knowledge through the act of making and building) becomes the unique characteristic that enables graduates to be socially engaged, active and impactful professionals. Smith's research interests include practice-based teaching and learning and housing affordability.

COLLEGE/SCHOOL

College of Architecture, Design and Construction, School of Architecture, Planning and Landscape Architecture

YEARS WITH AUBURN

21 years

RESEARCH AREA

Rural Studio, design-build architecture program, focused on providing affordable housing

Research and Scholarship Achievement Award

Auburn University's Research and Economic Development Advisory Board established the Research and Scholarship Achievement Award in 2014 and awards it to recognize high-quality, competitive research and scholarly activity and exceptional efforts to advance Auburn's research and scholarship mission. The recipient of the annual award receives a $25,000 grant to further his or her research.

Dr. Rex Dunham, Butler-Cunningham Eminent Scholar in Agriculture and Alumni Professor in the School of Fisheries and Aquatic Sciences, has taught at Auburn University for 41 years. He is recognized for his extensive research and mentoring of students in the genetic improvement of catfish. His specific research interests are focused on the areas and related areas with catfish genetics involving selective breeding, hybridization, gene transfer, gene mapping and genomics and reproductive physiology. Dunham was the first to produce a transgenic fish in the United States and says that his proudest professional moment was when the catfish industry adopted the Auburn-developed hybrid catfish technology. He has taught and mentored hundreds of students both at Auburn and in other countries where Auburn Fisheries is teaching and training students and others in aquaculture technologies. In addition to extensive work benefitting the catfish industry, Dunham has conducted population genetics research on native sport fish populations, influencing genetic management policy of various natural resource agencies in the South. He continues to advance the field of genetic reproductive control of fish, with the goal of having traditional and molecular genetic technologies used to improve aquaculture and fisheries management while ensuring the lowest possible environmental impact. During the course of his career, Dunham has obtained over $20 million in research funding and published nearly 400 scholarly works, including three manuscripts in the journal, Nature.

COLLEGE/SCHOOL

College of Agriculture, School of Fisheries and Aquatic Sciences

YEARS WITH AUBURN

41 years

RESEARCH AREA

Catfish genetics involving selective breeding, hybridization, gene transfer, gene mapping and genomics and reproductive physiology

Provost Award for Faculty Excellence in Undergraduate Research Mentoring

Established in 2012, the Provost Award for Faculty Excellence in Undergraduate Research mentoring recognizes faculty who demonstrate a strong commitment to undergraduate research and outstanding services to students, and whose efforts support Auburn students interested in careers in research and creative work.

Dr. Kathryn M. Floyd, associate professor of art history in the College of Liberal Arts, has served on Auburn's faculty for 11 years. She is recognized for her research focused on the history of art in 20th century Germany—particularly the history and historiography of art exhibitions and their mediation in catalogues, installation photographs and film—and her mentorship to undergraduate researchers. Floyd holds a bachelor's degree in art history and anthropology from Vanderbilt University, a master's of art history from the University of Georgia and a doctorate in art history from the University of Iowa. Before coming to Auburn in 2008, Floyd worked at the International Dada Archive at the University of Iowa Libraries and served as a visiting assistant professor of art history at Skidmore College. Her teaching at Auburn University has been recognized with an SGA Outstanding Faculty Member Award (2011) and a College of Liberal Arts Teaching Excellence Award (2017). Floyd believes in the importance of gaining real-world experience in learning and teaches her students the need for flexible thinking, the ability to adapt and recover, and the courage to fail productively when circumstances don't go as planned.

COLLEGE/SCHOOL

College of Liberal Arts, Art history

YEARS WITH AUBURN

11 years

RESEARCH AREA

History of art in 20th century Germany – particularly the history and historiography of art exhibitions and their mediation in catalogues, installation photographs and film

MINDING HER SPACE

By Maria Gebhardt

"Auburn University gave me this once in a lifetime opportunity to conduct research for my doctoral degree on the International Space Station (ISS)," explained Lori Scott, a graduate student in the Department of Physics.

Scott's experiment for her dissertation titled "Looking at thermal energy in complex plasmas" happened more than 200 miles above Earth and completely out of this world.

The project took place aboard the ISS on the Plasma Krystall-4 (PK-4).

Using the PK-4, the complex plasma was observed under microgravity to test how the thermal properties of dust particles in a plasma environment interact and evolve. The images aboard the ISS were recorded so the data could be reviewed and analyzed.

The goal of this project is to research polarity switching, a stopping technique used in PK-4, to see how the kinetic energy of flowing dusty plasmas is converted into other forms of energy once the particles are stopped.

Leading up to this day, months of planning were required to refine the proposal and test detailed computer scripts ensuring the appropriate data would be collected. Scott traveled multiple times to a center in Munich, Germany, to collaborate with other researchers.

In July 2019, Scott traveled to a location in France to interact with Russian cosmonauts on the ISS.

A cosmonaut began the actual experiment on the ISS and then Scott with Dr. Edward Thomas, Jr., associate dean for academic affairs and research from Auburn University, and Dr. Jeremiah Williams, associate professor from Wittenberg University, were in control.

"We had to quickly decide how to adjust the cameras recording the data since the dust clouds separated into multiples in microgravity," she said.

The experiment here on Earth would have shown the dust clouds as a two-dimensional layer on the ground. However, in microgravity, the dust clouds expand to a three-dimensional system where researchers can record and analyze detailed interactions among the particles.

more than
200
MILES
ABOVE EARTH

"Gravity masks the hidden forces and microgravity gives us an opportunity to see the plasma as a larger system," Scott added.

Once the experiment was complete, Scott traveled back to Munich, Germany, in November 2019 to collect the actual data recorded on the ISS.

"We will be comparing two sets of data. The ISS data will be compared to a ground module with the exact same settings," she mentioned.

After the research is analyzed, Scott is hoping to conduct another experiment on the ISS before defending her dissertation.

Scott and this dedicated team work in collaboration with other scientists, the German Center for Air and Space, European Space Agency, and ROSCOSMOS, the Russian Space Agency. Dr. Uwe Konopka, associate professor of physics, is the principal investigator of the joint NASA-National Science Foundation (NSF) grant that funds the project with Drs. Thomas and Williams as co-PIs. Additional support for Scott is provided through the NSF and Alabama EPSCoR project, "Connecting the Plasma Universe to Alabama (CPU2AL)."

"My favorite memory from this day was when I was able to wear a headset in the control room in France," Scott said. "I will forever be part of the experiment and part of the research."

For Scott, research will definitely be part of her career.

"I really do like to teach, but I love to conduct research," Scott said.

She began graduate school at Auburn and found an immediate connection in the Department of Physics.

"The smaller classes gave me more one-on-one time with my professors and helped me find a great fit with my graduate advisor, Dr. Thomas," Scott explained. "Once I began conducting research, I realized that research can take you anywhere and as a graduate student I had an incredible opportunity that I could have never imagined."

ALL AN "ACT"?

by Joe McAdory

The Tax Cuts and Jobs Act (TCJA) of 2017 was created to boost the American economy, and incentivizing U.S. firms overseas to invest domestically was part of that plan.

How? Prior to the legislation, U.S. firms on foreign soil were taxed on earnings brought back into the country and stockpiled trillions of dollars overseas. Prior to the TCJA, firms could defer paying taxes on foreign earnings if those earnings remained abroad.

Proponents of the TCJA believed new tax relief would provide "rocket fuel to the U.S. economy," helping to kick start economic growth, jobs and wages. On the other hand, the law's opponents disagreed, stating that money would instead be funneled to shareholders.

Dr. Mollie Mathis, associate professor in the Harbert College of Business' School of Accountancy, and a team of researchers examined thousands of U.S. companies in the three quarters before and after the legislation was passed.

The paper, "Early evidence on the use of foreign cash following the Tax Cuts and Jobs Act of 2017," co-authored by Mathis, Dr. Brooke Beyer of Kansas State University, Dr. Jimmy Downes of the University of Nebraska and Dr. Eric Rapley of Colorado State University, revealed which side of the argument might be correct.

"In our study, we found evidence that firms with high levels of pre-TCJA foreign cash increased payouts to shareholders," Mathis said. "In a nutshell, we find an increase in shareholder payouts rather than foreign investment. We asked, 'Do firms with high levels of pre-TCJA foreign cash also increase capital expenditures?' We found no evidence that firms with high levels of pre-TCJA foreign cash increased domestic expenditures."

Mathis noted that further research showed when U.S. firms on foreign soil were given a tax holiday in the early 2000s—allowing them to bring back foreign earnings at a reduced rate—most firms did not. For the firms that did repatriate, cash instead went to shareholders.

"One important caveat to note is that not much time has passed," she added in regard to the recent study. "It's possible that the long-term effects could be different than the short-term. We could extend our sample period and look at more years and what's happening over time. It's certainly possible that U.S. firms haven't made any decision in regards to this cash that's now available. We could see changes in the long run that we're not seeing in the short run."

Mathis hinted at possible corporate loopholes.

"There's a concern that this could lead firms to shift more income to their foreign jurisdiction to avoid the U.S. taxes," she said. "There are some new provisions aimed at limiting that behavior, and just from discussions with people in public accounting, it seems that firms are certainly taking those provisions seriously. So, I'm interested to see in the long term if this switch to a territorial tax system is going to be beneficial from a U.S. revenue perspective."

CHANGING LANDSCAPE

New faculty members share the latest in forestry, conservation and wildlife research

By Mitch Emmons

Professions are constantly evolving, technologies are rapidly changing, and our environment is continually shifting. To meet the demands of students seeking to have careers in the fields of forestry and wildlife conservation and management, Auburn University's School of Forestry and Wildlife Sciences has hired three faculty members, each bringing a unique set of skills and expertise to mentor and train students.

Dr. Kelly Dunning

Dr. Lana Narine

Dr. Janna Willoughby

Dunning's Research on Protected Resource Areas Suggests Local Authority is Best

After years of study and field work focused on the management of protected natural resource areas, Dr. Kelly Dunning says that giving natural resource management and decision-making authority to the local community may be the best practice.

Dunning, who joined the faculty last fall as an assistant professor, comes to Auburn with more than 10 years of field and academic experience. Dunning, who holds advanced degrees from the Massachusetts Institute of Technology (MIT) and Oxford University, is regarded as an expert in natural resource management and policy.

"I am interested in how fishermen, hunters and other sportsmen enact environmental policy change," Dunning said. "I also am interested in how sportsmen engage in collective behavior to conserve public lands; how communities adapt to ecological changes both human and man-made; and how ecosystem services, or the benefits to human well-being created by nature, are impacted by environmental change."

Before coming to Auburn, Dunning directed the Coastal Training Program at the University of Texas at Austin's Marine Science Institute and the Mission-Aransas National Estuarine Research Reserve. Her field work involves primarily aquatic MPAs (Marine Protected Areas), and she has spent time working in Africa's Congo region rain forests, as well as studying the coral reef management programs in Malaysia and Indonesia.

"In Malaysia, the highest levels of the government regulate national park resources—just as in the U.S.—but in Indonesia, power has been given to the local community to make major management decisions," Dunning said.

Dunning teaches conservation planning in the School of Forestry and Wildlife Sciences.

Spaceborne Remote Sensing Improves Forest Management Data-Gathering Capabilities

Using satellite technology to study the forest may sound a bit like science fiction, but Dr. Lana Narine is doing just that and says adding the capabilities of spaceborne technology in this effort greatly enhances forest management capabilities.

Narine joined the faculty as an assistant professor in the fall. She comes to Auburn from Texas A&M University, where she earned her Ph.D. degree in ecosystem science and management. Before returning to work on her doctorate, Narine worked for a time in the private sector as a geographic information systems (GIS) analyst in Houston.

Narine's dissertation, "Spaceborne Lidar for Estimating Forest Biophysical Parameters," involved the development of approaches for utilizing data from the Ice, Cloud and Land Elevation Satellite-2 (ICESat-2) for estimating forest attributes. "Light detection and ranging (lidar) systems provide data about the three-dimensional structure of forests, which can be analyzed to estimate forest parameters that are indicative of forest health and functioning," Narine said. "Data from lidar sensors on aerial and spaceborne platforms offer an incredible opportunity to assess forest resources over large extents, including areas traditionally inaccessible or difficult to access via ground inventories."

Narine became interested in geospatial technology as a graduate student at the University of Missouri, Columbia, where she earned bachelor's and master's degrees in forestry and a graduate GIS certificate. She later went on to Texas A&M, where she conducted research focused on remote sensing of vegetation structure.

At Auburn, she is teaching GIS applications in natural resources and applications in environmental informatics.

Genomics Research is Helping Environmentalists Learn About Effects of Climate Change

Climate change is a topic at the forefront among environmentalist and conservation groups, and Dr. Janna Willoughby conducts research that is showing how changes in the genetic makeup of species can lead to a better understanding of wildlife population adaptability to environmental change.

Willoughby has extensively studied steelhead salmon, a fish native to the Pacific Northwest. Steelhead are born in fresh water, migrate to live in saltwater oceans and then return to their natal freshwater origin to spawn. This is a cycle that is repeated annually.

About 100 years ago, steelhead salmon were successfully introduced to the Great Lakes region of the United States.

"They are native to the Pacific coast, but they have been introduced across the U.S. into wholly freshwater systems," Willoughby said. "They undergo that same annual spawning migration, with the Great Lakes serving as a sort of surrogate ocean. Although this is not the steelhead's natural habitat, they have effectively adapted to that environment."

A native of Columbus, Ohio, Willoughby earned her doctorate in genetics from Purdue University and a master's in conservation biology from Central Michigan University. She teaches a course in conservation history and law, and plans to introduce a new course in conservation genetics.

CUTTING OUT THE NOISE

By Latha Bhavnani

An annoying ringing in the ears is a symptom that has prompted many people to visit a health-care provider. Constant noise such as ringing in the ears, or even whistling, buzzing, chirping, humming, roaring or shrieking are symptoms of a condition called tinnitus. It is the perception of sound that originates in the head as opposed to sound coming from a source in the person's environment.

Tinnitus is a common condition often detected in people who have been exposed to extremely loud noise. According to the Hearing Health Foundation website, tinnitus is the leading service-related disability among veterans at the U.S. Department of Veterans Affairs (VA) Medical Centers. In 2017, there were 1.79 million disability compensation recipients for tinnitus, and 1.16 million compensation recipients for hearing loss. Members of both civilian and military sectors, especially those working in high-noise occupations and conditions encompassing the music industry, factory workers, miners and construction crews are susceptible to this disorder that can range from slightly annoying to incapacitating. In military members, those having experienced post-blast trauma can also have trouble understanding speech, while scoring normally on hearing tests.

Dr. Libba McMillan, associate professor at the Auburn University School of Nursing, has both a personal and professional interest in helping patients increase their quality of life following diagnosis of this condition. Additionally, McMillan has a passion for equipping health-care providers in understanding their vital role in getting the patient the help needed—such as determining when referrals to audiologists are necessary, obtaining further diagnostics (MRI), knowledge of resources available and techniques to assist with patient management of the bothersome symptoms.

"Training in tinnitus management is either non-existent, inconsistent or minimal across all health-care disciplines," said McMillan. "Clinicians are ill-prepared to offer evidence-based tinnitus service."

As the spouse of a retired Air Force F-16 and A-10 fighter pilot, McMillan understands firsthand the debilitating effect of tinnitus. "It was personal for me," said McMillan. "Last year, my husband suffered a host of psychological and physical symptoms related to the severe, intrusive condition of tinnitus, and expressed frustration in the lack of options provided by the medical community. The unabated noise prevented him from having a high quality of life." A nurse educator and a practicing nurse since graduating from Auburn's School of Nursing in 1983, McMillan sought out resources to help her husband. "I started searching for information that could help his condition; if not a cure, at least a way to manage the symptoms," added McMillan.

Her diligent research and passion to find solutions to help her spouse led to a life-changing conversation with the leading researcher in tinnitus, Dr. James Henry, senior research career scientist at the Veterans Affairs Office of Rehabilitation Research and Development in Portland, Oregon. Henry invited McMillan to collaborate on creating a "toolkit" for multidisciplinary health care professionals to understand and function in their roles to help veterans manage tinnitus. Their article, recently published in the Journal for Nurse Practitioners, discusses this multidisciplinary approach to tinnitus care. The article includes a case study of a veteran with tinnitus and follows the patient through diagnosis and treatment; it also includes strategies for understanding the patient's perspective.

"The patient's journey begins with the need for accurate information about the realities of tinnitus management from health-care providers," she added.

Determined to bring awareness of the condition to health-care providers, she organized a conference, held in March 2020, that included vital information for caregivers, patients, health-care providers and those researching the process of managing and providing tinnitus care.

In addition to research with tinnitus, McMillan also has presented work at international nursing research conventions with Dr. Joy DeBellis. This research centers on a pilot study in a collaborative partnership with the Alabama chapter of the American Legion, one of the oldest Veterans Service Organizations (VSO) in the country. McMillan and DeBellis' study examined the role of sleep on the quality of life and health among veterans.

Dr. Libba McMillan

During the evaluation of the veteran populations in their pilot study, McMillan and DeBellis discovered that tinnitus symptoms were highly correlated with sleep difficulties.

"Including tinnitus management strategies with sleep hygiene interventions could help alleviate the insomnia symptoms," added McMillan.

"It is an honor and privilege to work with our veterans, military and family members. Their bravery, courage and sacrifice for the country secured our nation's freedom. It is important for us as citizens and health-care providers to help improve the quality of their life," said McMillan. "Being able to help patients and their families experience and enjoy the best health possible—at any life stage—is why being a nurse for the past 37 years has been such a joy and a privilege."

SCULPTING A VISION INTO REALITY

By John Seitz

It took hundreds of volunteers, thousands of labor hours in the blazing summer sun and a veritable forest of Alabama sweetgum, but Patrick Dougherty's latest "stickwork" installation now stands in all its captivating, whimsical beauty at the Jule Collins Smith Museum of Fine Art at Auburn University.

This past September, Dougherty, the acclaimed environmental sculptor who served as guest juror for the museum's biennial 2019–20 "Out of the Box: An Outdoor Juried Sculpture Exhibition," rolled up his sleeves and set to work constructing one of his signature tree sapling sculptural works on the museum's north lawn.

Dougherty sculpts on a gargantuan scale, with some of his spiraling, cottage-sized structures reaching more than 25 feet in height. His project for the museum, "Down Where Paradise Lays," resembles a multi-roomed hobbit home, its construction demanding vast bundles of locally sourced Alabama sweetgum trees and a dedicated interdepartmental volunteer effort to complete the sculpture on time.

"Given the scale and content of Patrick's work, we recognized the opportunity for a rare collaboration among campus departments, such as forestry, architecture and building science," said Jessica Hughes, curatorial assistant and co-coordinator of the "Out of the Box" exhibition. "Forestry students, in particular, harvested much of the native sweetgum saplings used to construct the large-scale structures, and architecture and building science students participated in the sapling preparation and construction phase of the project."

The Department of Art and Art History also assisted in the process, with drawing and sculpture classes aiding in construction and students taking the opportunity for hands-on learning—sketching from life and developing wood-weaving techniques.

Jean Gannett, a junior in art, and an education student assistant at the Jule Collins Smith Museum, works with artist Patrick Dougherty on the installation of his stick sculpture, "Down Where Paradise Lays."

"In total, we had nearly 200 volunteers across departments," Hughes said. "We wanted to offer those varied individuals the opportunity to not only work with a world-renowned artist but facilitate the expansion and development of professional practices across disciplines, all while collaborating on the creation of a one-of-a-kind work of art that delights and engages museum visitors."

Over the course of three decades, Dougherty has crafted more than 300 giant-sized tree sculptures in public spaces throughout the world. He is the recipient of numerous awards and the subject of profiles in major media outlets, including The New York Times and CBS Sunday Morning.

"It has been an honor for the museum to host an artist like Patrick Dougherty," said museum director and chief curator Cindi Malinick. "His awe-inspiring sweetgum creation beautifully reflects the intersection of art with Auburn University's land-grant legacy."

Dougherty's installation, made entirely of biodegradable environmental materials, will remain on exhibit at the museum at least through Oct. 4, 2020, and then for as long as it remains structurally viable.

AUBURN'S BIG FOUR

Vision for research at Auburn focuses on discovery and innovation in four key areas

by Jonathan Cullum

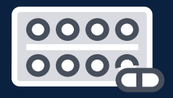
Auburn University researchers are working every day to find solutions to real-world problems through discovery and innovation. With an eye toward growing Auburn's impactful research efforts significantly over the next few years, Vice President for Research and Economic Development Dr. James Weyhenmeyer is implementing a strategic research vision that will incorporate grass-roots input from faculty across the university. With an emphasis on how Auburn can help improve the world around us, the plans for research growth will concentrate on commitments for change in four focus areas.

To move Auburn forward in these key areas, Weyhenmeyer said he will focus on strategic investments in research projects and new faculty hires for high-impact interdisciplinary teams whose work would support these core commitments. He noted this process could be "a game changer" for the research enterprise at Auburn, with faculty-led teams bringing forward the best and brightest ideas in each of these areas through projects which are anticipated to begin no later than the fall semester.

1 COMMITMENT

Improve Health and Health Care in Alabama and Across the Nation

As we work to improve health and well-being in the state, region and nation, possible areas of focus include next-generation therapeutics, health disparities, precision medicine, chronic and infectious diseases and health-care quality and cost.



2 COMMITMENT

Create Intelligent Solutions

With an ever-changing technological landscape, Auburn is committed to being on the cutting edge of research that moves the world forward in areas such as automation, artificial intelligence, machine learning, next-generation manufacturing, quantum computing and data science.

3 COMMITMENT

Create a More Secure World

Working to foresee and counter the latest cybersecurity and homeland security threats, Auburn's McCrary Institute for Cyber and Critical Infrastructure Security, along with the Center for Cyber and Homeland Security and Canine Performance Sciences will serve as key partners in making our world a safer place through innovation and discovery.

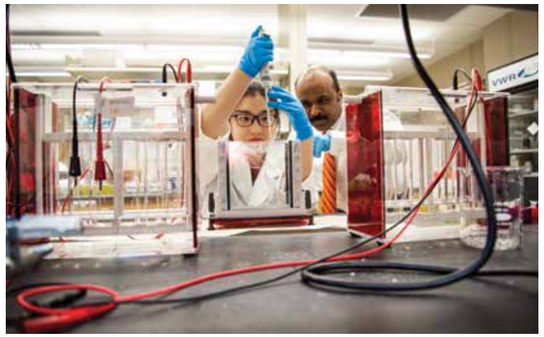
4 COMMITMENT

Build Resilient Societies

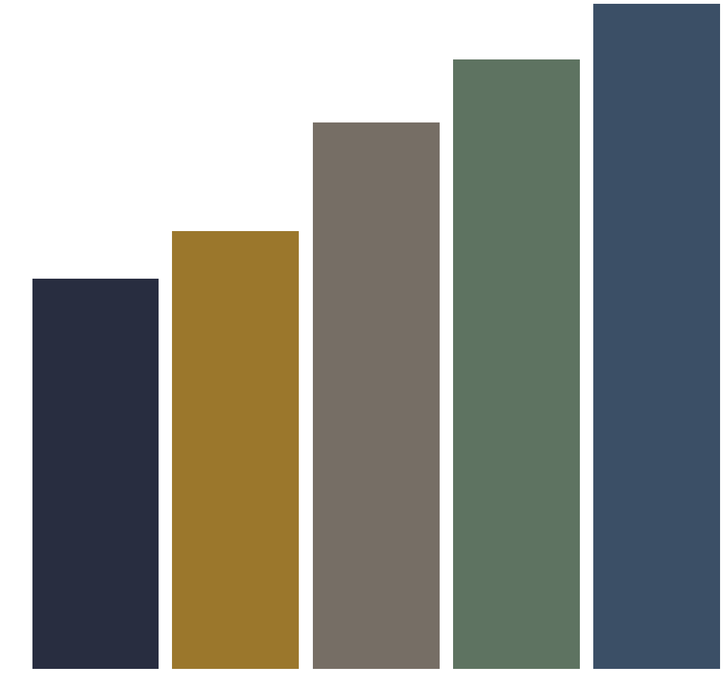
Auburn also remains committed to research that will advance society in areas such as energy independence and resilience, environmental sustainability, including coastal ocean science, and preserving a sustainable food water supply.

2019 YEAR-END **METRICS**

Auburn University is an R1 ("highest research activity") university in the Carnegie Classification and was named an Innovation and Economic Prosperity University by the Association of Public and Land-grant Universities. Auburn delivers an impressive return on investment for our state—for every dollar invested in Auburn, we return $8. The university system and its alumni contribute more than $5.4 billion to Alabama's economy, and we're responsible for some 25,826 jobs in our state. At Auburn, we have grown our research efforts in both STEM and non-STEM areas, furthering our commitment to benefit Alabama, the Southeast and the nation through research results that improve quality of life and enhance our students' learning experiences.



RESEARCH EXPENDITURES



Research expenditures* have increased 70% since FY2015.

**as reported in the NSF HERD survey*

+40%

IN RESEARCH FUNDING
FROM FY18 TO FY19

COMMERCIALIZATION METRICS 2019

75
INVENTION DISCLOSURES

12
STANDARD U.S. PATENT APPLICATIONS FILED

84
PROVISIONAL U.S. PATENT APPLICATIONS FILED

13
OTHER U.S. PATENT APPLICATIONS FILED

18
U.S. PATENTS

11
LICENSES/OPTIONS EXECUTED

2
STARTUP COMPANIES FORMED

$1,340,677
OPTION AND LICENSE INCOME

CLOSING THOUGHTS
FROM THE VICE PRESIDENT

James Weyhenmeyer, Ph.D.
Vice President for Research & Economic Development

As Auburn moves forward with plans for significant growth of its research efforts, we are focusing on investing in specific collaborative areas of research, as discussed in greater detail on pages 43-44. Auburn is committed to improving health and health care, finding intelligent solutions to problems, creating a safer world and building resilient societies.

Our innovative faculty members continue to be closely involved in this process of forming a plan to take Auburn to the next level, leveraging our research strengths for the greater good. As this process continues, we will work together to identify specific projects and teams that will support these larger, overarching commitments.

As you can observe from the variety of research underway at Auburn—everything from technological advancements in biomedical engineering to infectious disease research to world-class scholarship in the creative arts—we continue to see great things from our faculty and students. As we begin what will be a transformative period in research at Auburn University, building upon a solid foundation, I am confident the collective strengths of our research faculty, students and staff will help us continue the legacy of impactful research for which Auburn is known.

Spring is in full bloom across campus.

Photo by Philip Smith

AUBURN
UNIVERSITY

Office of the Vice President for Research
& Economic Development
1161 W. Samford Ave., Building 8
Auburn, AL 36849-0001

auburn.edu