

2018

Division of Research and Economic Development
2018 Annual Report



**NORTH CAROLINA
AGRICULTURAL AND TECHNICAL
STATE UNIVERSITY**





THE UNIVERSITY has been on a steady trajectory of growth over the past two decades, adding nearly \$46 million in annual research funding since 2001. Those contract and grant monies – which come largely from the highly competitive federal funding sector – support a wide range of projects in areas ranging from food security to bioenergy to computer science and many points in between. Our faculty continued to demonstrate a high level of curiosity and innovation during the past year as they explored solutions to a variety of complex problems impacting society, creating new technologies, building new financial models, or developing new techniques to improve food production and safety or human health. Our continued growth as a research university is a testament to their outstanding work.

Harold L. Martin Sr.
Chancellor

RESEARCH AND SCHOLARSHIP have always been core elements of life at N.C. A&T. Our rich and unique legacy and tradition in agriculture, engineering and technology makes us well-suited for solving today’s challenges in nanotechnology, bioengineering, health sciences, energy, the environment, cybersecurity and big data, in a way that positions us to address the unforeseen problems of the future.

N.C. A&T faculty and students work in laboratories and in communities, on farms and in cities, on campus, across the state and around the world. Our academic units and disciplines partner with other universities and with corporations and government researchers. We continue to distinguish ourselves as an institution with a rapidly-growing research enterprise fueled by external grants and contracts, producing scholarly projects and outstanding creative works and graduating civically-engaged citizens.

We invite you to learn more about how research at N.C. A&T advances education, fosters community engagement and catalyzes economic development.

Sanjiv Sarin
Interim Vice Chancellor for Research and Economic Development
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RESEARCH IMPACT AREAS:

- Advanced Materials and Manufacturing
- Securing Cyberspace
- Creating a Healthier World
- Educating the Next Generation
- Engineering for Better Living
- Entrepreneurship and Innovation
- Food for a Growing Population
- Harnessing and Protecting Big Data
- Heritage, History and Cultures
- Leadership and Community Development
- Living with Our Planet
- Moving People and Products
- Tools and Technologies of Tomorrow
- Transforming the Energy Landscape



More Autonomy, Less Human Engagement

Ali Karimodini is an associate professor in the Department of Electrical and Computer Engineering, College of Engineering. He is director of the university's ACCESS Laboratory and deputy director of the TECHLAV Center of Excellence in Autonomy at N.C. A&T.

DEVICES WITH AUTONOMOUS CONTROL

have the ability to self-govern with minimal human input. This reduces the level of engagement of human operators, allowing them to focus on higher-level issues such as mission planning. Karimodini and his team use smart technologies to systematically and reliably bring together a set of simple smart systems. As a team, these systems demonstrate enhanced capabilities that accomplish sophisticated tasks. This cooperative strategy is more robust against failures, attacks, and disturbances due to functional and software redundancy. Karimodini formulates complex systems as "systems of systems" which are composed of many task-oriented components, offering more functionality and performance through shared resources and capabilities. His teaching and research explore three areas at the intersection of control, communication, computer science and life science: self-driving cars, the control of drones and human-machine interactions.

LET'S DRIVE

In collaboration with the General Motors Company (GM) and the Society of Automotive Engineers International (SAE), Karimodini is leading an effort to establish a laboratory for self-driving cars at N.C. A&T. The university was one of the eight selected by GM and SAE to participate in a three-year national competition called the AutoDrive Challenge™, designed to involve universities in this game-changing technology and catalyze the development of self-driving cars. GM provided the university with a Chevrolet Bolt electric vehicle as the vehicle platform with strategic partners and suppliers like Intel® and Continental® providing vehicle parts and software.

The N.C. A&T team has three years to develop and demonstrate a fully-autonomous vehicle, with a technical goal of navigating an urban driving course at the end of the competition. They are off to a strong start with more than 30 students

and six faculty members comprising the Aggies Autonomous Auto (A3) team. In May 2018, the A3 team demonstrated the developed technology at GM's Desert Proving Ground in Yuma, Arizona, and the team placed third-fastest in the "Straight Line Challenge" portion of the competition when their fully-autonomous car followed a two-mile track appropriately stopping at stop signs.

The year-two competition will focus on enhanced autonomy levels of the self-driving cars, commanding them to avoid dynamic obstacles, safely pass through intersections, weather challenging road conditions and accomplish multiple lane changes.

Karimodini is also researching the ability of self-driving cars to detect and predict failures, as well as detect pedestrians and predict their behaviors. This research is being funded by the North Carolina Department of Transportation.

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**"Our technology is beautiful in its orchestration,
but the best part is how it improves the
human experience."**

— KARIMODINI

TECHLAV Annual Meeting

IN MAY 2018, the Center for Testing, Evaluation, and Control of Heterogeneous Large-scale Systems of Autonomous Vehicles (TECHLAV) convened nearly 100 professionals from across the academic, governmental and industrial spectrums to witness and celebrate research milestones regarding the autonomy capabilities of unmanned vehicles such as drones, rovers, surface and underwater vehicles. This event marks the third year in the five-year cycle of grant funding provided by the Department of Defense.

TECHLAV convened professionals from across the academic, governmental and industrial spectrum to celebrate its research milestones



Vehicles with autonomous control have the ability to self-govern with minimal human input. Autonomous system technology is of increasing interest throughout scientific and even consumer circles, especially as it relates to military applications. Autonomous systems empower human operators by self-controlling a system and allowing the human operator to focus on high-level mission planning and decision-making. As a result, multiple unmanned vehicles can be controlled by one human operator (pilot) from a ground control station. Creating this alignment through technology and research is TECHLAV's primary mission.

The TECHLAV Center, led by Director Abdollah Homaifar, organizes its research efforts within three parallel tracks called "thrusts." Thrust 1, led by Mo Jamshidi at the University of Texas at San Antonio, includes the modeling, analysis and control of Large-Scale Autonomous Systems of Vehicles (LSAVs). Thrust 2, led by Ali Karimodini, addresses resilient control and communication of LSAVs. Thrust 3 is led by Younho Seong which covers the testing, evaluation and verification of the LSAVs. The results of these research processes will undergo demonstration, implementation and integration to transition the technologies to higher testing readiness levels in years four and five. Learn more about TECHLAV at <http://techlav.ncat.edu>. ■

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EXCEPTIONAL FACILITIES DRAW INTEREST AND FUNDING

N.C. A&T is a national leader in its autonomy capabilities and infrastructure for control of drones. Two unmanned autonomous vehicle (UAV) laboratories exist on campus, run by Karimodini and his colleagues. The Autonomous Cooperative Control of Emergent Systems of System (ACCESS) Laboratory in Cherry Hall is designed to investigate the teaming of a large number of robots (called a swarm). There is also a UAV laboratory in TECHLAV Center in the Fort Interdisciplinary Research Center, primarily sponsored by the Department of Defense. Both laboratories contain designated flights zones as well as ample floor space for rovers and other robotics exercises.

"We are one of the few universities in the nation with these types of facilities," says Karimodini. "Our facilities have enabled us to attract government and industry sponsorship to investigate the development of drone technologies and their applications." The laboratories have also attracted many graduate and undergraduate students. "It is relatively easy to get students excited about autonomy here, because they have easy access to hands-on labs showing our cutting-edge technology." He often demonstrates drones swooping through challenging paths of narrow hoops along with many other robotic commands which show the proof of concept for the developed technologies in his laboratory.

SOCIAL IMPACT DRIVING TECHNOLOGY

Through technological advances in Karimodini's research, it is now possible to deploy a large number of smart entities to achieve very complicated tasks. Examples are smart cities, smart agriculture, smart transportation systems and mobile sensor networks. These systems use autonomy technology to create efficiencies, improve sustainability, create value and enhance quality of life for people.

Karimodini believes the social impact of technology is what makes his research so worthwhile. His latest effort is a collaboration with researchers at the Institute for Transportation Research and Education at North Carolina State University. The partners are pursuing funding to develop an economical, autonomous MicroTransit transportation system designed to provide improved access for mobility-disadvantaged communities.

Karimodini has also received research funding from the National Science Foundation to investigate the use of drones for smart agricultural systems. He will be using multiple drones to efficiently survey farmland for crop health monitoring. The use of drones for agricultural applications is less costly and safer compared to traditional machinery-based approaches; drones cause less harm compared to heavy machinery which crushes crops and spreads disease.

COOL AND BENEFICIAL

Karimodini's research work and his laboratories have the "cool" factor. His tools and technologies are tangible, easy to see and touch, and frankly, fun. "Wouldn't it be convenient to stay at home and send drones to remotely check your farm for possible problems, spraying chemicals to treat disease?" asks Karimodini. Autonomous control technology is poised to solve complex problems in virtually every facet of human life, from transportation and health, to security and agriculture. "It is a great time to be involved in autonomy," says Karimodini. "Our technology is beautiful in its orchestration, but the best part is how it improves the human experience."

Karimodini is the principal investigator (PI) or co-PI in active projects with over \$10 million in grants from funders like the Department of Defense (DoD) Army Research Office, the DoD Test Resource Management Center, the DoD Air Force Research Laboratory, the National Science Foundation and the North Carolina Department of Transportation. Learn more about Karimodini's research at <http://akarimod.info>. Read about the TECHLAV Center of Excellence in Autonomy at <http://techlav.ncat.edu/>. Read about the university's ACCESS Laboratory at <http://accesslab.net/>. Read about the Aggies Autonomous Auto team at <http://a3.ncat.edu/>. Watch the ACCESS laboratory YouTube Channel at <https://goo.gl/V5XByq>. ■

Empowering A&T's Emerging Agents

Damion Waymer is a professor and chair of the Department of Liberal Studies, College of Arts, Humanities and Social Sciences. Before joining the faculty at N.C. A&T, he served as the Associate Provost for Faculty Affairs, Development & Diversity at the University of Cincinnati where he led aggressive faculty recruitment initiatives.

CORPORATE GREED led to the fall of the economic market in 2008. Enter the Occupy Wall Street Movement in 2011. While crises such as national economic collapse often are considered incidents people and organizations should avoid at all costs, crises also provide opportunities for people whose voices are otherwise silenced the opportunity to inject their opinions publicly, challenge existing power structures and change the narratives in society. Crises can be an opportunity for the “little people” to change the course of history.

If you're 18-24 years old, Damion Waymer has news for you: you have the power to effect change. Once a marginalized, discounted population, America's youngest voting bloc is smart, aware, engaged and more connected than ever before. Waymer calls these folks *emerging agents*; the people who are coming onto the scene to effect change in policy and society. Young people not only *have* opinions, they have arrived at them through powerful personal experiences and meaningful discourse with peers from all over the world. Compounding this already

strident youthful activism is the fact that the parents (and grandparents) of today's young people have, well, completely dropped the ball. You needn't look much further than the national debt, the environment, school safety... we could go on. To their credit, young people appear ready and raring to step up and be the adults in the room. How can we help them be successful? The future of our nation depends on it.

DEFINE YOUR MESSAGE

Waymer is interested in *speech*. He has studied it (Purdue) and made a career of it (Cincinnati, Texas A&M, now N.C. A&T) but mainly he practices it. He immerses himself in what people say, what motivates them to say what they do, and how messages are received and acted upon. In his mind, speech has never been more important than it is today in 2018.

“One of my heroes in academia and life was a woman named Marie Nichols,” explains Waymer. “She was a professor of rhetoric, an author, and one of the most accomplished communicators of the 20th century. What

made her great was the tremendous emotional investment she made in speech. She knew the words people chose, and the way they said them, were powerful. I use Nichols' tenets in much of my teaching, and it guides my research as well.”

There are recurring themes in Nichols' written and spoken work: people should stop blaming the past and start speaking thoughtfully about the future they want to see; it isn't enough to throw an idea out there and see if it sticks—she called this *enlightened choice*, the best outcome will require a lot of thought; the most powerful thing a person can do is speak authentically from personal experience; and people should strive to speak with honesty, truth, justice, tolerance, courage and hope.

“It is fascinating to me that a woman born in 1908 has such a perfect message for 2018's emerging agents,” says Waymer. “The difficulties and strife we encounter today are not new experiences; they are part of the human condition. We have worked through difficulties before, and we will again, if we take responsibility and care in our speech

with one another.” Waymer wants the emerging agents in his classes to dig deep, acknowledge past personal experiences, but *look forward* as they define their message.

Based on persistent thought about your life, what do you stand for?

RAISE YOUR VOICE

Waymer's research projects address fundamental concerns about issues of power, race, class, and gender, and how these social constructions shape and influence how people receive, react, and respond to certain messages.

As a young person growing up in rural South Carolina, Waymer was exposed to some of the nation's most dysfunctional voting mechanisms. The 1965 Voting Rights Act allowed for the creation of “majority-minority” districts which were designed to empower the disenfranchised, allowing a racial minority the opportunity to elect their favorite candidates to public office. Unfortunately, unintended consequences turned things upside-down in South Carolina (and many other states in the

“The difficulties and strife we encounter today are not new experiences; they are part of the human condition.”

— WAYMER



United States), resulting in disproportional representation in state legislatures. To this day, 50 years after the legislation, the voices of African Americans are being diluted severely as politicians are gerrymandering voting districts, in part, to minimize African Americans' voting power. Waymer wrote a paper about the strategic manipulation of districts, which was published by the London School of Economics: <https://bit.ly/2bzuH2W>

Black representation is part of the personal message which Waymer has sought to define: marginalized populations must raise their voices through voting, activism and powerful, authentic speech. “Young

people often ask me what they can do to change a world which they perceive as stacked against them. The first thing they need to understand is that the world has always been stacked against someone. The good news is, there are many examples where people just like them have defined their message, and raised their voices.” With many modern elections being decided by a few hundred votes, it's obvious that every American vote counts. But, when we make our *voice* count in addition to our vote, we can change opinions, affect many votes and create the change we want to see.

EMERGING AGENTS!

How will your voice manifest itself this year? Will you *vote*? Will you *march*? Will you *write*? Will you *speak*? Think about your unique experience, allowing your past to help define your message. Now look at the tools in front of you, and get started. Use your voice to influence others and aim to create a world where all people, all ideas and all voices are represented. ■

Love Your Gut

Marc Cook is an assistant professor in the Department of Human Performance and Leisure Studies in the College of Health and Human Sciences. He is studying how exercise and dietary choices impact specific gut bacteria, resulting in better cardiovascular health outcomes.



UNLESS YOU'VE been living under a rock the last few years, you have probably heard the discussions surrounding gut bacteria. Clinically known as “microbiota”, these terms reference the microbe population which lives in the human intestine. Now supported by a stocked shelf of over-the-counter pro-biotics, ensuring the health and survival of gut microbiota is big business, and big science for researchers like exercise physiologist and immunologist Marc Cook.

Gut microbiota is comprised of trillions of microorganisms; over 1,000 different species of known bacteria with more than three million genes! If you took out the average adult’s gut microbiota and put it on a scale, it would weigh over four pounds! About a third of your gut microbiota is common to most people, but two thirds

Marc Cook conducts his exercise research at Gateway University Research Park in Browns Summit

A third of your gut microbiota is common to most people, but two thirds are unique to you.

are unique to you. While each of us has a unique microbiota profile, it fulfills the same physiological functions: it aids in digestion, helps with the production of vitamins, helps us combat harmful microorganisms and plays an important role in the development and maintenance of our immune system.

Healthy and balanced gut microbiota is key to good health, and Cook is working to give N.C. A&T athletes and individuals with high blood pressure a glimpse into the inner-workings of their bellies. “African Americans experience hypertension at a higher rate than people of other races,” explains Cook. “This racial health disparity, and the role of specific gut bacteria have in cardiovascular health, is the subject of my research. We can utilize exercise to better understand which gut microbes are associated with better blood pressure.”

Some beneficial bacteria in the human gut produce what are called short-chain fatty acids. These have been shown to aid in

maintaining a health blood pressure and a host of other immune responses with anti-inflammatory benefits. By examining factors affecting the amount of bacteria, and the number of short-chain fatty acids present in the blood and a person’s blood pressure readings, Cook is starting to understand how different populations of microbes can take active measures to improve their health.

“Here’s what we know so far. Exercise increases bacteria that produce short-chain fatty acids in the gut. A diet high in fiber energizes short-chain fatty acid bacteria. The more active our beneficial gut bacteria are, the more short-chain fatty acids are produced, resulting in lower blood pressure and therefore decreased risks for cardiovascular disease, various cancers, and other ailments. An active short-chain fatty acid producing gut translates into better health, so I am engaging populations that are intentionally and unintentionally impacting their gut bacteria.”

SINCE 2001, **37** PATENTS
HAVE BEEN ISSUED TO
N.C. A&T RESEARCHERS



How Should We Use This Land?



Lyubov Kurkalova is a professor in the Department of Economics in the College of Business and Economics. She received her Ph.D. in Agricultural Economics from Iowa State University. She joined N.C. A&T in the Spring of 2007 after working at Southern Illinois University Carbondale, and the Resource and Environmental Policy Division of the Center for Agricultural and Rural Development, a public policy research center at Iowa State University.

WHEN SOLVING any economic puzzle, we are trying to arrive at an optimal outcome given scarce resources. For Lyubov Kurkalova, her economic puzzles involve land (scarce resource) and what to plant on it to arrive at the very best combination of: the products buyers want, the amount they are willing to pay, while maximizing profits and using farming practices that minimize environmental impact. It's already complicated, made more so with the added effects of tariffs and changing economic policy, dwindling agricultural workforces, and volatile weather patterns.

"If you are intrigued by how societies choose what to produce and how to distribute goods among different people and global issues, with a healthy dose of uncertainty, economics is the field for you," Kurkalova tells N.C. A&T students in search of an exciting career. "What we reveal in our science solves some of the world's biggest

challenges, and it's very rewarding work."

Kurkalova's journey to N.C. A&T was circuitous, contributing to her level of success in this field. She started her career in the Midwest with exposure to soybeans and corn. Her early research involved conservation tillage, environmental effects of crop production practices, nutrient standards and other factors impacting planting and harvesting of traditional crops. Her arrival to North Carolina in 2007 provided access to a more complex agricultural ecosystem and a broad array of producers and markets.

In addition to tobacco, soybeans, numerous vegetables, fruits, and berries, North Carolina is home to multiple varieties of short-rotation woody crops (fast-growing trees) with vast potential for products ranging from wood pellets to construction materials to feedstock for evolving biofuels markets. Kurkalova is leading N.C. A&T's

research to understand the economics of forest management practices and productivity.

"The forest products industry is one of North Carolina's economic advantages," says Kurkalova. "Our climate and geography are very tree-friendly." Fast-growing trees like poplar, sweetgum, sycamore and loblolly pine are grown productively throughout the state.

Kurkalova's work aims to develop economic feasibility maps for North Carolina's short-rotation woody crops to help managers make the best decisions regarding which of those varieties to cultivate for their particular circumstances and needs.

Kurkalova's research programs have attracted in excess of \$10 million of funding over the years, from the United States Department of Energy, the National Science Foundation, the North Carolina Department of Agriculture and Consumer



Services and the United States Department of Agriculture. She is currently leading several multidisciplinary research projects assessing the interactions between bioenergy technologies and energy and agricultural markets. She currently contributes to the economic analysis effort in the university's Bioenergy Center.

Her research has been published in a variety of economics and interdisciplinary journals including Energy Economics, the Journal of Soil and Water Conservation, Environmental Modeling and Software, Biomass and Bioenergy, Environmental Management, the Journal of Environmental Economics and Management, American Journal of Agricultural Economics, Economics Letters, Climatic Change, the Journal of the American Water Resources Association and Ecological Applications. In 2007, she received the Outstanding Journal Article award from the Canadian Agricultural Economics Society. She is also the recipient of the Outstanding Interdisciplinary Research Award at N.C. A&T in 2014, and was named the Outstanding N.C. A&T Senior Researcher in 2015. ■

Fast-growing trees like this Loblolly Pine are common throughout North Carolina

N.C. A&T HAS AN **R2** CLASSIFICATION:
DOCTORAL, HIGHER RESEARCH ACTIVITY UNIVERSITY



Engineering a Better Food Bank

Lauren Davis is an associate professor in the Department of Industrial and Systems Engineering, College of Engineering. She is steering a National Science Foundation-funded project that is changing the way North Carolina addresses hunger. Her team collects food bank data, analyzes it and creates computational models of supply and distribution processes to improve the food distribution process.

PRINCIPAL INVESTIGATOR LAUREN DAVIS and her cross-disciplinary team have secured a five-year, \$3 million grant through the National Science Foundation’s Research Traineeship (NRT) Program. The NRT grant will support food insecurity research in a project called Improving Strategies for Hunger Relief and Food Security Using Computational Data Science. In addition to Davis, the research grant involves four additional co-PIs, Seong-Tae Kim, Kenrett Jefferson-Moore, Steven Jiang and Albert Esterline. The team represents talent and expertise across three N.C. A&T Colleges: Engineering, Science and Technology, and Agriculture and Environmental Sciences.

“One thing that makes this project so exciting is that we are bringing together students and faculty from diverse disciplines to tackle such an interesting research problem,” says Davis. “The feedback from our first cohort of students has

Food insecurity occurs when individuals have limited access to safe and nutritious food.

been positive. They are learning about topics that are not native to their curriculum, which means this experience will add challenge and relevance to their normal coursework.” Over the course of the five-year grant, Davis expects 50 students will go through the program.

Davis has been working to solve the problem of food insecurity for about eight years. Food insecurity occurs when individuals have limited access to safe and nutritious food. To address this issue, humanitarian organizations work collaboratively with government and the private sector, relying on uncertain sources of supply, responding to uneven and variable needs, and making decisions regarding scarce resources. In this process, data is generated on a massive scale concerning food supply,

distribution and need. This NRT grant will develop an innovative, interdisciplinary training model in data science designed to grow the workforce that will help these organizations better analyze their efforts and improve the provision of food aid at the local, state, and federal level.

“Until now, no formal training existed to help students acquire the interdisciplinary knowledge needed to derive insight from big data generated by the food aid supply chain,” explains Davis. “This research will use data from the domestic humanitarian hunger relief supply chain as the basis for an innovative, evidence-based, scalable approach to training the future workforce.” The grant will provide a unique and comprehensive training experience for a total of 50 masters and doctoral students,

including 45 funded trainees, by combining disciplines in industrial and systems engineering, computer science, mathematics, agricultural economics, sociology, and public policy.

The NRT program is dedicated to effective training of STEM graduate students in high-priority interdisciplinary research areas, through comprehensive traineeship models that are innovative, evidence-based, and aligned with changing workforce and research needs. NSF’s mission is to advance the progress of science, a mission accomplished by funding proposals for research and education made by scientists, engineers, and educators from across the country. ■



N.C. A&T's Transportation Institute: Aggies on the Move

THE TRANSPORTATION INDUSTRY is one of the most exciting, evolving sectors in our modern economy. The United States faces unprecedented challenges from population growth, a changing climate and increasing freight volumes. The flow of people and goods — and the infrastructure, logistics and technology needed to accomplish both — are moving forward at an astonishing pace. Students and researchers at N.C. A&T are on board and actively working to address these challenges.

In 2016, an N.C. A&T-led consortium received a \$7.8 million, five-year grant from the U.S. Department of Transportation's University Transportation Centers (UTC) Program. The grant, one of the most coveted transportation grants in the nation, was used to establish and manage the Center for Advanced Transportation Mobility (CATM) through N.C. A&T's Transportation Institute. The CATM also includes Virginia Polytechnic Institute and Embry-Riddle Aeronautical University and is directed by Maranda McBride, also director of N.C. A&T's



Students from the College of Business and Economics are joining counterparts in Engineering to analyze the campus bike sharing program. Photo courtesy of LimeBike

Transportation Institute and an associate professor of management in the College of Business and Economics. The UTC programs are designed to advance state-of-the-art transportation research and technology, and to develop the next generation of transportation professionals. The goal of each UTC is to form a unique center of transportation excellence on a specific

research topic. N.C. A&T's CATM is focused on improving the mobility of people and goods.

"Students are surprised when they learn about our country's needs in terms of transportation expertise," explains McBride. "The career opportunities are endless in this field, and offer students the chance to be part of meaningful solutions that impact every level of our community." N.C. A&T estimates over 100 (mostly minority) students have already been positively impacted by activities performed by the CATM. "The UTC grant has provided crucial funding for our students as they work to develop cutting-edge solutions in transportation to improve infrastructure, protect the environment and plan for future growth."

A SUMMER WELL-SPENT

While the university's transportation-related efforts include supporting research, supporting workforce development and initiating technology transfer activities, the most important work is focused around

educational opportunities. The Summer Transportation Institute (STI) was created over 25 years ago to grow awareness of and interest in the many viable career paths available in the transportation industry. The STI gives high school students opportunities to interact with transportation industry professionals and discuss theory and practice in a classroom setting. It fosters diversity in education and career opportunities in transportation by providing participants with skills that will enable them to make knowledgeable decisions concerning transportation/logistics or transportation engineering as a field of study. Students are offered the opportunity to enhance their academic skills, explore career choices available in the transportation industry, and engage in a wide range of educational and interesting, hands-on activities.

The program currently brings around 15 rising junior and senior high school students to campus each year to learn about the transportation profession. They participate in classroom lectures, projects and field trips, all designed to expose them to careers in the transportation/supply chain management industry. The STI is the beginning of a pipeline for students which can end in lucrative, fulfilling transportation and supply chain management jobs. The STI program provides students with a variety of valuable opportunities, including attending

a national industry conference. STI and Transportation Institute graduates have gone into careers with Fortune 500 firms, federal and state agencies and public and private companies.

RESEARCH THE RIDE

Students from the College of Business and Economics are joining their counterparts in the Department of Industrial and Systems Engineering to analyze the campus bike sharing program. The LimeBike® Program arrived at N.C. A&T and Greensboro in the summer of 2017, allowing riders to borrow bikes to travel throughout campus and parts of Greensboro. The bikes were brought to the N.C. A&T campus in August, with bicycle share stations strategically located to ensure equality of availability for all populations throughout the city and surrounding communities, especially those serving low-income residents.

To ride a LimeBike®, a person uses a smart phone app to unlock a bike and pay. The rental cost for students and employees of universities is 50 cents per 30-minute ride, while others pay \$1 per half hour. Students with the N.C. A&T Transportation Institute are conducting surveys of LimeBike® users to gauge the effectiveness of the program. Thus far, the research has revealed that bike share participants tend to be repeat users. While some own cars, they prefer to use the bikes

to get around campus, or for short trips off campus and back.

TRANSPORTATION CROSSES BOUNDARIES

The Transportation Institute works with local, regional and state transportation agencies and private sector partners to help find solutions to challenges that directly impact communities and affect the efficiency of the nation's transportation system. The Institute also brings together the university's best and brightest minds to bear on transportation issues. Professionals in the College of Business and Economics, the College of Engineering, the College of Health and Human Services and the College of Science and Technology all have solutions to the many and differing challenges facing the transportation sector.

By enhancing student learning and faculty development through educational and research experiences in transportation, the Transportation Institute is making a difference. The research and scholarship underway position the university to become a regional resource for transportation issues. N.C. A&T is proud to be in the position of being able to implement transportation programming that advances diversity in the transportation workforce and fosters learning for the 21st century. ■

Waters Advancing Practice of Metal-Based Additive Manufacturing

Cynthia K. Waters is an associate professor in the Department of Mechanical Engineering, College of Engineering. She has joined researchers at UNC Charlotte and NC State University to pursue work covered under a UNC System grant for Advancing the Science and Practice of Metal-Based Additive Manufacturing.

THE THREE INSTITUTIONS have an opportunity to lead the nation in the adoption of additive manufacturing (a 3-D printing-based manufacturing process) by supporting companies as they transition from traditional manufacturing to 3-D printing-based manufacturing. The project brings together experts across the three institutions to develop new, metal-based manufacturing methods with a goal of establishing North Carolina as the pre-eminent U.S. center of expertise for these processes. The funds provide equipment in addition to faculty and graduate student support which allows for advances in N.C. A&T's research reputation in addition to impacting the education of students.

Waters' work has been centered around powder metallurgy and now the role of the powder metals in the 3-D processes that build

parts through additive manufacturing. Waters and her graduate students work with metal alloy compounds which are 3-D printed with a binder jet process and then infiltrated. On this project she will be providing detailed characterization and testing of the pre and post manufactured parts. Her other collaborations with various national DOE labs (Oak Ridge National Labs, Y12 National Security Complex, Savannah River Labs and Honeywell Federal Manufacturing & Technologies) center around research and design of metal-based additive manufacturing. She is also a part of the National Nuclear Security Administration's new Minority Serving Institution Partnership Program (MSIPP), a consortium program organized to build a sustainable STEM pipeline between DOE plants and laboratories and HBCUs.



Cindy Waters and a grad student examine surface characteristics of metals with the electron microscope

In 2016, Waters was selected by The American Society for Engineering Education (ASEE) as its Zone II Outstanding Campus Representative. The award honors local campus representatives who have achieved excellence in their roles as supporters of the Society. ■

CERT Emerges as STEM Leader in Guilford County

THE CENTER FOR ENERGY RESEARCH AND TECHNOLOGY (CERT) was awarded a \$300k National Science Foundation (NSF) grant to create a pathway to the STEM workforce for minorities and women. The NSF funding is for a CERT-created program called EMERGE in STEM, which stands for Education for Minorities to Effectively Raise Graduation and Employment in STEM. It will offer STEM-related career exposure to Guilford County students in grades 4-12.

Through EMERGE in STEM, CERT is working closely with Guilford County Schools and a large network of private, governmental and educational institutions to meet the objectives of the program. An EMERGE in STEM website (www.EMERGEinSTEM.org) serves as the hub to provide information and a calendar of events throughout the year, both in and out-of-school, to parents, children, educators, public and private entities about STEM opportunities. The expectation is to have hundreds of organizations linked to the network, with volunteers from most STEM-oriented industry and entrepreneurial



CERT team members kickoff their EMERGE-in-STEM program

partners in Guilford County.

Learning Blade, a game-based software, is one of the mechanisms to provide both STEM lessons to students, as well as knowledge of exciting and fulfilling jobs in the STEM workforce. The EMERGE in STEM funding provides the Learning Blade software to Guilford County Schools at no

cost, having been shown to significantly improve student interest in STEM careers in other school systems.

The EMERGE in STEM program is being led by Greg Monty, Director of CERT. It aspires to be the go-to STEM program and website for Guilford County by the end of the pilot in December 2019. ■

It's All About Surface Area

Lifeng Zhang, this year's recipient of the Outstanding Young Investigator Award, is an associate professor in the Department of Nanoengineering at the Joint School of Nanoscience and Nanoengineering. His research interests involve polymer, ceramic and carbon nanomaterials as well as their nanocomposites which are used in a wide variety of energy, composite and biomedical applications.

LIFENG ZHANG'S RESEARCH interests lie in engineered materials at nanometer scale. The advanced nanomaterials developed in his research have seen a wide range of applications such as energy conversion and storage, optical/gas/bio sensors, photo-catalysis, ballistic protection, biomedical uses like bio-separation, antimicrobial fabrics, dental composites, scaffolds for tissue engineering and controllable drug release. Zhang's nanomaterial research is broad, but one application of great interest to him is the promising results using nanomaterials in the water treatment process.

Rapid worldwide industrialization and population growth is leading to extensive environmental pollution. The discharge of wastewater from commercial and industrial wastes, untreated domestic sewage and chemical contaminants into surface waters has led to ongoing and worsening environmental situations. This fact has, in turn, threatened food security, human health and natural ecosystems. The scarcity of clean water is a global challenge that is

expected to get worse.

Nanotechnology refers to a broad range of tools, techniques and applications involving materials on the approximate size scale of a few to hundreds of nanometers in diameter. How do such small things tackle a big problem like global water pollution?

"It's all about surface area," explains Zhang. "Consider two pots of boiling water. One pot contains spaghetti pasta, the other, large manicotti noodles. Which will cook more quickly? The spaghetti will, because it has exponentially greater surface area than its manicotti counterpart."

The main advantage of using nanomaterials, as opposed to conventional water treatment systems, is their efficiency due to incredibly large surface areas. Nanotechnology can address a wide variety of water impurities, including the removal of sediments, chemical effluents, charged particles, bacteria and other pathogens. Toxic elements can also be efficiently removed using nanotechnology, which is one of the subjects of Zhang's recent research.

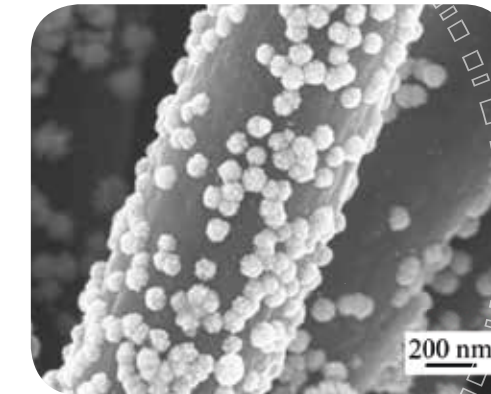
Heavy metal ions such as Chromium are highly toxic. Chromium is on the list of top toxic pollutants furnished by the United States Environmental Protection Agency, with a maximum contaminant level of 0.1 mg/L for drinking water.

There are a wide range of Chromium sources such as metal plating, leather tanning, metal corrosion inhibition, pigment production, mining and wood-preserving industries. Various methods have been used in past attempts to remove the ions from water, including conventional filtration, chemical precipitation and electrodeposition. Unfortunately, these methods require disposal of metal residual sludge, and result in membrane clogging, intensive energy consumption and high cost.

The nanomaterial for water treatment in Zhang's research involves in a hierarchical nanostructure: ~50 nm diameter Zero Valent Iron (nZVI) nanoparticles dispersedly distributed on ~300 nm diameter electrospun carbon nanofibers. This type of nanomaterial possesses high capacity for

"Consider two pots of boiling water. One pot contains spaghetti pasta, the other, large manicotti noodles. Which will cook more quickly? The spaghetti will, because it has exponentially greater surface area than its manicotti counterpart."

— ZHANG



Electrospun carbon nanofibers with surface attached nanoparticles

remediating Chromium in water, owing to its unique nanostructure, large surface area, high reactivity, non-toxicity and ease of production. It is noteworthy that Chromium ions from a 50 mg/L aqueous solution can be completely removed in as little as five minutes!

Additionally, mechanical flexibility as well as the size and shape of this material allow for space-saving and geometric-requiring applications. The inter-fiber pores and continuous nanofibrous form of the material allow for high flow rates. Compared to state-of-the-art organic/inorganic media being used for heavy metal ion remediation, electrospun carbon nanofibers have excellent chemical resistance, ensuring super-fast and effective Chromium ion remediation in an acidic environment. Furthermore, metal recovery becomes very convenient with this type of nanomaterial after water treatment. The nanofibrous material can be readily collected from water and burned in air quickly and completely to CO₂ gas, leaving metal-rich solid residue



behind without environmental concerns; the metal-rich residue is then ready to be recycled for metal recovery. It is expected that electrospun carbon nanofibers with surface attached nZVI nanoparticles are going to serve admirably as a novel nanomaterial for efficient heavy metal remediation in contaminated groundwater as well as in waste water treatment.

Future generations of nanotechnology-enabled water treatment will capitalize on

the properties of new nanoscale materials like the ones Zhang is using. Nanomaterials have unique physical, chemical and surface properties that lend themselves to solve some of the major problems we face on the global scale: ensuring a supply of safe drinking water for a growing population, as well as addressing issues in medicine, energy, and agriculture. ■

Data-informed Decision Making

Mohd Anwar is an associate professor in the Department of Computer Science, College of Engineering. He is director of both the Center for Advanced Studies in Identity Sciences and the Secure and Usable Social Media & Networks Lab, and co-director of Cyber-Human Analytics Research for Internet of Things.



INTERNET-CONNECTED SENSORS blanketing the bodies of soldiers send information such as location, heart rate, ambient temperature, body temperature, body camera video, voice and data from each node in a coordinated way, to leadership in a controlled environment conducive to sound decision making. Defense officials here in the United States can assess cyber threats or intrusions from real-time data on the battlefield.

A college student can walk into a restaurant or a grocery store and know exactly what food items to purchase to help him meet his nutritional goals and avoid the pitfalls of obesity or diabetes. In what's called predictive analytics, student health data is married with food preferences, level of activity, budget, dietetic goals and the nutritional value of the food items in the store. Furthermore, smartphones in student pockets can also be utilized to help gauge physical and mental well-being.

These scenarios illustrate two of many research projects being pursued by Anwar. The common thread woven through all of Anwar's interests are the use of the Internet and cloud computing to monitor and aggregate disparate data in order to help human beings arrive quickly at optimal outcomes.

"I'm working with technology capable of filling in a lot of blanks," explains Anwar. "Consider any problem we want to solve these days... avoiding diabetes, preventing opioid abuse, preserving the lives of deployed troops, ensuring CPR-trained personnel are nearby during a cardiac event... mobile applications and cloud computing allow us to problem-solve in real time without being there in person."

Anwar and his 15 graduate students are supported by funds from the Department of Defense, the Air Force Research Lab, the National Science Foundation, the National

Security Agency, RTI International, and the State of North Carolina. They endeavor to design secure, privacy-preserving and trusted infrastructures, systems and applications across many sectors: defense, public health, online social media and e-Learning. Their research incorporates usability and human factor issues in the design and development of smart security and privacy solutions, and their multidisciplinary research approach integrates computer science concepts with social science theory compatible with today's regulatory environment.

"Gathering and modeling the data is actually the easy part," asserts Anwar. "The difficult part about what we do is making sure the only people who see the information are the intended recipients." Security and privacy are critical when people's lives and futures are at stake, which they often are in Anwar's research.

"Mobile applications and cloud computing allow us to problem-solve in real time without being there in person."

— ANWAR

His recent research publications include topology-based access control models for social network systems, trust-based approaches to mitigating attacks on IP networks, access control policy models, various artificial intelligence-based techniques for intrusion detection, privacy-enhancing technologies and smart and connected healthcare.

In addition to his teaching and research, Anwar is the first N.C. A&T faculty member to be selected as an RTI University Scholar. The RTI University Scholars Program supports highly-talented academics who take scholarly leave from their home institutions to collaborate with RTI researchers. Anwar will collaborate with RTI's Kevin Conway and Steve Cohen to gather meaningful and actionable insight on the opioid crisis using social media. Learn more about Anwar's research at <http://anwar.ncat.edu>. ■

Student Researchers Find Value in Silver

Misty Thomas, a new assistant professor in the Department of Biology, sponsors a cohort of young researchers who are trying to understand how bacteria can resist the antimicrobial properties of silver. That's right, silver. The shiny metal we see so frequently in jewelry, tableware and coins is earning its keep as an effective germ killer.

SILVER (Ag on the periodic table for those who need a reminder) is a solid by itself at room temperature but exists as a liquid in compounds such as silver nitrate, silver chloride and silver sulfide. Silver-based compounds have been used as effective bactericides and germicides since before we knew microbes existed, though its use decreased significantly with the discovery of antibiotics in the early 1920s. Since then, five major classes of antibiotics have been discovered and introduced to treat and prevent common infections: penicillins, tetracyclines, macrolides, fluoroquinolones and carbapenems. Unfortunately, with the overuse and misuse of antibiotics in both medicine and agriculture over the last few decades, bacteria are adapting and finding ways to survive antibiotics (a phenomenon called antibiotic resistance). These resistant

bacteria are being detected in nature within only a few years of the introduction of the new antibiotic to the public. Because of this, it has been 30 years since a new class of antibiotics has been put on the market! Therefore, the use of compounds such as silver are again gaining traction in an effort to fight these multidrug-resistant bacteria.

Silver is commonly used in the medical field for wound dressings, burn ointments, medical implants and other devices such as catheters and breathing tubes. We are also seeing silver make an appearance in many hard surfaces we'd like to keep germ-free such as refrigerator doors, stethoscopes, food containers, athletic garments, toilet seats and laboratory surfaces. What is it about silver that makes it the latest, greatest germ fighter?

Silver and most of its related

compounds are toxic, even in low concentrations, to bacteria while having no effect on human cells. Its antibacterial property is dependent on the silver ion and its ability to irreversibly damage key enzyme systems in cell membranes of pathogens. In addition, it punches holes in bacterial membranes and wreaks havoc once inside the cell by binding to essential cell components like DNA, preventing bacteria from performing even its most basic functions such as cell division.

What makes silver even more compelling as a germicide is that it has long-lasting effects. It is actually incorporated into the bacteria it kills. Dead bacteria killed by silver can kill additional bacteria, protecting humans from harmful pathogens by keeping germs at bay long after the initial silver treatment. Consider catheters, stents

and other internal medical devices which can maintain antimicrobial properties long after their introduction into the human bloodstream.

With silver use on the rise, just as with antibiotic use, we have begun to see silver-resistant bacteria emerging in nature, most notably in burn wound victims and in soils containing high levels of silver, specifically near mining areas. With the increased use of silver compounds in our everyday lives it has been predicted that resistant bacteria will become even more prevalent. Therefore,

the Thomas lab in collaboration with Joseph Graves at JSNN been researching how bacteria are capable of surviving in lethal levels of silver. Thomas and her team believe that if they understand what tools bacteria need to survive, they will have better insight into how to treat and kill these organisms when they do show up in nature.

Thomas' lab is on the ground floor of Barnes Hall, where she continues to marry two of her passions, mentoring and microbiology. Each year she sponsors five to seven undergraduates who carry out

the daily procedures and experiments to test and record laboratory findings related to silver research. Six of the seven young researchers graduated in the spring of 2018 with three headed into prestigious research programs (Mary Omotoso, Ph.D. program at Johns Hopkins University, Bre'Ida Riddick, Master's program at Auburn University and Kiara Whitaker, Post-Bac Program at the National Institutes of Health) and the others (Telah Wingate and Perice Manns) applying to dental and medical school respectively. ■



Thomas (fifth from left) and her team of undergraduate researchers are exploring the antimicrobial properties of silver

SINCE 2001, **16** LICENSE AGREEMENTS
HAVE BEEN SIGNED

Ongeri Investigating Acute Kidney Disease



ELIMELDA ONGERI, associate professor in the Department of Biology, was awarded a \$1.42 million grant from the National Institutes of Health (NIH) National Institute of General Medicine (NIGMS) to investigate acute kidney disease initiated by ischemia/reperfusion (reduced blood flow to the kidneys and subsequent oxygen deficiency).

Acute kidney disease costs tens-of-billions of dollars to treat each year, and is associated with extremely high mortality rates because there are no effective therapies. Ongeri's work will focus on determining how meprin metalloproteases (meprins are enzymes, abundant in proximal kidney tubules) influence ischemia/reperfusion-induced kidney injury via modulation of inflammation and fibrosis.

Previous studies by Ongeri's group and other N.C. A&T investigators utilizing meprin knockout mice have shown that meprins enhance kidney damage associated with ischemia/reperfusion,

however, the underlying cellular and molecular mechanisms are not fully understood. This research will advance understanding of kidney disease and the development of effective therapies.

This individual research grant was awarded under the Support of Competitive Research (SCORE) Program. SCORE is a research capacity-building program that seeks to increase the research competitiveness of faculty at under-resourced institutions with limited NIH R01 funding that have explicitly stated historical missions or historical track records focused on training and graduating students from groups nationally underrepresented in biomedical research. Past SCORE grant recipients at N.C. A&T include Robert Newman, associate professor in the Department of Biology, and Yeo Heung Yun, associate professor in the Department of Chemical, Biological and Bioengineering. ■

A&T Hosts Regional Diabetes Research Symposium



DIABETES RESEARCHERS from across the state convened in Greensboro for the first annual Regional Diabetes Research Symposium, which was hosted by N.C. A&T in collaboration with Duke University, UNC-Chapel Hill and Wake Forest University. The universities are interested in promoting inter-institutional collaborations in diabetes research as part of the new North Carolina Diabetes Research Center (NCDRC).

"N.C. A&T was pleased to host the Regional Diabetes Research Symposium which created an opportunity for North Carolina's diabetes researchers to learn

about the research strengths and cores of each partnering institution," said Meriel Parker, director of life science research at N.C. A&T. "We are eager to witness the diversity of diabetes research proposals which culminate from the symposium and this unique funding mechanism."

The event featured presentations from physicians at three of the state's medical schools. "Multi-center applications require history of collaboration and justification, with an emphasis is on bringing new diabetes investigators in," said Donald McClain from Wake Forest University. John

Buse of The University of North Carolina at Chapel Hill, said, "The environment is a large focus at UNC-CH, and an area of great opportunity in diabetes research." David D'Alessio at Duke University conveyed his enthusiasm about this regional cooperation. "One advantage of the partnership is the complimentary science of the institutions."

The one-day event was held at the Union Square Campus in Greensboro, convening around 100 researchers from across the translational spectrum who are interested in developing cross-institutional projects in diabetes, obesity and metabolism. The event featured presentations, workshops, networking opportunities, information about the pilot research award opportunities and the core research initiatives which are being led by this regional consortium. Plans are underway for a similar event in 2019. ■

N.C. A&T IS HOME TO **17**
CENTERS AND INSTITUTIONS

Pioneering the Medicinal Uses of Ginger

THE LIST OF MEDICINAL USES of ginger continues to grow, thanks to the lab of Shengmin Sang. A professor and lead scientist for functional foods at the A&T Center for Excellence in Post-Harvest Technologies in Kannapolis, Sang and his colleagues have produced research resulting in three patents in three years and a licensure this year.

In January 2017, a patent identified a method of treating colon cancer by administering chemical compounds similar to the ones formed by the body after ginger is ingested. This patent partners with another which protects Sang's discover of those compounds' abilities to treat colon and lung cancer.

"When a person takes in ginger, the metabolites formed in the body are just like a drug," says Sang, who made the discovery

with Yingdong Zhu, research scientist at the CEPHT, and Huadong Chen, on faculty at the David H. Murdock Research Institute at the N.C. Research Campus in Kannapolis.

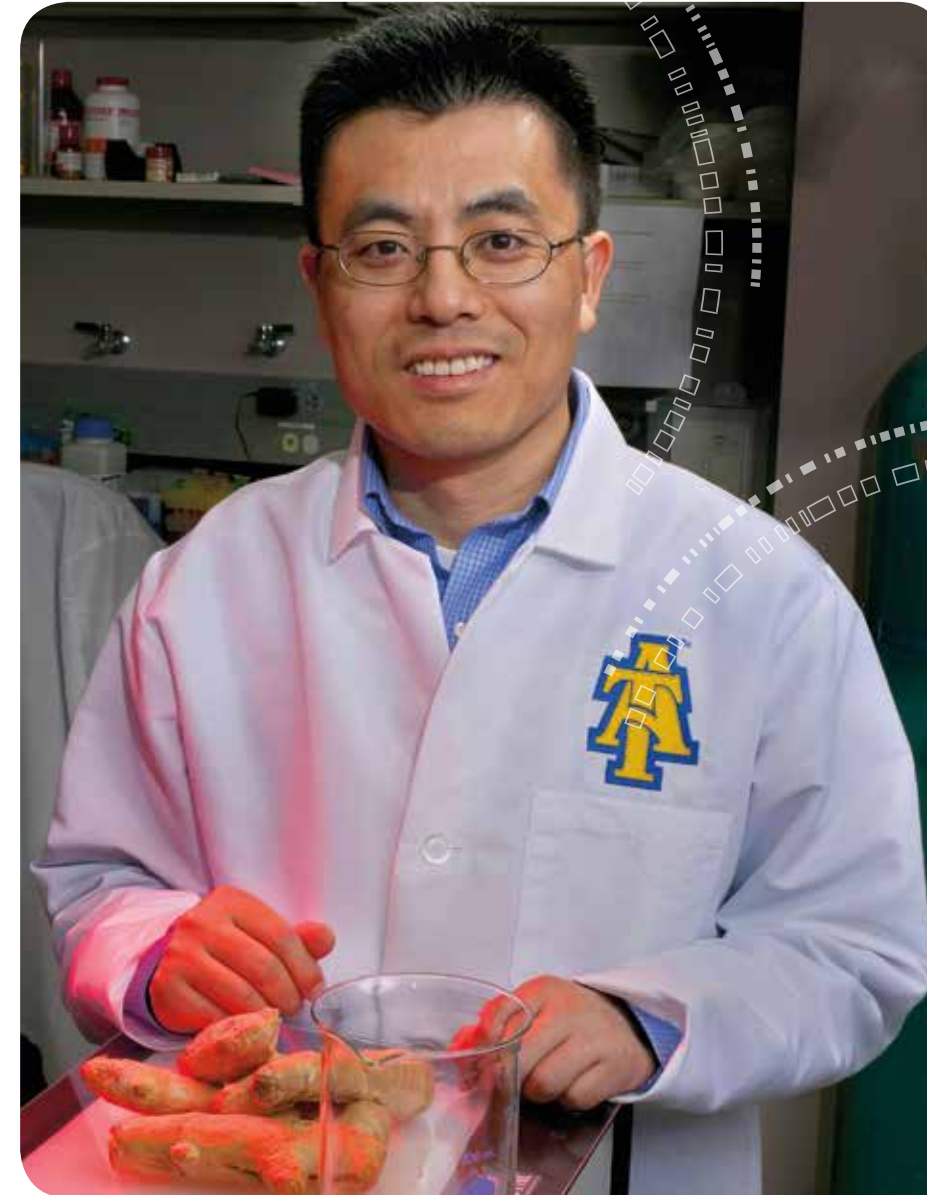
Those metabolites, related to a family of active compounds in ginger called shogaols, have strong cancer-fighting properties. Sang's tests on shogaol derivatives have reveals their effectiveness as a cancer treatment.

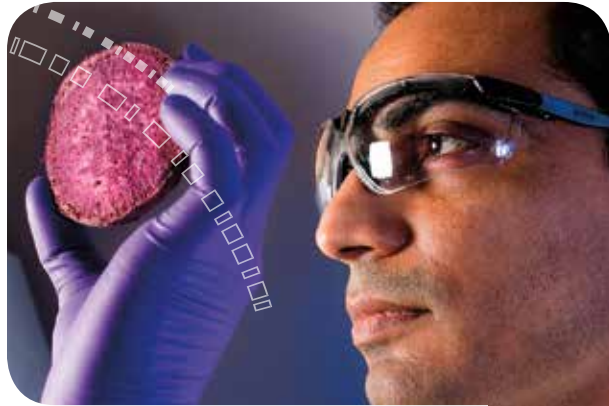
In March, Sang licensed a 2015 patent for a family of aspirin- and ginger-derived compounds to industry after his research revealed that dry ginger helps buffer aspirin's corrosive effects, allowing patients to receive aspirin's benefits without adverse side effects. Sang won a research award from SoBran BioScience and N.C. Biotechnology Center in April 2017 for the innovative approach. Then in August 2017, Sang

received another patent for compounds combining aspirin and ginger derivatives.

Despite its well-known curative powers, aspirin, which is derived from willow bar, is highly caustic to the stomach lining. Ginger however, relieves stomach irritation, and has many other well-documented health benefits as well.

Sang's research and patented compounds could be a benefit to patients who require aspirin but suffer from the accompanying stomach pain. The results of the licensure could be a new generation of aspirin that has far fewer corrosive effects. Tests on colon cancer cell lines showed Sang's novel compounds, containing both aspirin and bioactive phytochemicals, were more effective at inducing cancer cell death than any of the individual components used alone or physically mixed. ■





Sweet Potatoes' Potential to Treat Diabetes

Rishipal Bansode researches the health benefits of purple sweet potatoes. He is a research scientist at the N.C. A&T Center for Excellence in Post-Harvest Technologies in Kannapolis.

Rishipal Bansode researches the health benefits of purple sweet potatoes

THE PURPLE SWEET POTATO is an attention grabber. Sure, the shape is familiar; oblong, hand-sized, with a creased and rooty texture that resembles a common culinary friend. But even at a distance, the color stands out: dark purple, instead of the customary orange. Cutting a slice confirms its uniqueness: lavender flesh, not orange.

It's not a hoax or genetically altered anomaly. The purple sweet potato is a naturally occurring variant of the popular brown-and-orange tuber. Originally from Japan, it is the most recently cultivated of the eight or so sweet potato varieties grown in North Carolina. Only available since 2003, a variety called Stokes Purple, developed in Stokes County, is grown primarily on the North Carolina coast. Still, it's natural to double-take—the remarkable tuber is,

frankly, weird.

When Rishipal Bansode, research scientist at the N.C. A&T Center for Excellence in Post-Harvest Technologies (CEPHT) in Kannapolis looks at a purple sweet potato, he sees not a surprising variant of a familiar food, but a delicious conglomeration of polyphenols and anthocyanins, two antioxidant-rich compounds found in plants. Antioxidants are protective substances found primarily in fruits and vegetables. Nutritionists recommend eating them to protect against a host of diseases, including heart failure, dementia, diabetes and some types of cancer. Anthocyanins, in addition to their health benefits, are the same source of the pigment that makes cherries red, blueberries blue and cabbage purple. In these health benefits, Bansode sees

an opportunity. Thanks to their huge polyphenol and anthocyanin content, the royal-hued *I. batatis* shows great promise in regulating blood sugar levels in diabetics.

"I want to show the healthy aspects of sweet potatoes and get people to eat them," Bansode says. "By eating a healthy diet that includes sweet potatoes, people can get the same benefits as taking medicine. Diet won't solve the whole issue, but it can be a synergistic effort along with drug treatment, and by eating healthy, people can avoid the long-term health effects of medical conditions."

Since the 1990s, the incidence of obesity-related Type 2 diabetes has steadily increased to the point that now, one-third of the U.S. population is at risk for developing the condition. Particularly worrisome to the health community, many of the vulnerable

are children. Obesity leads to resistance to insulin, the hormone that balances changes of the blood sugar glucose in the body; when the amount of insulin being produced can't keep up with the level of glucose being ingested, diabetes results.

Bansode sees, in the unusual vegetable, a way to sensitize resistant cells to insulin and bring about more stable glucose levels in Type 2 diabetics. "I looked at the anthocyanin components in purple sweet potatoes and thought they were a good candidate for producing glucose homeostasis," he said. "I also wanted to change the perception that 'sweet' is always bad, even where diabetes is concerned."

Glucose is processed in the liver. When Bansode exposed liver cells grown in petri dishes to anthocyanins extracted from purple sweet potatoes, the cells began to produce an enzyme associated with glucose regulation called AMP kinase.

Animal studies, often the last precursor to testing in humans, have also been performed at CEPHT with funding from the N.C. Research Center, and have yielded similar positive results: Pre-diabetic mice, fed a high-fat diet, experienced increased liver activity after ingesting purple sweet potatoes. "Lots of research has been done with animals and diabetes. Our center is unique in showing how this works at the cellular level—how anthocyanins simulate AMP kinase pathways," Bansode says.

The tests were also able to identify and categorize for the first time, the health-promoting polyphenols found in sweet potato skins.

As the medical and farming communities become aware of the purple sweet potato's health benefits, this variant of what is already the state's most important cash crop could prove a boon to North Carolina agriculture. "If there's a market for it, farmers will grow it," Bansode says. "We can help create a market for it by making everyone aware of the purple sweet potato's health benefits."

Education efforts targeting the state's farmers are already under way with the help of the N.C. Sweet Potato Commission, a nonprofit corporation made up of more than 400 sweet potato growers and the processors and business that support them. The sole purpose of the commission is to increase sweet potato consumption through education, promotional activities, research and ethical horticultural practices among its producers. Bansode has met with members of the commission and a selection of farmers and packagers. The USDA, which

was independently studying the lavender sweet spud's health benefits, is breeding different varieties to see which grow best in North Carolina soil. "As a commercial enterprise, vendors could sell the sweet potatoes outright or they could extract the polyphenols and make them into a capsule or tablet," Bansode says.

Although this research furthers the CEPHT mission of providing alternatives to drug treatment, food researcher Bansode takes a personal interest in the challenge of alleviating a national health problem. Food researchers have long partnered with industry to find ways to make foods more shelf-stable, attractive and flavorful by developing trans fats, preservatives, artificial colors and flavors that have had dubious effects on consumers' health. "Food researchers got us into this mess; now, it's our responsibility to lead the way out," he says. "We added trans fats to make processing faster, and it took nearly 60 years for the USDA to get implications. Now consumers are requesting foods that are more natural, and we have to find ways to encourage that." ■

"I also wanted to change the perception that 'sweet' is always bad, even where diabetes is concerned."

— BANSODE

Serving Those at Risk for HIV/AIDS

IF YOU THOUGHT HIV/AIDS was a health epidemic from the past, Sharon Parker has news for you. The disease is spreading through at-risk populations, and her research aims to identify these groups and make them aware of pre-exposure prophylaxis (PrEP), which is a course of HIV drugs taken by HIV-negative people to prevent infection. Truvada® is a daily pill that reduces the risk of contracting HIV by at least 90 percent when taken as prescribed. PrEP is prescribed through the N.C. A&T Student Health Center and other healthcare providers, however, many people are unaware of PrEP and have little information about the medication.

Getting a prescription for PrEP means admitting to a lifestyle which places people at risk for contracting HIV, but Parker wants to emphasize the most important point which is personal safety and overall health and wellbeing. She helps individuals assess their own risk for contracting HIV. She is the chairperson for the Triad PrEP Work Group which is a collaboration between community-based agencies, local health

departments, Cone Hospital, Carolina Central Health Network, the NC AIDS Action Network and Wake Forest University.

People who meet one of the following criteria can benefit from taking PrEP: (1) have a partner who is HIV-positive, (2) have multiple sex partners or your partner has multiple sex partners whose HIV status is unknown, (3) have sex without a condom, (4) recent history of a sexually transmitted disease (5) share needles or equipment to inject drugs, or (6) recently released from a drug program. To some Americans, these populations may seem isolated and insignificant, but a disease like HIV/AIDS affects every community across the U.S. “There will always be people who participate in risky behaviors. You can pretend they don’t exist, but they do, and they’re right next door. Successful public health initiatives face reality and address health concerns with honesty, acceptance and optimism.”

Parker has four research grants underway which help her find people who could benefit from taking PrEP. She is the

principal investigator for a University of North Carolina at Chapel Hill Center for AIDS Research Developmental Award funded by the National Institutes of Health. The study, *Perspectives of HIV Prevention among Incarcerated Women: Pre-Exposure Prophylaxis as a Potential Biomedical HIV Intervention*, aims to learn more about women’s knowledge of HIV and PrEP, explore barriers and facilitators to the uptake of PrEP, factors that contribute to high risk behaviors and their perceptions of preventing HIV infection by taking PrEP after release from prison. The study focuses on women with a history of sex work or survival sex and is being conducted at the North Carolina Correctional Institute for Women.

She is a collaborator in *Bringing Pre-Exposure Prophylaxis to Campus: Understanding HIV Pre-Exposure Prophylaxis Uptake Behaviors at Historically Black Colleges and Universities*, a study funded through Duke University and the National Institutes of Health. Parker’s research focuses on generating new knowledge about students’ familiarity and perception of HIV, knowledge of PrEP, students’ willingness to take PrEP if



Kathy Norcott and Sharon Parker educate Piedmont citizens about HIV prevention

prescribed by a physician, and barriers and facilitators to the uptake of the drug. The study is designed to identify methods to introduce new biomedical HIV prevention tools to students attending Historically Black Colleges and Universities.

Parker is a member of the HIV/AIDS Interdisciplinary Working Group (HIW) involving faculty from the University of South Carolina, University of Georgia, Georgia Southern University, N.C. A&T, as well as community-based agencies and persons living with HIV (PLWH). The HIW

to PLWH and to increase HIV/AIDS care through the enhancement of collaborative relationships with community agencies serving PLWH and develop a community-engaged response to the HIV epidemic.

Parker is a co-investigator on the grant *Preparing for Prison Release* in collaboration with the UNC Center for Aids Research Developmental Award. HIV prevalence among the prison population is three-to-five times higher than the non-incarcerated population, because prisoners disproportionately come from

“Successful public health initiatives face reality and address health concerns with honesty, acceptance and optimism.” — PARKER

implemented a study, *HIV/AIDS Community Needs Assessment in Three Southern States*, to better understand services provided to PLWH in South Carolina, Georgia, and North Carolina. The study is designed to access services provided

groups impacted by HIV (people who use drugs, racial-ethnic minorities, lower socioeconomic status individuals). People released from prison are also more likely to have engaged in high-risk HIV behaviors such as commercial sex work and drug use. Since some incarcerated people could really benefit from PrEP, Parker and colleagues propose to examine the integration of PrEP as a part of the *Formerly Incarcerated Transitions (FIT)* program which currently links people released from prison to a primary care provider.

The medical and pharmacological advances towards the spread of HIV/AIDS have been truly remarkable, and are something our society can take great pride in. Thanks to decades of research and funding, many people with HIV live long, full lives. Now, we have the ability to prevent this disease altogether, if we put forth a concerted effort to put PrEP in the hands of people who need it. ■

A Promising Future for Industrial Hemp



GONE FOR DECADES, industrial hemp is poised to make a comeback in North Carolina, and N.C. A&T is helping to lead the way. Following recent changes to federal and state laws, industrial hemp is again becoming a profitable crop in the U.S. with uses including food, dietary supplements, paper, textiles, biodegradable plastics, biofuel and animal feed. The Hemp Industries Association estimates that the 2015 retail market for hemp products was more than \$570 million.

“It’s potential is huge, industrial hemp can do a lot of things,” says Guochen Yang, a professor in the Natural Resources and Environmental Design department and a member of the N.C. Industrial Hemp Commission, the group developing the state’s rules and licensing structure related to the plant. “You can grow it for seeds, or you can grow it for fiber.”

Yang answered questions about what farmers must do to grow industrial hemp at Small Farms Field Day on June 15. The

following day, A&T planted eight varieties of industrial hemp on almost half an acre at the University Farm. The trial has offered insights about which varieties would work best for different uses, such as providing fiber, biomass, oil or seeds.

Grown by George Washington and Thomas Jefferson, hemp was widely cultivated for most of the nation’s history. Since World War II, however, drug enforcement laws had prevented the growing of industrial hemp because of its similarity to marijuana; both varieties are of the species *Cannabis sativa*.

The difference between industrial hemp and marijuana comes down to levels of tetrahydrocannabinol (THC), the main psychoactive component in marijuana. THC concentration may not be higher than .3 percent in industrial hemp, according to federal and state laws.

The federal farm bill of 2014 allowed the growing of industrial hemp as part of state research projects. In 2015, the N.C. General

Assembly legalized industrial hemp production and established a pilot program to help small farmers generate income by growing the crop. The law was updated in 2016 to establish a research program using the faculty expertise at N.C. A&T and N.C. State University, the state’s two land-grant institutions.

To be included in the research, farmers must apply to the Industrial Hemp Commission for a permit to grow the plant. Research will focus on evaluating varieties of industrial hemp that will grow in North Carolina, assessing soil and other growing conditions, investigating possible uses of the crop in new energy technologies, and exploring other potential uses.

As of mid-September, the Industrial Hemp Commission had issued permits to almost 100 growers to plant more than 1,900 acres and 150,000 square feet of greenhouse space of industrial hemp. ■



With multiple commercial uses, industrial hemp has the potential to become a valuable cash crop in North Carolina



Antoinette Maldonado-Devincci is an assistant professor in the Department of Psychology, College of Health and Human Sciences. In 2016-2017 she received the College's Research Excellence Rookie of the Year Award. In 2016 she received an NC TraCS Faculty Development Research award and was selected as N.C. A&T's K Faculty Scholar.

Understanding the Relationship between Alcohol and Neuroactive Steroids

NEUROACTIVE STEROIDS are naturally-occurring steroids, which are synthesized in the body and brain from cholesterol. Neuroactive steroids are actually very similar to hormones that our adrenal glands produce to fight stress associated with illnesses and injuries, as well as reduce inflammation and bolster the body and brain's immune system. They help govern our moods and affect our ability to learn, which make them very important molecules to the human brain.

In order to be effective, neuroactive steroids need to be present in their normal range for humans, which is different for males and females. When the levels drop below normal, there are increased rates in the development of depression, inflammation and a host of autoimmune diseases. On the other hand, if neuroactive steroid levels are elevated, altered reactivity

to stress can occur, which could promote relapse to alcohol and drugs of abuse.

Maldonado-Devincci's research explores two broad areas including the development of neuroactive steroids during adolescence and how drug exposure during this developmental period might contribute to abnormal brain development and subsequent drug-seeking and drug-taking behaviors. Her second aim is to understand how alcohol dependence changes brain neurocircuitry and how these changes can be reversed by potential therapeutic intervention.

During her appointment as an NC TraCS K Scholar, her goals for the three year grant are to expose adolescent male and female mice to a model of binge alcohol and examine long-term changes in their brain neurosteroid levels and changes in behavior in adulthood. During this period she will explore alcohol-induced

changes in brain neurosteroid levels in brain regions important for motivation, emotion and higher level cognition using techniques including chromatography/mass spectrometry and biochemical methodologies. From a behavioral level she will binge alcohol-induced changes in alcohol drinking, depression, anxiety and stress reactivity in adulthood.

Maldonado-Devincci's research is exploring the relationship between alcohol drinking, stress responses, and neuroactive steroids. Results from her work using a mouse model will help her better understand the adolescent human brain and how drug exposure can permanently alter the brain. Thus far, her findings suggest that neuroactive steroids contribute to alcohol sensitivity and tolerance, protect against dependence and reduce excessive alcohol consumption. ■

Meeting Diverse Learning Needs in North Carolina

Nicole Dobbins is an associate professor in the Department of Educator Preparation, College of Education. She is currently serving as the department's Special Education Program Coordinator and is the co-principal investigator with Dawn Waegerle for the College's PETAC grant through the Department of Education.

NICOLE DOBBINS AND CO-PI DAWN WAEGERLE are the proud stewards of a teacher recruitment and preparation effort supported by a \$1.2 million grant through the Department of Education, entitled Project PETAC — Preparing Exceptional Teachers through Accountability and Collaboration. Project PETAC is designed to address the chronic shortage of special education teachers throughout the state of North Carolina.

Project PETAC represents a collaborative effort between N.C. A&T, Alamance-Burlington Schools, Guilford County Schools and Winston-Salem Forsyth County Schools. Project faculty like Dobbins are recruiting, enrolling, supporting and graduating a total of 24 scholars (two cohorts over a five-year period) who will be prepared to teach diverse students with persistent learning and behavioral problems.



“As an engaged researcher, I am committed to the discovery and implementation of effective academic, behavioral, social, and cultural strategies for diverse learners,” says Dobbins. My mission is to provide tomorrow's teachers with effective academic, behavioral, social, and cultural strategies for the diverse learner student population.”

To date, the PETAC Project is supporting 22 graduate students enrolled in the Master of Arts in Teaching in Special Education degree program. Additional goals of PETAC include:

- Increasing the number of fully-credentialed masters level special education teachers
- Improving the quality of the preparation of highly-qualified teachers
- Redesigning, implementing, and evaluating a rigorous research-based master's training program

While the criteria for being accepted into the program are rigorous, aspects of the experience are very unique and rewarding. Admitted scholars complete a Summer Institute and receive professional development training in TEEACH, Foundations of Reading and Non-Violent Crisis Intervention Training. They also receive tuition support, free travel to conferences and a stipend to cover the cost of books and technology needs. At the end of the term, the cost of all state licensure exams are covered by the grant. ■

Campus Focus



Hello New Center, Farewell Friend

IN 2018, the university proudly unveiled its newest Center, the Visualization and Computation Advancing Research Center (ViCAR). ViCAR serves as a focal point for computationally-intensive interdisciplinary research at N.C. A&T. The Center

provides researchers both scalable computational resources and visualization display systems. Its resources and expertise are available to students, their advisors and instructors, as well as other groups comprising the research and development community.

The concept and creation of ViCAR was the tremendous accomplishment of Kenneth Flurchick, associate director of the Center. His brilliant mind and salty disposition made him a well-known and highly-regarded figure among students, staff and colleagues. Though Flurchick is no longer with us, his vision for accessibility to high performance computing lives on through this Center.

The Center, located in the Fort IRC building, features accessible computational resources comprising a robust, staff-supported, scalable, High Performance Computing environment, including high performance clusters, robust 3D visualization systems, large-storage systems for backup and data management, and high end workstations. The Center provides expertise, training, and support for researchers and developers to engage in:

- Modeling, simulation, and visualization
- Data sciences, computational statistics, and machine learning
- High-performance and scalable computing
- Numerical methods, algorithms, and computational thinking ■

Tuttle Elected to NORDP Board of Directors



THE DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT is proud to announce that Paul Tuttle, director of proposal development, has been elected to a four-year term on the

Board of Directors of the National Organization of Research Development Professionals (NORDP). Research development encompasses a set of strategic, proactive, catalytic, and capacity-building activities designed to facilitate individual faculty members, teams of researchers, and central research administrations in attracting extramural research funding, creating relationships, and developing and implementing strategies that increase institutional competitiveness. NORDP serves research development professionals and their institutions by providing a formal organization to support professional development, enhance institutional research competitiveness, and catalyze new research and institutional collaborations. ■

Researchers Honored at Annual Banquet

Forty N.C. A&T faculty were honored at the university's annual spring Faculty Excellence Awards Banquet. Awards were given in the areas of research, intellectual property, teaching, advising, community engagement and promotion and tenure. Among the year's winners were six individuals recognized for their outstanding achievements related to research.

Shengmin Sang, professor in the Center for Post-Harvest Technologies in the College of Agriculture and Environmental Sciences, was honored with the Senior Researcher of the Year Award for his work involving the identification of bioactive components from functional foods and herbal medicines to prevent chronic diseases such as cancer, obesity and diabetes.

Lifeng Zhang, recipient of the Outstanding Young Investigator Award, is an associate professor in the Department of Nanoengineering, Joint School of Nanoscience and Nanoengineering (JSNN). His research interests involve polymer, ceramic and carbon nanomaterials and nanocomposites which are used in a wide variety of energy and biomedical applications.

Hyung Nam Kim won the Rookie of the Year Award. The assistant professor in the Department of Industrial and Systems Engineering, College of Engineering conducts research related to the information and technology necessary to aid older adults with visual disabilities as they obtain, process and use health services.

Sung-Jin Cho was honored with the Intellectual Property Award. An assistant professor in the Department of Nanoengineering at the Joint School of Nanoscience and Nanoengineering, Cho conducts research in energy storage. He was named inventor on three provisional patent applications, had a Patent Cooperation Treaty application nationally filed, and a commercial license executed with BioSolar.

Joseph Graves, Jr. and the **BEACON Center** won the university's Interdisciplinary Team Award. Graves is professor and interim dean of nanoengineering at JSNN. The BEACON Center supports over 20 faculty researchers at the university, bringing together biologists, computer scientists and engineers to offer solutions to classic problems in organic evolution.

Jenora Waterman is the winner of the new Undergraduate Research Faculty Mentor Award. An associate professor in the Department of Animal Sciences in the College of Agriculture and Environmental Sciences, she has mentored 22 undergraduate students in research since joining the N.C. A&T faculty in 2008. Her team utilizes basic science and translational research approaches to develop models of respiratory diseases affecting farm animals and humans. ■



ADVANCE IT: Catalyzing Gender, Leadership, and Scholarship Equity

WOMEN ARE SEVERELY underrepresented in tenured and tenure-track faculty positions within science, technology, engineering, and mathematic (STEM) fields at most universities, and N.C. A&T is no exception. To address this gender inequity, N.C. A&T was awarded a National Science Foundation ADVANCE Institutional Transformation grant aimed at catalyzing university-wide systemic changes to increase the representation of women at all levels. In its fourth year, N.C. A&T's ADVANCE IT project is working to create an environment conducive to the growth, development and advancement of all faculty, but particularly women in STEM and social and behavioral sciences (SBS) disciplines.

This project, led by Beryl McEwen, N.C. A&T's provost and executive vice chancellor for academic affairs, focuses on:

- Increasing recruitment, retention and advancement of women in STEM by building a strategic pipeline for academic and professional success;
- Increasing opportunities for sustained achievement for all faculty by creating a whole campus culture of excellence in STEM research and scholarship; and

- Increasing the knowledge of roles of gender and gender/race intersectionality within the academy

The ADVANCE IT team has taken steps to integrate various aspects of the project into the fabric of the university. To embark on this task, the ADVANCE IT project has enlisted broad support from campus partners including the Division of Academic Affairs, Institutional Research, the Division of Research, Human Resources, the Center for Leadership and Organizational Excellence, the Academy for Teaching and Learning, the FD Bluford University Library, and the University Writing Center. The project outlook is positive toolkit data, the number of tenured and tenure-track women faculty in STEM and SBS departments has increased 11.5 percent from spring 2015 to fall 2017.

Additionally, ADVANCE IT provided networking, professional development and writing/research skill development activities geared to increasing scholarly productivity. From spring 2015 to fall 2017, 75 percent of the attendees/facilitators for these events have been women faculty, staff or administrators. In addition, the project is beginning to see a slight increase in the



Professional development opportunities abound for women faculty in STEM through the ADVANCE IT project

number of STEM women moving up the ranks to associate and full professor positions.

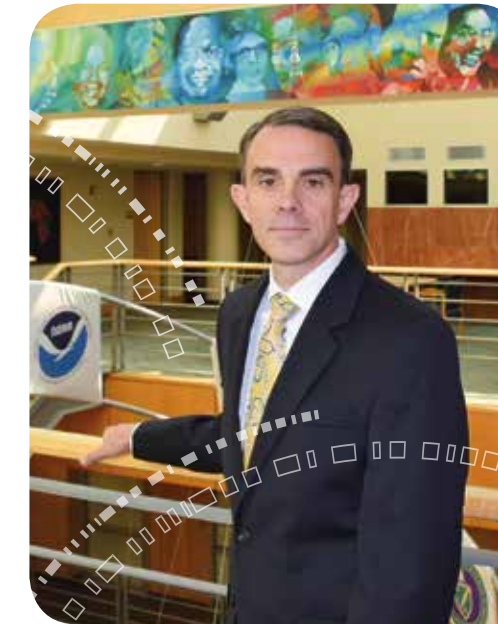
One of the most impactful efforts of the project thus far has been the establishment of the ADVANCE IT Faculty Scholars Program. This program is designed to connect a cohort of STEM and SBS women faculty, who will participate in activities designed to increase excellence in teaching, research and engagement, boost their scholarly productivity, and enhance women's competitiveness for leadership roles at the university. In its first three years, 27 women faculty have come through the Faculty Scholars Program. From fall 2015 to fall 2017, Faculty Scholars in cohorts one and two have achieved some major milestones, with 21 grants funded, over \$5 million dollars in funding, 45 publications/conference proceedings published, as well as four books. These increases in scholarly productivity can

be partly attributed to the participation of Faculty Scholars in the one-week intensive STEM Women's Writing Retreat.

During the writing retreat, participants engaged in professional development programming (proposal and grant development, and work-life balance) and participated in focused writing time. The writing retreat is open to STEM and non-STEM female faculty and several faculty have attended multiple times.

"I have attended three writing retreats, which position us to create winning grant proposals," said Cynthia Waters, an associate professor in the Department of Mechanical Engineering in the College of Engineering. "I value the time away with no distractions. I think it's important to bond with other members of the cohort because we support each other and hold each other accountable."

Faculty who have been part of one of the first three cohorts have enjoyed fast-track acceptance into ADVANCE IT professional and research/writing skill development opportunities, individualized and peer mentoring, a welcoming and accepting community of support, targeted research initiatives, writing retreats and specialized leadership development. ■



DORED Welcomes Tim Linker to Staff

THE DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT is pleased to welcome Tim Linker as its new assistant vice chancellor for research administration. The offices of Sponsored Programs, Contracts & Grants, and Financial Compliance will report to him. Prior to joining our team, Tim served High Point University where he was the director of research administration and sponsored programs. His undergraduate degree (political science) is from UNC Charlotte, with his two master's degrees (international studies and organizational communications) being conferred by North Carolina State University. ■

Undergrads Share Research Accomplishments

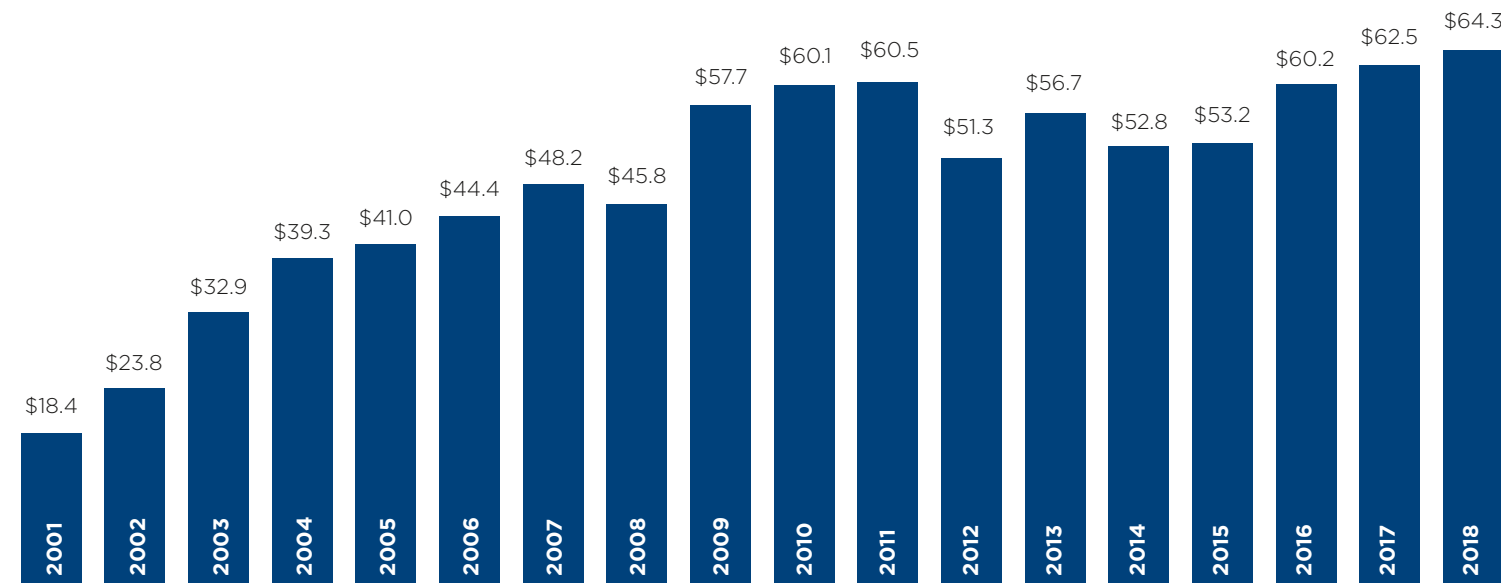
THE HALLMARK for achieving institutional success lies in the university's commitment to create and expand learning experiences beyond the classroom. Undergraduate research in any discipline compliments and enhances the student experience, which is why the Office of Undergraduate Research (OUR) exists to encourage, facilitate, support, and promote all types of undergraduate research and scholarly inquiry. Each fall and spring OUR showcases a wide variety of student research activity in their Undergraduate Research Symposia. Students who are pursuing research, accompanied by their faculty mentors, gather for a poster competition, oral presentations, keynote address and research-oriented workshops. ■

SINCE 2001, **\$320,000**
IN REVENUE HAS BEEN GENERATED
FROM LICENSING AGREEMENTS

Sponsored Funding

Total Awards by Fiscal Year, 2001 – 2018

Since 2005 N.C. A&T has ranked third in UNC System (dollar figures in millions)



FY 2018 Research Highlights

LAUREN DAVIS, College of Engineering, Department of Industrial and Systems Engineering, \$3 Million, The National Science Foundation, Improving Strategies for Hunger Relief and Food Security through Computational Data Science

SHENGMIN SANG, College of Agriculture and Environmental Sciences, Center for Post-Harvest Technologies, \$2.8 Million, United States Department of Agriculture, A Nutrismetabolomics Approach to Identify the Biomarkers of Whole Grain Intake

ABOLGHASEM SHAHBAZI, College of Agriculture and Environmental Sciences, Department of Natural Resources and Environmental Design, \$2.1 Million, The National Science Foundation, CREST Center for BioEnergy, Making Biomass a More Viable Source of Renewable Energy

SAMEER HAMOUSH, College of Engineering, Department of Civil, Architectural and Environmental Engineering, \$2.0 Million, United States Department of Energy, Pipeline Development of Skilled Workforce through Research in Advanced Manufacturing

MARANDA MCBRIDE, College of Business and Economics, Transportation Institute, \$1.4 Million, United States Department of Transportation, Center for Advanced Transportation Mobility

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SINCE 2001, **7** COMPANIES
HAVE LAUNCHED BASED ON N.C. A&T
RESEARCH INNOVATIONS



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