Innovations

Basic and Applied Sciences Magazine

Winter 2017 Vol. 4, No. 1

NOT-SO-STRANGE BREW

Amidst a growing national trend toward bolder-flavored food and drink, MTSU launches a Fermentation Science degree

MIDDLE TENNESSEE STATE UNIVERSITY

Innovations

Winter 2017, Vol. 4, No. 1

University Editor
Drew Ruble

Contributing Editors
Darby D. Campbell, Carol Stuart

Contributing Writers
Skip Anderson, Allison Gorman, Vicky Travis, Randy Weiler

Director of Creative and Visual Services
Kara Hooper

Designer
Brian Evans

University Photographers
Andy Heidt, J. Intintoli, Eric Sutton

University President
Dr. Sidney A. McPhee

Interim University Provost
Dr. Mark Byrnes

Dean of Basic and Applied Sciences
Dr. Bud Fischer

Vice President, Marketing and Communications
Andrew Oppmann

Special thanks to
Nicole Chitty, Marlene Lawson, Nancy Miller, and the MTSU News and Media Relations Team

Cover photo by Darby D. Campbell

1,500 copies printed at Falcon Press, Nashville, Tennessee
Designed by MTSU Creative and Visual Services

MIDDLE TENNESSEE STATE UNIVERSITY

Table of **Contents**

Feature Stories

Celebrating a Renovation and a **Bright Future**

It's a new year, which is the perfect time to reflect upon this past year and all of the things we have to celebrate (and those things for which we are thankful).

For more than 100 years, MTSU has been on the cutting edge of teaching, research, and outreach education in Tennessee. We are thankful that the renovation of Davis and Wiser-Patten science buildings is complete. Our Physics and Geosciences departments and our Mechatronics and Forensic Science programs have moved into the buildings and are conducting their normal activities after being displaced for about two years.

The renovation has been accomplished to an exacting standard and involved significant changes in floor plans to meet contemporary needs. The quality of construction is outstanding, assuring a long and distinguished service life. Moreover, we have realized significant energy savings. In addition to being highly efficient, the buildings include many new features that will improve functionality. This includes dimmable LED lighting, three-pane glass windows that are faithful to the original Wiser-Patten design, projection technology and presentation systems, and flexible classrooms that can be arranged into various pedagogical designs. We also ensured that the buildings are student-friendly by providing significant work areas for graduate students, including graduate teaching assistants. Furnished public areas are available on each floor, providing study spaces with whiteboards for collaborative learning opportunities.

If you have a chance to visit campus, please drop by Davis, Wiser-Patten, and the new Science Building to see how we continue to advance education and research through state-of-the-art facilities. I also invite you to the official grand reopening of the buildings on Feb. 15.

We are thankful that over the past five years, our College of Basic and Applied Sciences has been able to expand and enhance opportunities for our undergraduate students through educational and cocurricular improvements. We have worked to improve the academic experience and better prepare students for their future in a changing global economy by building a stronger sense of community in the college, enabling and encouraging more students to participate in study abroad and other international educational experiences, and continually improving our academic programs. We have accomplished the latter in part by introducing new modes of teaching and learning, providing more and better career information and advising, and increasing the number of scholarships available, among other things.

I am thankful for our faculty's commitment to the research endeavor. The college presently has approximately **$20 million in total research funding** from such granting agencies as the National Science Foundation, National Institutes of Health, and U.S. Department of Agriculture. We continue to pursue new research programs and partnerships in emerging and topical fields from big data, precision agriculture, unmanned aircraft systems, nanotechnology, and alternative energy—and find new ways to link those programs to new learning opportunities for our students.

We are also thankful for the upwelling of support for CBAS that has been shown recently. Many have stepped up to help us in our mission with donations of time, expertise, and gifts. Contributions include those from the private sector, who have offered facilities for research and internship training; those in state and federal government, who have provided subject matter expertise and facilitated grants; and those in a position to donate, who have graciously given scholarships, endowments, and funds to improve facilities. We encourage you to read the following pages that highlight a few of the unique ways we have benefited by the incredible generosity of our alumni and community partners.

It is our belief that **through our commitment to innovation, excellence, and quality, we are creating new knowledge** and share that knowledge by educating and inspiring tomorrow's leaders to believe they can make a difference for Tennessee, the United States, and for people around the world.

The faculty and staff of MTSU's College of Basic and Applied Sciences join me in wishing you and your family and friends a great new year.

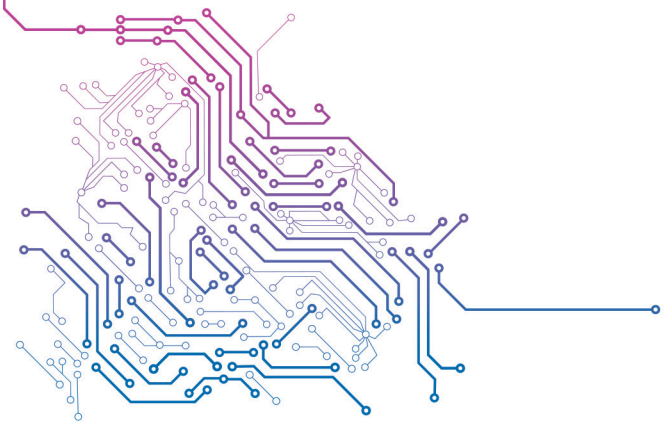
True Blue!

Dr. Bud Fischer, Dean

THE CALL OF DATA

Demand for tech-savvy graduates has MTSU Computer Science students poised for professional success

by Vicky Travis



MTSU graduates Chris Hefley ('99) and Amy Henderson ('97) expected to hire between 10 and 20 tech-savvy college graduates last year at their red-hot, fast-growing, Franklin-based technology company, LeanKit.

CEO Hefley's 2015 acquisition of Henderson's company, Firefly Logic, nearly doubled LeanKit's size, bringing the seven-year-old startup to 125 employees as of the spring of 2016. Among the company's more than 2,000 customers are Xerox, CarMax, IBM, and Target.

LeanKit delivers visual project management software to improve productivity. Hefley founded the company with two other partners in 2009 after graduating from MTSU and spending years working in IT at various corporations.

LeanKit's need to hire so many new, tech-trained professionals is just one example of the ever-growing tech job opportunities available in Nashville. About 1,500 technology positions need to be filled locally, according to the Nashville Technology Council (NTC), and that number is expected to rise if recent trends continue. Such a dire need for tech talent in Music City led the Nashville Area Chamber of Commerce—in part through its WorkIT initiative—to formally market Nashville as a great place to land a tech job, going so far as to highlight the city's atmosphere, opportunities, and lifestyle in newspaper advertisements in cities like Boston.

A main supplier of that much-needed local tech talent, though, is located much closer than Massachusetts. It's MTSU, and, specifically, the University's large and expanding Computer Science Department, the largest in the state.

As evidence, consider that 24 of LeanKit's 125 employees (including Hefley and Henderson) are MTSU graduates.

The Future Is So Tech

With nearly every aspect of our lives touched by technology, the need for people who can write code, keep systems secure and maintained, and create applications and software will only continue to grow. Nationally, jobs in computer and information technology could grow 12 percent from 2014 to 2024, according to the Bureau of Labor Statistics.

"All companies employ tech now," said Colleen Hoy, director of the NTC's We Build Tech platform. "In Nashville, tech growth is tremendous within the entrepreneur community and in industries like health care IT across the state."

A big part of the NTC's mission is to connect business, tech professionals, and educators.

"Our role is to build a bridge between education and business," Hoy said. "With MTSU being one of the pre-eminent universities, [all parties] need to know what opportunities are here."

MTSU is most certainly right in the thick of the action, enjoying and building on its connections with local and national employers and organizations such as the NTC. Just a few examples of the varied places MTSU Computer Science graduates have recently launched careers in Nashville include Dell, Gibson Guitar, Passport Health, and Vanderbilt. MTSU Computer Science grads have also recently landed tech jobs nationally at name-brand employers ranging from Google to Microsoft to Oak Ridge National Laboratory.

"They come out with a lot of passion," Hefley said of his own MTSU hires. "Throw a problem at them, and they figure it out."

That "get-it-done" attitude, Henderson said, is a primary reason MTSU graduates get hired in the first place.

"It's a joy to work with them," she said, adding "Today's graduates are in a really good spot. . . . There's a different level of energy in the Nashville area."

Cracking the Code

So how does a student prepare themselves for a role in Nashville's burgeoning tech sector? For MTSU undergraduates eyeing such future employment, an abundance of preprofessional opportunities await them on the MTSU campus.

Nowhere is such real-world, problem-solving more evident than at the University's annual "hack-a-thon," an intense, caffeine-fueled few days of coding and working in teams to create apps, websites, games, or other tech developments. (The word "hack," better known for its negative computing definition, actually means to intensely write code.)

Members of the Hack MT Gold Motherboard Award-winning team "Star Jam" are shown with the plaque they received during awards' presentations at the conclusion of the first-time event Jan. 31 in the MTSU Science Building. Team members include Mitch Hauge, Steven Sheffey, Stephen Kinser, Milan Zanussi, Luke Stanley, Michael Murphy, Deeksha Adiani, Zach Yarid and David Chen.

(continued from page 5)

In partnership with Hack Tennessee, whose founders have hosted more than 20 hack-a-thons locally, MTSU's Computer Science Department held its first, highly successful Hack MT in January 2016. Sponsored in part by (appropriately enough) LeanKit and mentored by professionals including Hefley and Henderson, the event involved about 200 computer science students alongside MTSU professors and mentors collaborating (read: creating) for 36 consecutive hours. In the end, 16 projects made it to the presentation-judging phase.

Among the creative accomplishments were a travel app and MTSU tutoring and food service apps. The "Hey, Waiter!" one can provide users with estimated wait times for meals at MT Dining/Aramark venues on campus. MTSU-based Star Jam team members earned the Gold Motherboard Award. The My Myo team, which included students from MTSU and other universities, earned the silver for creating a sensor for a gesture-control armband. A University of Tennessee–Knoxville student team named Mooch captured the judges' bronze award.

"It absolutely exceeded any expectations I had," Henderson said. "To see the energy level, the number of students who stayed, and the sponsors' involvement, it was a positive event and great for the computer science community."

"I was astounded by all of them," said Chrisila Pettey, chair of MTSU's Department of Computer Science. "It was amazing the work they did. Projects were all so different and all so creative. . . . It's about quickly learning, being adaptable, and working in teams. A hack helps build all those things."

Just like in the real world, a team of co-workers must be able to listen and learn from each other. "At a hack, you work quickly, in teams, and may have to ask for help," Hefley said. "It's just a great microcosm of everyday life as a developer."

LeanKit's satisfaction with the event is evidenced by the fact that the company will be back on campus in February 2017 as a returning sponsor of the second annual Hack MT (see sidebar "Back to Hack" for more information.).

"Why would we go to a headhunter and spend $15,000 when we can sponsor a hack and meet the talent ourselves," Hefley said. "The people who self-select to spend a weekend doing this, to lock up and write code—we want to meet them."

Computer Science master's student Michael Murphy was among the talent Hefley was able to meet at the first event.

Murphy said he enjoyed MTSU's inaugural hack-a-thon so much that he intends to return for the second annual event even though he will no longer be an MTSU student. "There's no pressure but self-pressure," he said. "[It's] friendly, encouraging, where the whole community is about helpfulness and support."

In the Pipeline

The hack-a-thon weekend, though, is just one way MTSU grows students' skills and connections in the tech space. "We care about our students and try to provide many opportunities," Pettey said.

Along with fielding the stream of queries from companies, MTSU brings potential employers to campus. About 20 companies came to campus in fall 2015 for the IT Connect Fair, attended by 200 students. The University planned to bring in additional companies this fall (among those firms were representatives of Genesco, Digital Reasoning, and Nissan). Companies present on a topic and stay available to talk with students. Google officials travel to MTSU at least once a year to do presentations and activities with students.

"I remember the visits from businesses," Hefley said of his time at MTSU. "Those made a big impression on me."

Perfectly complimenting MTSU's Computer Science Department in the College of Basic and Applied Sciences

is the Computer Information Systems Department in the Jones College of Business. Each graduates about 150 students every year. Combined, the two departments have about 400 undergrads. (Basic and Applied Sciences also boasts a top-notch M.S. program in Computer Science and a Computational Sciences Ph.D. program.)

"Both of our departments are doing great things and creating two types of IT professionals," said Charles Apigian, chair of Computer Information Systems. "Employers are looking for both information systems and computer science."

Indeed, employers are looking. And MTSU has built a trust with companies who routinely call for job candidates. "There is a continual stream of people asking me for students/alums to apply for internships and positions," Pettey said.

Apigian agreed. "HCA might call and say 'Hey, I need four candidates or interns.' I feel so strongly about some of our students that I will urge them to take an internship. Many times, that becomes a job," he said.

"We've created trust that our grads are ready," Apigian added. "Our students have certain characteristics employers love. They're not entitled. They're hard-working and willing to work on their own."

Case in Point

Henderson was one such grad. After a professor noticed her talent in math, she switched her major. But a required Computer Science class would be the real game-changer for her. "Computer Science changed my life," she said. "I thought, 'People get paid to do this?"

Henderson co-founded Firefly Logic in 2004. The company grew to be one of the Nashville area's hottest software programming companies, boasting clients that included Microsoft, Travelocity, and the Country Music Association prior to LeanKit's acquisition.

Henderson's passion to tell others about the opportunities in computer science stems from her time at MTSU where she said she jumped on every opportunity professors presented to her. Time evidently hasn't changed her "seize the day" mentality. Henderson, now LeanKit's director of organizational development, currently serves on the board at NTC and advises on curriculum at MTSU along with Hefley.

"They want success for all of their students," she said of the MTSU Computer Science faculty. "That's the culture. They really work to encourage. It meant a lot for them to say to me, 'You can do this.' MTSU gave me the foundation, the core principals. It taught me how to learn."

And by being taught how to learn, MTSU students in the Computer Science program are well-prepared to complete the work Nashville so desperately needs.

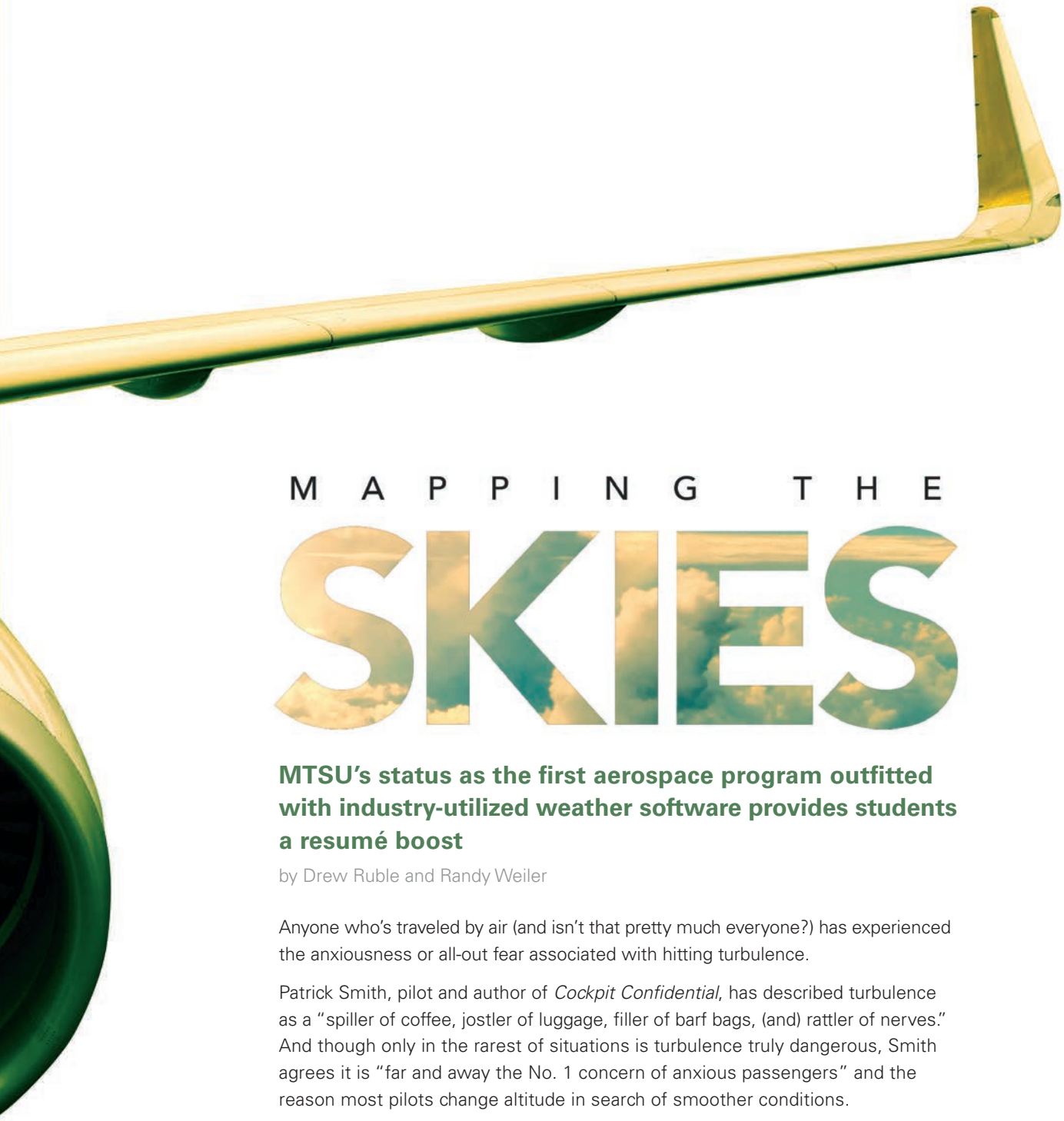
Back to Hack

In 2017, Hack MT will once again be hosted by the MTSU Computer Science Department. In collaboration with Hack Tennessee and TN STEM Innovation Network, Hack MT will be held at MTSU's $147 million Science Building on Feb. 3–5.

The purpose of the event is to gather software developers, visual designers, programmers, and computer science students from local universities and form teams to invent new web platforms, mobile apps, and electronic gadgets during 36 high-intensity, uninterrupted hours. Hack MT will facilitate networking between students and business partners and support the businesses' mission of attracting and retaining new talent to our region.

The success of Hack MT relies on the philanthropy of the College of Basic and Applied Sciences community. To partner with CBAS by becoming a sponsor of this exciting event, call 615-898-5003. Contributions are tax-deductible through the MTSU Foundation.

MTSU Hack MT participants share the results of their projects with judges and others attending the three-day, 36-hour event in the Science Building.



MAPPING THE SKIES

MTSU's status as the first aerospace program outfitted with industry-utilized weather software provides students a resumé boost

by Drew Ruble and Randy Weiler

Anyone who's traveled by air (and isn't that pretty much everyone?) has experienced the anxiousness or all-out fear associated with hitting turbulence.

Patrick Smith, pilot and author of *Cockpit Confidential*, has described turbulence as a "spiller of coffee, jostler of luggage, filler of barf bags, (and) rattler of nerves." And though only in the rarest of situations is turbulence truly dangerous, Smith agrees it is "far and away the No. 1 concern of anxious passengers" and the reason most pilots change altitude in search of smoother conditions.

(continued from page 9)

"The pilots aren't worried about the wings falling off," Smith concludes. "They're trying to keep their customers relaxed and everybody's coffee where it belongs."

According to publicly traded Gogo Business Aviation, turbulence incidents cost airlines around $100 million annually due to crew and passenger injuries, unscheduled maintenance, and operational inefficiencies, as well as revenue lost while planes are out of service. Other studies have revealed that aircraft encounters with turbulence are the main cause of non-fatal injuries in the commercial airline industry. (A summer 2016 Jet Blue flight that experienced strong turbulence even sent more than 20 passengers and two crew members to the hospital and attracted national headlines.)

As a result of a recent corporate gift, MTSU's Aerospace students now have access to an industry-utilized aviation operations management solution, WSI Fusion, in their simulation lab. Weather plays a critical role in aviation, and this state-of-the-art software will better prepare and equip MTSU students for their future careers in aviation. WSI stores information from all Southwest Airlines flights, meaning MTSU professors can use information from these flights—such as weather patterns, altitude, and detours—to implement different training scenarios that wouldn't be possible without the technology.

WSI Fusion is the industry's most advanced, proactive flight monitoring application that fuses public and proprietary weather information with real-time flight and airspace data into one common view and then facilitates timely communication directly with aircrafts. It is designed to integrate with existing systems so dispatch, operations, and management can stay aware—and ahead of—changing conditions, as well as mitigate the impact of disruptive events. All of this allows users to leverage big data and feel more confident about operational decision-making. (And, yes, though less significant than other functions, spot turbulence ahead and notify pilots how to avoid it.) The software is utilized at a large number of airports nationwide.

The gift makes MTSU the first educational institution with the capability to use this product, allowing students to graduate with a distinct competitive advantage not offered at other aviation schools, officials said.

"Before we received this, we had to use whatever weather would occur on that day. Now with this captured weather, we can run them through thunderstorms, severe wind, and other different scenarios," said associate professor Andrea Georgiou, who helped the department secure the product. "The industry is beginning to find out about this and they love it. Now when employers see MTSU NASA FOCUS Lab on resumes, our students are getting more jobs and internships, and their careers are advancing quicker."

"Exposure to this product during their capstone experience will be a significant advantage to all Aerospace students as they begin their professional careers," added Wendy Beckman, department chair. "Our Flight Dispatch students in particular will benefit from familiarity with the software package as they apply for jobs. . . . We are very appreciative of Southwest Airlines and The Weather Company for allowing our students this opportunity."

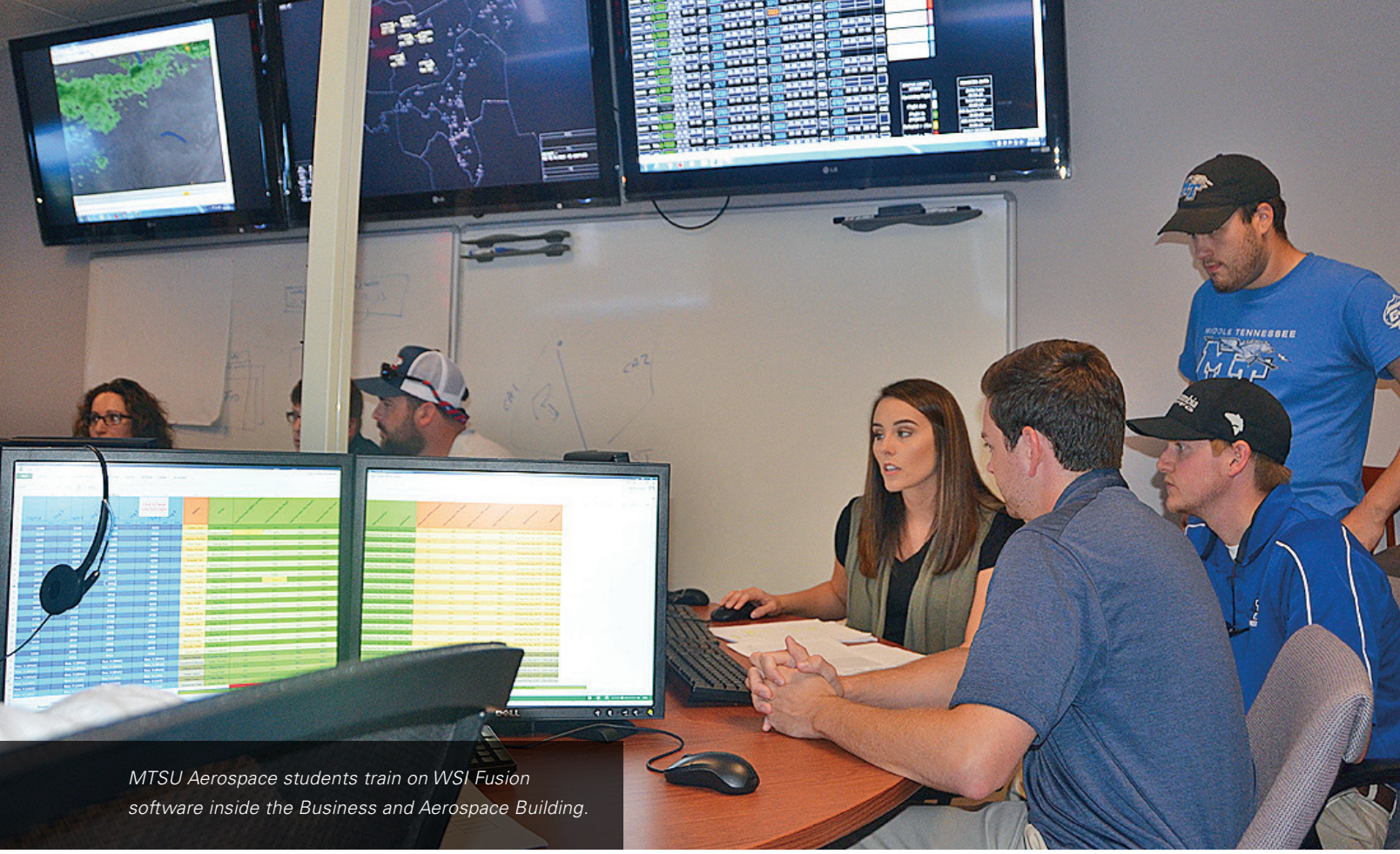
Gift That Keeps on Giving

The College of Basic and Applied Sciences' Aerospace Department secured the donation of WSI Fusion from The Weather Company, an IBM Business, through an ongoing partnership with Southwest Airlines. Southwest Airlines is also a sponsor of MTSU's NASA Flight Operations Center–Unified Simulation Lab (FOCUS), which trains students in real-life scenarios and provides a unique opportunity for seniors to learn how to work in teams to safely and efficiently run a virtual airline. The NASA FOCUS Lab stemmed from a 2010 grant obtained by professor Paul Craig.

The gift makes MTSU the first educational institution with the capability to use this product . . .

MTSU alumni with ties to Southwest attending an on-campus event honoring the gift included Capt. Ken Hamilton ('92, '93), Larry Schadle ('92, '93), and Whitney Dix ('99), all of whom helped secure the software contribution and have roles with the MTSU-Southwest relationship. Dix became the first MTSU student to graduate with a degree in the Flight Dispatch concentration.

Back in 2015, Georgiou attended a five-week dispatch training session offered by Southwest. Establishing a rapport with Southwest officials, Georgiou invited them to visit MTSU's facilities.



MTSU Aerospace students train on WSI Fusion software inside the Business and Aerospace Building.

"They came and saw the FOCUS lab and were really impressed with it," she said. "They saw a platform (with weather) and wanted to improve the lab."

As part of the lab, students from all six Aerospace concentrations must work together to solve issues as they arise during their shift. To ensure the highest level of realism, Aerospace and Psychology faculty and graduate and undergraduate students monitor the simulations, implement real-world problems and disruptions, and conduct debriefings.

Georgiou and student Evan Lester, who graduated in May 2016 but returned as a graduate student, visited Southwest Airlines this past summer for software training. Lester oversees the NASA FOCUS Lab. The Weather Company and Southwest officials are slated to return to campus to view the product in use.

Icing on the Cake

The new software is just one of the latest new developments in the Aerospace Department that continues to solidify MTSU's international reputation as one of the finest places in the world to study flight.

A first-of-its-kind, state-of-the-art, $3.4 million, 360-degree, seamless air traffic control tower flight simulator unveiled in recent years placed MTSU in the pilot's seat in the development of next-generation controllers. The simulator—of a size and scope unlike anything else in place at recognizable flight schools like Embry-Riddle—is a crown jewel of MTSU's now six-decade-old Aerospace program. Even the Federal Aviation Administration's top simulator boasts only a 270-degree screen that is not seamless.

The department's cutting-edge Unmanned Aircraft Systems program offers even more proof of MTSU's commitment to one of its signature and reputational programs. From search-and-rescue operations to public utilities monitoring to archeological mapping, there's a burgeoning job market on the horizon, and MTSU is already preparing students to fill those positions through the newly launched bachelor's degree in UAS Operations, currently one of only five such programs in the nation.

Together with this latest gift of weather software, the program boasts the kind of foresight that people have come to expect from MT Aerospace, a department that always has its eye on the horizon.

A HERD MENTALITY

One professor's efforts in cattle husbandry yield medical advances for humans as well

by Allison Gorman

Dr. Warren Gill has spent his career using farmer's instincts and academic detective work to keep Tennessee's cattle healthy.

It was Gill who, in the early 2000s, got to the bottom of a mysterious illness that had been plaguing Tennessee-bred calves. Then a member of the University of Tennessee's agriculture faculty, he linked the affected herds' rough coats to a copper deficiency. When he tested their forage, the results were puzzling: it was low in copper, but also extraordinarily high in sulfur.

"I had to draw on my old chemistry background," he recalled. "Sulfur and copper combine, particularly in the presence of molybdenum, to make an insoluble compound. . . . Sure enough, we had a serious high sulfur problem that was manifesting itself in a copper deficiency."

After four years spent gathering samples throughout Tennessee and into Kentucky, Gill identified the culprit: coal-burning power plants.

Years later, that discovery would lead Gill to an improbable partnership with a geneticist from the Vanderbilt University School of Medicine. Now their work together has taken on new dimensions—global, human, and life-saving. And it's all part of their effort to build a better cow.

A Skin-Deep Solution

Fixing copper deficiency in cows is relatively easy, Gill said; you adjust their mineral supplements. What isn't easy is getting liver samples from cows to test for copper deficiency. For years, however, that was the only good option.

The problem was solved and a research partnership born in 2012, when Gill—who by then had joined MTSU's School of Agribusiness and Agriscience—met Dr. James West, a Vanderbilt specialist in gene editing. Together they developed a skin test for copper deficiency using blood, skin, and liver samples from affected cows.

(continued from page 13)

While gene testing had been used to identify parentage and some diseases in cows, Gill said, "nobody [had] ever come out with a nutritional gene test. We hope that it will be very widely used. It's very much needed."

When Gill and West collaborated again, they were focused on a far greater need.

It was 2013, and Gill had just attended a conference where ranchers and farmers discussed the challenges of developing livestock that could withstand the scorching temperatures typical of so many of the world's impoverished regions. The Brahman cattle raised there are inefficient breeders and grazers relative to the amount and quality of the beef they produce; however, they're heat-tolerant, with short, white coats.

Angus cows, bred for cooler climates, are the opposite in every way, down to their tender, abundant beef and double layers of long, black hair.

What we need, Gill thought, is a short-haired, white Angus . . . Gill floated the idea to West, who signed off on it.

What we need, Gill thought, is a short-haired, white Angus. But with the global population estimated to hit 9.6 billion by 2050—up 38 percent from 2010—conventional genetics would take too long. Perhaps West could use genetic material from various cattle breeds to create "overnight" what otherwise would have taken decades.

Gill floated the idea to West, who signed off on it.

By November 2015, the first fertilized white Angus eggs were ready for transfer to their bovine incubators. They share traits of three breeds: the Angus; the Silver Galloway, a heritage breed with darker skin and long, white hair; and the Senepol, a slick-coated breed famous for its heat tolerance.

"When Dr. West looks at these genes, he knows what's in there," he said.

Meanwhile, the researchers are incubating a new business, Ag Genetics, which will market the technology—such as the copper deficiency test—for which MTSU and Vanderbilt hold the patents.

Following the Research Where it Leads

The collaboration has also taken a new turn and gained a new ally. This latest development is focused not on the product, but on the process of Gill and West's research, and that process may have promising implications for some cancer patients.

To gather the genetic material for the white Angus, Gill harvested testicular stem cells that West then strengthened in his lab. Debra Friedman, M.D., associate professor of pediatrics at Vanderbilt, said a similar process could be used to reverse sterility in male cancer patients—a frequent side effect of chemo and radiation.

Ultimately, she said, "this [research] could lead to interventions for male children and adolescents where sperm stem cells could be drawn through needle biopsy before treatment, expanded in culture, and then reintroduced after treatment, ameliorating the sterility conferred by the treatment."

Friedman is now working with West and Gill on that application, one the men hadn't anticipated. West notes that they used testicular stem cells simply because it seemed a cost-effective option. "It's hard to predict the direction research will take until you follow it to the end," he said.

That journey is one Gill has gone all in for, even stepping down as director of MTSU's School of Agribusiness and Agriscience (and later retiring), in order to have more time to pursue this life-saving research. What began as an inquiry into nutrition deficiencies in cattle has rapidly expanded into a multi-faceted research project, a new business, and, possibly, a new breed of bovine. With so much potential, there's no end in sight.

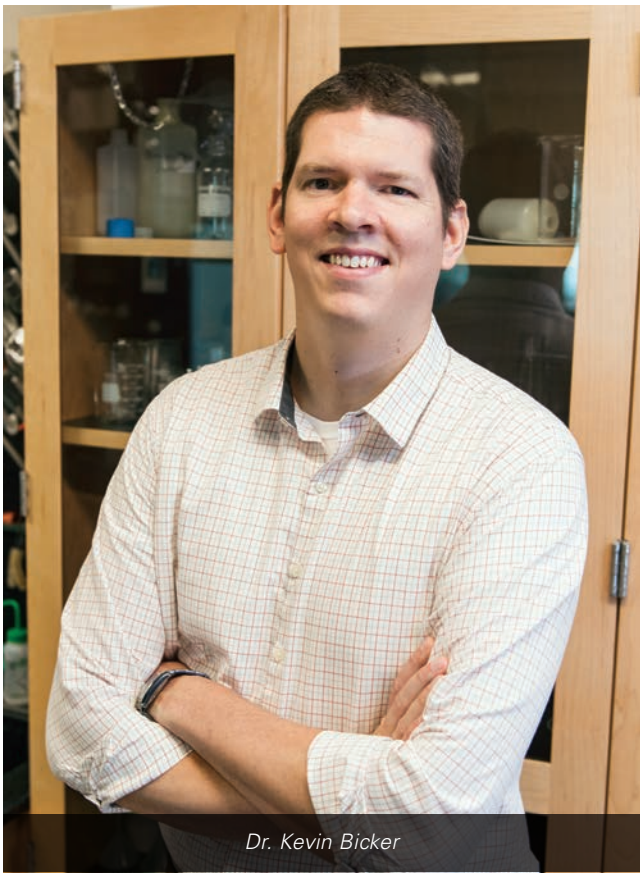
Research for Answers

Warren Gill is by no means the only MTSU professor working on research with the potential to make a lasting impact on the world as we know it. The following pages offer just a glimpse into the research of three other Basic and Applied Sciences faculty members chasing new discoveries.

(continued on page 16)

Dr. Warren Gill

(continued from page 14)



Dr. Kevin Bicker

Chasing a Cure

Kevin Bicker uses a volume approach in the fight against breast cancer

Focused in the area of drug discovery, Kevin Bicker's current research targets a receptor (called a leptin receptor) that has been shown to be "over expressed" on triple negative breast cancer, a truly aggressive, difficult-to-treat cancer that's generally nonresponsive to the traditional breast cancer therapies.

Current research has revealed that signaling through this receptor leads to an "intracellular cascade," causing all sorts of terrible things you don't want—like angiogenesis. Bicker is searching to find a drug that blocks the hormone from binding and then prevents all these downstream signals. The therapeutics he is most interested in are peptoids, which are a mimic of peptides. But, whereas most peptides have a half-life on the order of 10 to 20 minutes in the body, peptoids can last for hours and hours.

One way Bicker is trying to identify antagonists is using combinatorial libraries. This is a synthetic technique that allows him to generate 100,000 compounds in a matter of a couple of days. Then he can take those compounds and run them through a screen to identify the best binders of this receptor. Once he has identified those binders, he figures out what the sequence is, resynthesizes, and then does some more traditional tests.

Bicker also is working to develop new antimicrobial agents (he has some funding for this from the National Institutes of Health) in an effort to battle multidrug-resistant bacterial infections, which are increasingly occurring in clinical settings, creating life-threatening infections for patients already dealing with other conditions. With his students, he has published this work in *ACS Combinatorial Science* and holds two patents, including one regarding a peptoid effective against a deadly fungal pathogen.

Decoding the Virus

Joshua Phillips employs big data to aid big pharma

Joshua Phillips' research revolves around machine learning and computational structural biology, using algorithms to extract interesting features or to summarize data and statistical analysis from large data sets.

In that vein, he does a lot of modeling and simulation work with proteins, DNA, and RNA—molecular interactions—building models and trying to understand these interactions.

Among the wide array of projects he has worked on (mostly in collaboration with the Los Alamos National Laboratory) are HIV vaccine designs. "We want to get our bodies to generate antibodies to pull out a virus and we inject certain protein targets, proteins that are part of the virus, so that your body can start to identify parts of the virus before it's exposed to the real thing," Phillips explained. "But picking out the particular proteins to use can be challenging. . . . So we're trying to understand how different types of environmental factors can affect the interactions between antibodies and proteins or just between proteins and proteins."

Among the wide array of projects he has worked on . . . are HIV vaccine designs.

Phillips also researches how to engineer enzymes to better perform their functions. So, for instance, he is searching for a way to degrade nerve agents used in chemical warfare.

(continued on page 18)

Dr. Joshua Phillips

(continued from page 16)

Phillips additionally is researching protein-intrinsic disorders. A lot of proteins function in a completely disordered nature and don't form the kind of nice, neat structures we're used to seeing in textbooks. Again, by applying machine learning and simulation approaches, Phillips attempts to understand their relationships to each other, what makes them similar or dissimilar, and to classify them.

Lastly, Phillips studies neural networks and selective attention, using machine learning to understand how the brain works.

AI, Robotics

Sal Barbosa's research in artificial intelligence aims to help machines think on the fly

Sal Barbosa works primarily in the area of applied artificial intelligence (AI). He aims to infuse AI and learning algorithms into areas that have not previously made extensive use of AI. Among these are characters in simulations and games, as well as small unmanned aircraft systems (UAS).

"Synthetic role players" is one of Barbosa's research interests.

"It's expensive to train human teams, and often we gather an entire crew to train a single individual," he said. "Can such role players be realistically represented by computers? This is an opportunity for AI techniques like natural language processing, knowledge representation, and computer vision. When these methods are augmented by machine learning, sophisticated and non-scripted role players for simulation training become possible."

These programs may enable detection of someone waving for help in an otherwise unremarkable area of the video.

Inexpensive UAS often lack onboard computers, and computation is restricted to the microcontroller manipulating the aircraft's flight. As such, they can be non-adaptive, with no re-planning ability. Barbosa's research seeks to answer the question of whether computers running machine learning and planning algorithms might equip them with greater flexibility in accomplishing their missions.

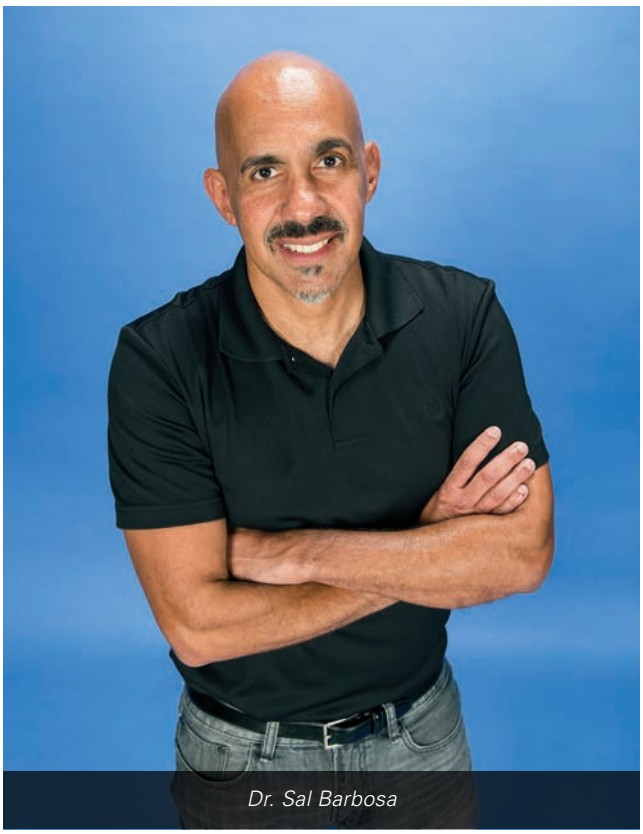
An example application is small UAS searching for survivors during a flood. Usually the UAS cameras are remotely controlled by operators visually looking at video for signs of survivors. In a chaotic environment, they may miss signs of human distress. With onboard computation for motion detection and image processing, Barbosa believes that these programs may enable detection of someone waving for help in an otherwise unremarkable area of the video, and alert the operator.

It's expensive to train human teams, and often we gather an entire crew to train a single individual.

Another use is in precision agriculture.

"If we're able to use machine learning and computer vision to detect an infestation of some sort, we can reroute the system for a closer look or to similar areas without having to wait for the next flight," he said.

Barbosa is also establishing a simulation, gaming, and virtual reality lab to engage students in research. "I've already had many students express interest and look forward to getting the lab going," he said.



Dr. Sal Barbosa

MTSUNEWS.COM TRUE BLUE NEWS ANY TIME

Stay up to date all year round

CHEMISTRY CAREER FAIR

Dozens of MTSU Chemistry and preprofessional students in medical fields learned about opportunities they can explore with companies and colleges during the Chemistry Career Fair Sept. 29. The event was held in the Liz and Creighton Rhea Atrium in the Science Building and attracted nearly a dozen companies and about 20 colleges. Companies represented included *The Princeton Review*, recruiters from the U.S. Army and Navy, Eastman Chemical, Vi-Jon, Aegis Sciences, and the Tennessee Bureau of Investigation.

mtsunews.com/2016-chemistry-career-fair

INNOVATION NETWORK PICKS MTSU

The Tennessee STEM Innovation Network and Battelle Education formally announced that MTSU's Tennessee STEM Education Center would guide the work of the Middle Tennessee STEM Innovation Hub, moving it from Belmont University. The STEM hub provides a valuable exchange network of ideas and resources for K–12 schools, colleges and universities, and network partners to serve the STEM needs in the midstate, which is comprised of 25 to 30 counties and approximately 50 school districts.

mtsunews.com/tennessee-stem-innovation-network-hub-fall2016

DISTINGUISHED ALUMNI

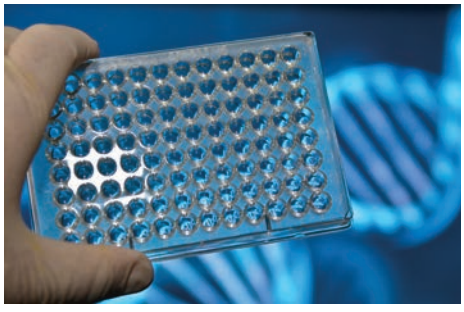
Each year, the MTSU Alumni Association recognizes outstanding alumni who represent excellence and distinction through their professional careers. This year's Distinguished Alumni Award winner was Jeff Creek, a highly acclaimed petroleum chemistry expert. This year's Young Alumna Award, given to a younger graduate making a positive impact in the world, went to Bobbie Jo Meredith, a key figure with Schneider Electric and in recruiting girls and young women to the STEM (science, technology, engineering, and mathematics) fields.

mtsunews.com/2016-17-distinguished-alumni

STAR PARTIES

Lecturer Rob Mahurin discussed "Gravity Waves," which are ripples in the fabric of spacetime, during the Oct. 7 MTSU First Friday Star Party, a free event that is open to the public and campus community and where children are welcome. MTSU's Department of Physics and Astronomy presents the First Friday Star Parties to bring the MTSU, Murfreesboro, and surrounding communities together. Each event features a special lecture followed by telescope viewing at the MTSU Observatory, weather permitting.

mtsunews.com/oct-7-star-party



A CENTER OF ATTRACTION

Though a relatively new program, MTSU's Forensic Science program, housed in the Department of Biology, has already made a name for itself, attracting a diverse group of degree seekers. For MTSU undergraduate Jillian Bower, the program is the key to becoming a DNA analyst. "MTSU provides the scholarly investment, instrumental resources, and tangible experience that I need to emerge competent on the professional level," Bower said.

mtsu.edu/programs/forensic-science

ENGINE GIFT

MTSU Aerospace Maintenance Management program students will be taking their training to new heights thanks to Southwest Airlines' generous donation of a turbofan airplane engine. Alumnus Chad Rhyne, who works for Southwest, facilitated the gift of the 4,300-pound CFM56 engine, which was used on flying aircraft. It has an estimated market value of $100,000, though such engines can cost millions of dollars brand new.

mtsunews.com/southwest-turbofan-donation-2016

Basic Highlights

A look at recent awards, events, and accomplishments in CBAS

A+ Science Project

With the recent completion of $167 million in new and renovated science facilities, the College of Basic and Applied Sciences celebrated the opening of MTSU's new **Science Corridor of Innovation** (or SCI) this winter. With the 2014 completion of MTSU's new $147 million Science Building and the fall 2016 completion of $20 million in renovations to MTSU's pre-existing science facilities—Davis Science Building and Wiser-Patten Science Hall—the University now boasts some of the finest combined science facilities in the South. A true campus-within-a-campus, this complex is already helping MTSU prepare more teachers for math and science in K–12 schools, creating additional science graduates to fill high-technology jobs, and enhancing the economy of the region and state. The physical improvements will also make MTSU more competitive for research projects, science scholarship, and entrepreneurial efforts. State funds from the original Science Building project were allocated for the renovation project.

Aerospace

Up, Up, and **Away**

MTSU students are the beneficiaries of a new $700,000 Department of Aerospace Flight Simulator Building dedicated in May 2016 at the Murfreesboro Municipal Airport. The 3,600-gross-square-foot metal facility houses four flight simulators at MTSU's Flight Operations Center. Other features include a classroom, six briefing rooms, and infrastructure to support spaces. The profile of the building's roof is inspired by that of an aircraft wing. The simulators are used by all Professional Pilot students, from early training through their transition to turbine-powered aircraft.

Global Reach

Organizers of a Chinese college opening in the fall of 2016 to help the country meet its demand for aerospace professionals approached MTSU in July 2016 to form one of its first foreign partnerships. Jiangsu Aviation Technical College in China's Jiangsu province hopes to link with MTSU for expertise in air traffic control and aircraft maintenance education. China's central government is expected to open general aviation space to private enterprise, which will create a demand for aerospace facilities. Jiangsu officials anticipate as many as 500 airports will be built in the next five years—and more than 3,000 will open within 10 years.

Agribusiness/Agriscience

By Land and Air

A $714,000 U.S. Department of Agriculture grant to MTSU for collaborative research with two Texas universities will support a partnership to discover novel ways for land management to solve important ecological problems regarding changing climates and agricultural management. The three-year joint venture between MTSU, Texas A&M, and Sam Houston State University is the largest USDA grant the MTSU School of Agribusiness and Agriscience has ever received and largest of 12 national competitive awards granted by the USDA in February 2016. The award is for precision agriculture, agroecological education, and research. Song Cui, assistant professor in Agribusiness and Agriscience, will oversee the overall research and educational components of the project and coordinate with the other partner institutions. The award was made in part due to the combined strength in agriculture, aerospace, and math between MTSU and its strong partners. That combination has MTSU poised to become a leader in the study of precision agriculture, which is the science of using computer information systems, sensors, geographic information systems, and global position system technologies to enable producers to apply the right inputs at the right location at the right time and in the right quantity and right manner.

(continued from page 21)

Not **Horsing Around**

MTSU's Equestrian Team, led by Coach Anne Brzezicki, was named the 2016 Regional High Point Team in the Western Division in a hotly contested season over teams from Murray State University, the University of Tennessee–Knoxville, Western Kentucky University, and Tennessee Tech University, securing a slot in the Intercollegiate Horse Shows Association Western Semi-Finals. In addition, six MTSU riders qualified for individual slots at the semifinals, which were held in three sites across the country March 19–20. MTSU hosted one semifinal at the Miller Coliseum in March.

Dr. Robert "Bob" Garrigus

In **Memorium**

Dr. Robert "Bob" Garrigus, a retired MTSU faculty member who is fondly remembered for the many livestock-judging teams he coached, died on Feb. 28, 2016, at the age of 79. He taught at Purdue University for five years and then in 1967 began a 34-year teaching career at MTSU, retiring in 2001. In 1973, he was given the Outstanding Teacher award. In 1988, he was recognized by the American Polled Herford Association and honored for his outstanding youth work. The Tennessee House of Representatives and Senate also recognized him for his meritorious service to the citizens of the State of Tennessee. Most recently, he was honored by MTSU through the establishment of the Robert Garrigus Scholarship Endowment Fund. In January 2016, MTSU alumnus and retired U.S. Army Gen. Les Fuller ('73) organized an alumni and friends' effort in Fayetteville, generating nearly $27,000 in funds and pledges for the scholarship for students in the School of Agribusiness and Agriscience.

Biology

Giving Back

Alumnus John Hurt's unique donations of geodesic domes to the MTSU Aerospace and Biology departments will aid unmanned aircraft systems and spider research for students and faculty. Hurt ('82) owns Buffalo Valley-based Zip Tie Domes, which makes 10- to 25-foot structures primarily used for chicken coops and greenhouses. A Pre-Law and Political Science major while attending MTSU, Hurt received a U.S. patent for his geodesic dome kits in 2013 and later patents from New Zealand, Australia, and the United Kingdom. "I just wanted to help," Hurt said of his donation. Aerospace's Unmanned Aircraft Systems program will utilize the dome for testing and evaluation purposes in an enclosed environment. Biology professor Ryan Otter will use the domes as artificial habitats in field work related to the December 2008 Kingston, Tennessee, coal ash spill. In Otter's lab, he works with spiders that live at the edges of rivers and lakes. "With these domes, we are hoping to build artificial habitats that spiders will use, so we improve our collection efficiency," he said.

Game **Changer**

MTSU and Tennessee Tech student and faculty researchers discovered two new species of bacteria found in a cooling tower and hot tub in Putnam County. The discovery may provide clues to new pathways of disease and treatment, said the lead scientists, whose nearly 20-year research endeavor has been published in *Genome Announcements* (January 2016) and the *International Journal of Systematic Microbiology* (February 2016). Including nearly $1 million in U.S. Environmental Protection Agency grant funding, MTSU and Tennessee Tech researchers and students used a variety of microscopic and genomic techniques to describe these organisms, which have been named "Candidatus Berkiella aquae" and "Candidatus Berkiella cookevillensis." MTSU professor Mary Farone named them in honor of the city of Cookeville, where the cooling tower and hot tub were located, and for Sharon Berk, a Tennessee Tech researcher for 27 years, who is now an MTSU senior scientist writing grant proposals for research for the Office of Research and Sponsored Programs. Through the years, more than a dozen MTSU graduate and undergraduate students assisted with the research in on-campus laboratories and locations where bacteria samples were collected.

Chemistry

A Banner Year

MTSU faculty and staff received 91 new awards and contracts during FY16 to support research, public service, and instructional activities. During FY16, the University had 224 active grants and contracts with a total sponsored programs portfolio value of $40,213,452. As but one example, Chengshan Wang in the Department of Chemistry earned a grant from the National Science Foundation, in the amount of $199,878, for a project titled "RUI: Determination of the orientation of 13C labeled specific residues of alpha-synuclein (61-95) in the pore structure formed on supported phospholipids bilayer by IRRAS." The central aim of this proposal is to use infrared reflection-absorption spectroscopy to evaluate the 3D structure of a protein, alpha-synuclein, that is abundant in the human brain and has been linked to Parkinson's disease. Another goal of this project is to provide a research environment for MTSU students to increase their career success in industry or admission to top graduate programs in chemistry.

Capitol **Gains**

MTSU undergraduate researchers talked about their scholarly efforts with state legislators during the 11th annual Posters at the Capitol in February 2016. The annual event gives student researchers a chance to visit with their senators and representatives, allowing the legislators to catch a glimpse of what these academic achievers are pursuing. Daniel Cunefare, Lauren Heusinkveld, Alesha Hicks, Sam Hulsey, Trang Huynh, Mary Poss, Nausheen Qureshi (pictured below), Kelly Saine, and Ryan Tilluck represented MTSU. Their research included Cunefare's low-cost sensing and diagnostic system to continuously monitor the recovery process of heart-failure patients, Hulsey's comparisons of climate change affecting water resources in northern Peru's mountainous regions, Huynh's assessment of traditional Chinese medicine herbal extracts' potential to inhibit herpes simplex virus type 1, and Poss' study of an effective way to rehabilitate a deteriorating Dominican Republic coral reef system.

(continued from page 23)

Expanding Horizons

Murfreesboro native and retired astronaut Dr. Rhea Seddon served as keynote speaker at the 20th annual Expanding Your Horizons in Math and Science Conference at MTSU. More than 300 girls attended the event, which encourages them to investigate potential careers in STEM fields.

Computer Science

Champions of **Student Success**

Each year, MTSU President Sidney A. McPhee presents his President's Student Success Award, which is given to a department "to recognize innovation and proven results in helping our students succeed." The on-campus award is connected to the University's ongoing Quest for Student Success initiative to improve student retention and boost graduation rates. The 2016 winner, announced by McPhee at the fall faculty meeting, was the Department of Computer Science, which received a $20,000 recurring award for its efforts.

Students brainstorming at Hack MT in 2016.

Concrete and Construction Management

School of Rock

MTSU's Concrete Industry Management Department was the nation's first and served as the template for all similar university programs that exist nationwide. The three-decade-old department was recently merged with the Construction Management program to form a new school within the College of Basic and Applied Sciences—the MTSU School of Concrete and Construction Management. The officially merged programs now offer two degrees (B.S. in Concrete Industry Management and B.S. in Construction Management) with five concentrations to focus a student's education in an area that most interests them and fits their skills. Led by industry powerhouse Heather Brown, the school currently enrolls 300 students with plans to increase to 500 over the next five years. MTSU is the only university in the state offering programs in this area under a stand-alone school. MTSU's goal is to be mentioned in the same conversation with schools like Auburn, North Carolina State, Purdue, and Mississippi State, all of which have excellent construction programs. The new school is proud to have a robust recruiting program to help students connect with internships and full-time careers. Student labs allow for a realistic educational environment with a lot of hands-on learning experiences and opportunities to work with faculty on research projects. The strong ties to industry give students unique opportunities including travel to conferences, field trips to job sites, guest lecturers, involvement in research, and a huge network of alumni to help mentor students in the industry. In addition, CCM has an online graduate M.B.A. program with an emphasis in concrete.

Engineering Technology

One Giant Step for MTSU

The MTSU Experimental Vehicles Program's lunar rover team members used a new airless tire design and parts assembly to land a top-10 finish at the 2016 NASA Human Exploration Rover Challenge. Motivated by a competition rules change regarding tires, recent MTSU graduate Thomas Kenney's design and the machine shop work by junior Mechatronics Engineering major Kelly Maynard and others kept the MTSU entry among the elite in the international field competing April 8-9 in Huntsville, Alabama, after a best-in-U.S. and third-place overall finish in 2015. The event is held annually for university and high school teams to encourage research and development of new technology for future mission planning and crewed space missions to other worlds.

Leading Edge

MTSU's Department of Engineering Technology began a Mechatronics Engineering degree program nearly three years ago. During the MTSU's May 2016 commencement ceremony, 13 seniors became the first MTSU mechatronics graduating class. Mechatronics is a multidisciplinary field of engineering that includes a combination of systems—mechanical, electrical, telecommunications, control, and computer engineering. The program is based on a three-level international certification program created by Siemens, a German engineering company. Program coordinator Ahad Nasab said he and the faculty are very excited about the first group to graduate. "They are very sought-after from our industry. Most of them already have jobs offered to them," Nasab said. "We have really focused on this group. They have accomplished amazing things so far."

Geosciences

Speaking **Science**

In the midst of a four-day visit to the campus she attended as an undergraduate from 2004 to 2008, Jessica Morrison shared the story of a career path that has taken her from Tennessee to Washington, D.C. Morrison, who majored in Geosciences at MTSU, spoke on campus as part of the 2016 Women in Science Lecture series, a highlight of National Women's History Month activities. Morrison is an assistant editor on government and policy for *Chemical and Engineering News*, the weekly journal of the American Chemical Society.

Hitting the **Road!**

Racha El Kadiri, who recently joined the Department of Geosciences as a full-time professor in hydrogeology and hydrology, and Warner Cribb conducted a three-day joint Mineralogy-Hydrogeology field trip to the Blue Ridge Mountains of western North Carolina. More than 40 students attended the field trip. Separately, Melissa Lobegeier held field trips throughout middle and western Tennessee for both her Historical Geology and Paleontology classes, and Jim Henry led a field trip to southeast Tennessee for his Geomorphology class. Geosciences students also attended the annual Geoconclave meeting at Fall Creek Falls State Park. Lastly, six undergraduate students participated in the national meeting of the Geological Society of America in Baltimore and worked as volunteers for both GSA and the American Institute of Professional Geologists.

(continued from page 25)

Mathematical Sciences

Play Ball!

Actuarial Science student Kim Page, an M.S. in Professional Science graduate in August 2015, won honorable mention for her research presentation on "Predictive Analytics for Minor League Baseball Pitchers" at the 50th Actuarial Research Conference held in Toronto, Canada, Aug. 6–7, 2015. MTSU is the only university in Tennessee that offers actuarial science coursework for both undergraduate and graduate degrees. The program, founded at MTSU in 1987, now has been elevated from an undergraduate concentration to a major.

Harnessing **Big Data**

In the summer of 2015, Danielle Marcella Baghernejad, a Mathematical Sciences master's student, worked with AT&T's Big Data department in Plano, Texas, to learn how to use data science to solve business problems. The volume of data in the AT&T network has grown by over 50,000 percent in the past few years, and the company now collects 30 billion data points every hour. With the company's recent merger with DirectTV, this data has grown even more, and with it comes the overwhelming need to process and analyze it. Big Data strives to leverage this data to increase operating efficiency, identify opportunities for growth, reduce environmental impact, and help the community. Baghernejad was given a unique opportunity to get involved at a very deep level within Big Data. She said it was exciting to see that her work would actually be implemented to improve existing operations. Each intern is given a unique project fitted to his or her skill set, and her project focused specifically on insight within AT&T's Unified Communications portfolio. It was reassuring to see that the analytics they performed, while complex, have their roots in the regression and programming skills she learned in school. She was able to take what she already knew and incorporate it into the business environment, most notably bridging the gap between her own skills with R and Python to work directly with the Hadoop framework. Baghernejad felt it was an amazing experience, helping her identify what she needed to focus on at school to prepare for a career in data science. Baghernejad is writing a master's thesis under the direction of Qiang Wu on the topic of "missing value imputation methods and their effects in predictive modeling with regard to improving MTSU student retention." She is applying to doctoral programs in statistics and data science.

Military Science

Changing of the Guard

Lt. Col. Jackie McDowell has been an active-duty U.S. Army Green Beret for more than a decade and was deployed five times to Iraq and Afghanistan. As of August 2015, he became professor and leader of the MTSU Department of Military Science and its ROTC program.

As McDowell entered his new Army assignment at MTSU, he and his staff received an added boost for training cadets—a six-station obstacle course, built by the Tennessee Army National Guard's 212th Engineering Company out of Paris and Camden with support from ROTC alumni, on the east side of campus adjacent to the rappelling tower. McDowell, pictured swearing in new ROTC cadets below, replaces Lt. Col. Joel Miller, who became a history professor at the U.S. Military Academy in West Point, New York, this fall.

Lt. Col. Jackie McDowell swearing in new ROTC cadets.

A New **Diagnostic**

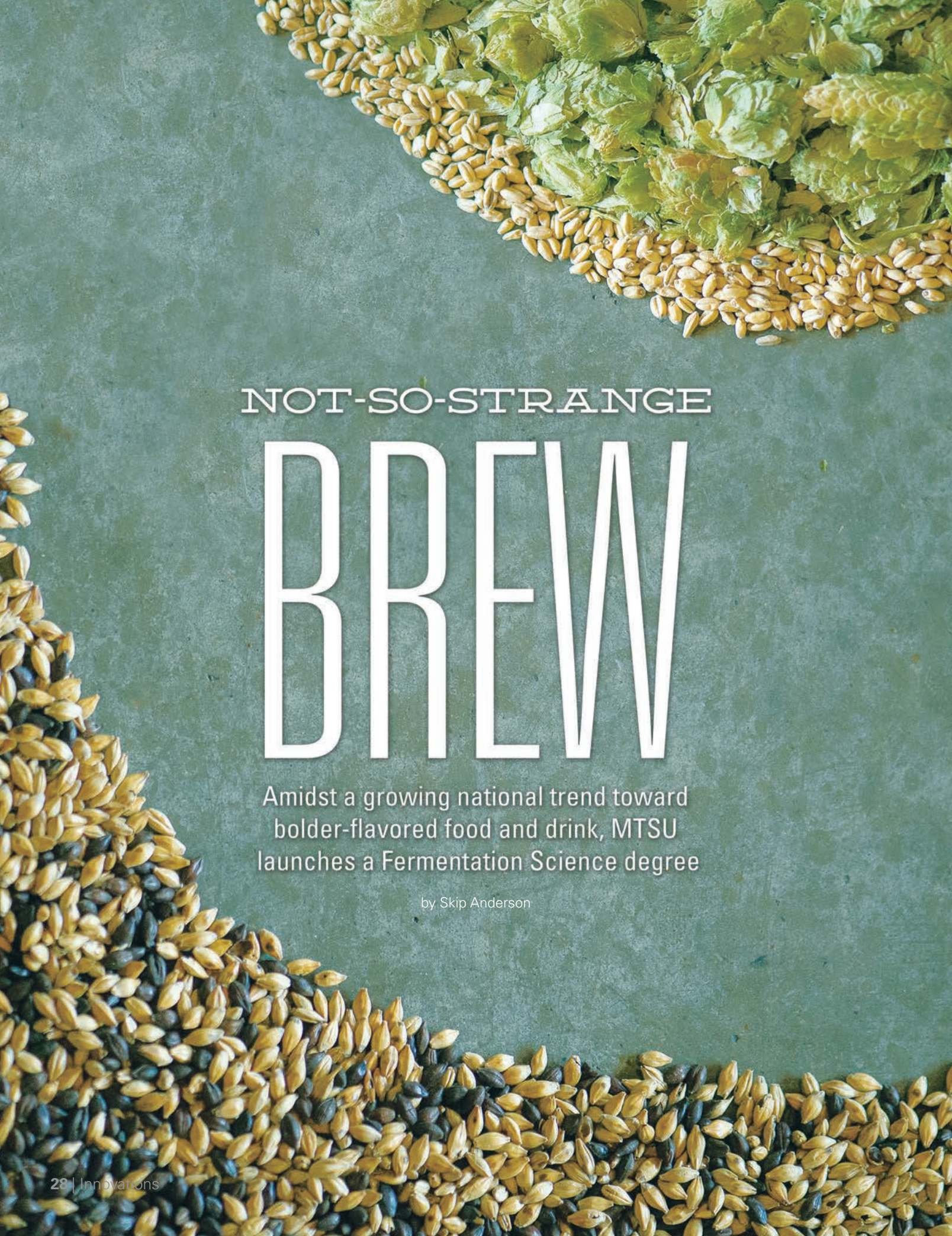
MTSU and Tecport Optics of Orlando, Florida, entered into a licensing agreement to commercialize the University's biosensor technology as a medical diagnostic tool for research labs and point-of-care health professionals. The technology, which has the capability to revolutionize medical diagnostics, was invented by MTSU professor Bill Robertson, a member of the Department of Physics and Astronomy. An interdisciplinary team from MTSU including Drs. Robertson, Steve Wright (Biology), and Andrienne Friedli (Chemistry) developed the new technology with support from the National Science Foundation and the Department of Homeland Security. "The growth of personalized medicine creates a pressing need for faster and better ways of diagnosing diseases and individual responses to pharmaceutical treatment," Robertson said. "In addition, drug discovery can be shortened when a rapid . . . more accurate way of screening for biological changes can be used in the process." Dr. Nabil El-Hag, Tecport's vice chair and architect of the strategic relationship, said the long-term goal is to use biosensor technology as a mainstay in point-of-care medical diagnostics, not only in doctors' offices and clinics, but in the local drugstore. "This represents an opportunity to participate in the fast-growing $40 billion-plus medical diagnostic market," he said. "In Third World countries, where health care is often inaccessible, our biosensor technology could speed up and reduce the cost of diagnosis and treatment." Tecport designs, manufacturers, sells, and services state-of-the-art thin film vacuum deposition systems to customers across the globe.

Physics and Astronomy

Physics is Our **Business**

MTSU's Department of Physics and Astronomy recently became a member of an exclusive club. MTSU is one of just 12 universities named to The 5+ Club by the Physics Teacher Education Coalition (PhysTEC) a joint project of the American Physical Society and the American Association of Physics Teachers. The designation, announced during the organization's national meeting March 12 in Baltimore, recognizes institutions that have graduated five or more physics teachers in a given year. Brigham Young University topped the list with 17. According to the organization, the great majority of institutions graduate fewer than two physics teachers a year. The most common number of graduates is zero. Monica Plisch, PhysTEC director, described MTSU as "a national leader in physics teacher education. . . . We need more universities to follow the lead of MTSU to address the severe shortage of high school physics teachers." Physics and Astronomy chair Ron Henderson said the department "started a concerted effort to improve our teacher education program in 2008. Some courses were redesigned, three new physics teaching classes were added, and we won a National Science Foundation grant to fund scholarships for future teachers," Henderson added. "The end result is that we have graduated more than 10 highly qualified physics teachers since 2011." PhysTEC has since invited Henderson to give presentations at national meetings. MTSU's Department of Physics and Astronomy was also recently one of just three programs nationally (along with Indiana University–Purdue University Fort Wayne and Rochester Institute of Technology) honored by the American Physical Society for improving undergraduate physics education for its students, partly as a result of course redesign. Every physics department in the country was eligible. MTSU received the honor, in part, for "consciously adopting a mission to provide exceptional classroom experiences, career-focused courses, and pathways and intensive research opportunities to prepare students for targeted careers."

Student Travis Lauback uses a modern slingshot in a physics experiment



NOT-SO-STRANGE BREW

Amidst a growing national trend toward bolder-flavored food and drink, MTSU launches a Fermentation Science degree

by Skip Anderson

LIKE A FINE WINE, OR THE BACTERIAL BASE FOR

a tasty sourdough bread, good things often require time to come into the fullness of their being.

The same is true for MTSU's forward-thinking Fermentation Science degree program, launching in 2017. The program, led by director Tony Johnston, required approval from both the Tennessee Higher Education Commission and Tennessee Board of Regents.

The degree concept was the product of a challenge by former Provost Brad Bartel and Dr. Robert "Bud" Fischer, dean of MTSU's College of Basic and Applied Sciences, who pushed his faculty to develop innovative new programs not offered elsewhere in the region. Presented with the idea of a new Fermentation Science degree, Fischer realized that, for the most part, academia had yet to respond to game-changing trends redefining the multi-billion-dollar fermentation industry across the country—specifically the brewing industry highlighted by craft beers and small-batch brewing.

"The original concept was we'd launch a brewing science program," Johnston said. "Craft beers had become very popular. Ten years ago, it was just an outgrowth of the home hobbyist—probably the biggest name people can associate with this is Sam Adams, which started with a bunch of guys who wanted to make a better beer. They were one of the first craft breweries to go nationwide. Since that phenomenon, craft brewing has become extremely popular—it's grown to the point that the big brewers are seeing their market share shrink due to the growth of craft brewing."

According to the Beer Institute, a Washington, D.C.-based lobbying organization representing the beer industry, the combined economic impact of brewers, distributors, retailers, supply chain partners, and related industries in the U.S. was more than a quarter-trillion dollars in 2014—$252.6 billion—generated by around 3,300 brewers, importers, and 6,700 beer distribution facilities across the country.

A BROADER SCOPE

Importantly, though, the new degree is not simply about brewing beer and distilling spirits. The full scope for the new degree has grown beyond just fermenting hops and barley—key ingredients in brewing beer—to any and all fermented foods and beverages.

According to published reports, 53 percent of U.S. customers are seeking bolder flavors in their foods—and foods with nutritional and long-term health value—and that demand is being met by fermented foods. Food fermentation is also the only food preservation technique that does not require the input of energy to accomplish, making it a critical new tool at a time when there are concerns regarding increased global demands for energy sources and land use for food production.

"The science behind brewing beer and fermenting foods is largely the same," Johnston said. "We use microorganisms such as yeast, bacteria, and mold to create foods we like to consume—cheese, sour cream, buttermilk, yogurt, sauerkraut, summer sausage, pickles, kimchi, to name just a few. That's fermentation."

Fermenting foods and beverages, according to Johnston, elevates the food's nutritional impact.

"The idea is that when we ferment milk, for instance, it has more vitamin content than before because the microorganisms have put more nutrients into the products," Johnston said.

But the benefits of fermentation aren't limited to what they can add to foods; it's also what the process can remove from them.

Dr. Tony Johnston, director of the new Fermentation Science degree program, is also MTSU's faculty nominee to the University's Board of Trustees.

(continued from page 29)

"These microorganisms can also convert sugars into acids that are much better for us than the sugars," Johnston said. "For example, people often don't realize how much sugar is actually in fluid milk—and we have enough sugar in our diets."

While the practice of fermenting foods is longstanding—credible evidence suggests fermenting dates back 8,000 years or so in China—the science behind the processes continues to evolve. It wasn't until the late 19th century when scientists began to understand that tiny living creatures—including yeast, bacteria, and mold—were at the heart of cheese creation, as well as beer, wine, alcoholic spirits, and thousands of other fermented foods. And even today, scientists are finding new efficiencies by adjusting the balance of the microorganisms that drive fermentation processes.

"Most consumers are concerned with three things: Does it smell good, does it taste good, and is it available for a price I'm willing to pay?" Johnston said. "What consumers don't understand is there's a whole world of science that goes into the product sitting on the shelves. These students are going to graduate and go to work in the industries to create products these consumers want to buy because it's good, it's safe, and at a price I'm willing to pay."

A TENNESSEE TRADITION

And that includes alcoholic beverages, which can be problematic when teaching the science behind brewing beer to undergraduate students, most of whom will be too young to sample the products legally in Tennessee. However, Tennessee's state legislature addressed the paradox by passing a much-publicized law in the spring of 2016 to allow juniors and seniors under the age of 21 and majoring in Fermentation Science to taste the fermented products containing alcohol they create as part of their coursework.

"This was a very important issue for everybody because we don't have really good instrumentation to tell us the flavor or aroma of a food," Johnston said. "Humans have to taste it and smell it to know whether it meets our requirements. Even with the new law, [under-age] students still aren't legally allowed to swallow the stuff. And, as silly as that sounds, as a professional taster you never swallow food anyway."

Another potential boon to the program is that out-of-state students could save tens of thousands of dollars in tuition. This degree program would be rare in the 15-state Southern Regional Education Board's Academic Common Market. (The nearest universities offering similar coursework are Appalachian State in North Carolina, Eastern Kentucky in Kentucky, and Auburn in Alabama).

"That means a student in a neighboring state could be eligible for in-state tuition because there is no school in his or her state that offers this program," Johnston said. "Schools from Maryland to Florida and over to Texas are members of this Southern compact—this program has the potential to draw [students] from a huge part of the country."

HANDS-ON DEGREE

Out-of-state students and in-state students alike in the program will be required to participate in internships.

"I'd especially love to hear from MTSU alumni who have a company or connection who might be interested in hosting an interning student from our fermentation program," Johnston said.

One alum with big plans for MTSU's new program is Mark Jones ('90), founder of Steel Barrel Brewing Co., a new 82-acre agribusiness enterprise slated to open on John Bragg Highway in Murfreesboro in 2017. (Think Arrington Vineyards, only serviced by a brewery instead of a winery and raising hops instead of grapes.)

Jones' business will be the permanent location of MTSU's new fermentation and sensory labs, a sort of "psychological space" highlighted by blind testing, tasting, and smelling activities. Set to open at the same time as the proposed launch of the new MTSU Fermentation Science degree program, the modern, cutting-edge facility promises to greatly expand the real-world opportunities for Fermentation Science students to work and learn in a real-world setting.

"It's almost meant to be, the way things are laying out," said Jones, who along with Basic and Applied Sciences Dean Fischer recently hosted a group of state lawmakers at the site. "Part of the new degree requires internships, and we can give students hands-on, real-world opportunities, as well as prepare what will become a qualified labor force for us."

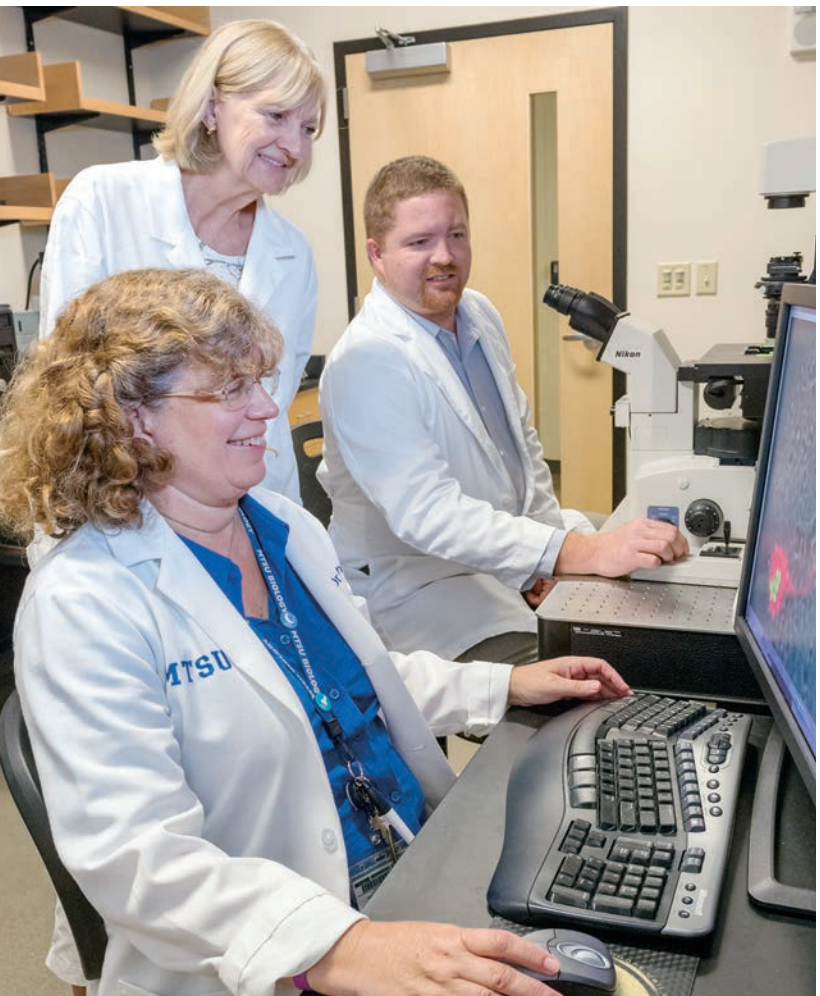
Indeed, the Steel Barrel partnership serves as just one example of the many ways the new Fermentation Science

program will closely align with Tennessee's workforce development agenda. Graduates of the program will have the opportunity go to work in a variety of positions for major manufacturers operating in middle Tennessee, including General Mills (home of Yoplait, the largest manufacturer of yogurt in the nation), Kroger (Dairy Division), Brown-Forman (Jack Daniel's), and Diageo (George Dickel), as well as an ever-increasing number of locally owned and operated fermented food producers. Statewide, the latter includes at least 28 other distilleries, 52 breweries, 60 wineries, and 10 cheese-making operations.

As home to such a large and diverse community of food processors, many of which have experienced the most growth over the past decade in their fermented foods divisions, the local and regional area will no doubt benefit economically from MTSU's new role in producing graduates with specialized chemistry, biology, business, marketing, and entrepreneurial training ready to sustain and advance the industry. It won't hurt the middle Tennessee area's burgeoning farm-to-table food and drink scene, either.

MIDDLE TENNESSEE
STATE UNIVERSITY
1301 E. Main Street
Murfreesboro TN 37132

Non-profit
Organization
U. S. Postage
PAID
Permit 169
Murfreesboro, TN



RESEARCH FOR ANSWERS

The College of Basic and Applied Sciences is changing the boundaries of scientific endeavor, seeking solutions to some of the world's greatest challenges, and preparing tomorrow's STEM educators.

Support from alumni and friends is critical in attracting and retaining exceptional faculty, providing scholarships for our outstanding students, and maintaining a technologically equipped learning environment.

Visit ***mtsu.edu/supportcbas***
to make an online gift.

I AM *true*BLUE™