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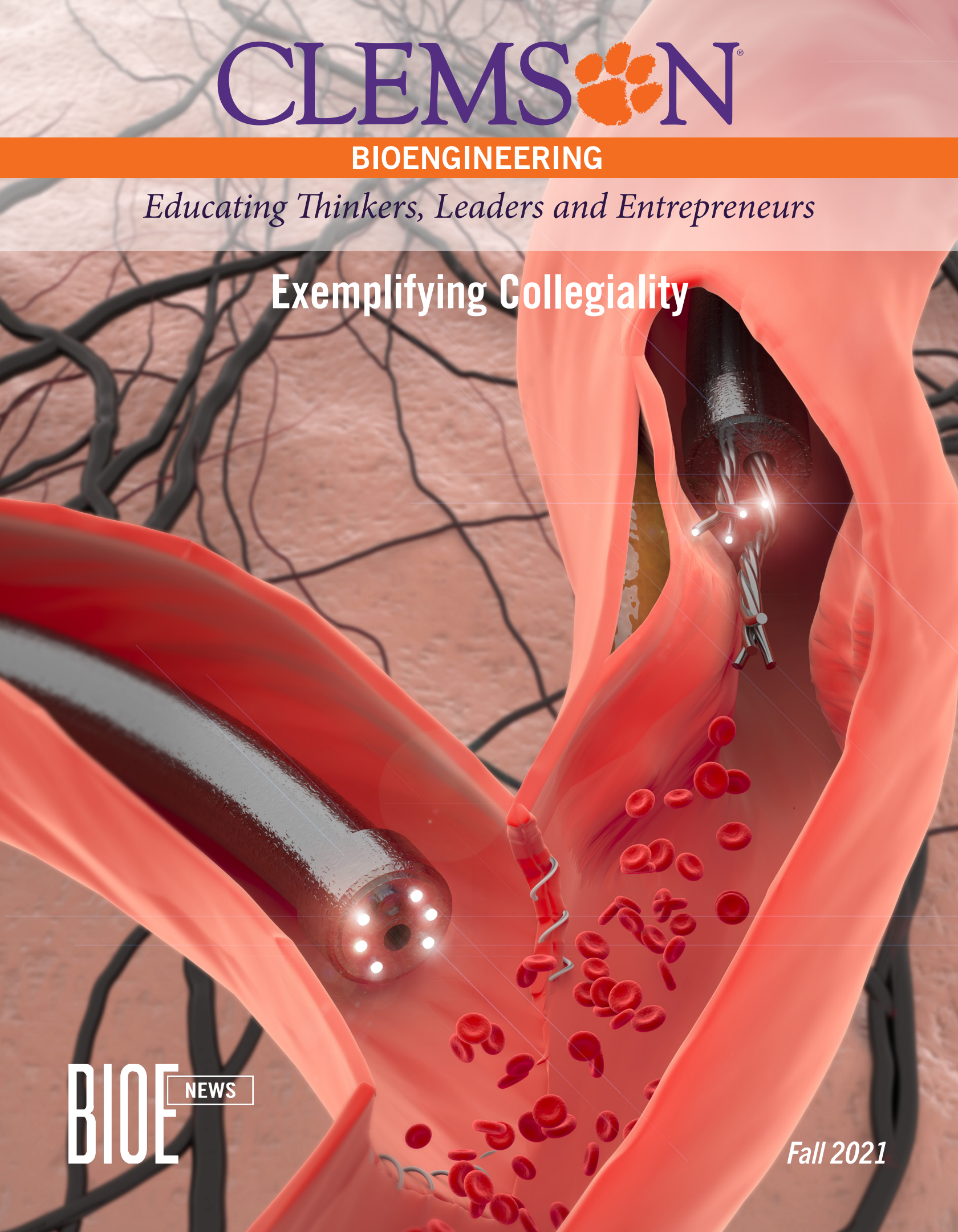
BIOENGINEERING

Educating Thinkers, Leaders and Entrepreneurs

Exemplifying Collegiality

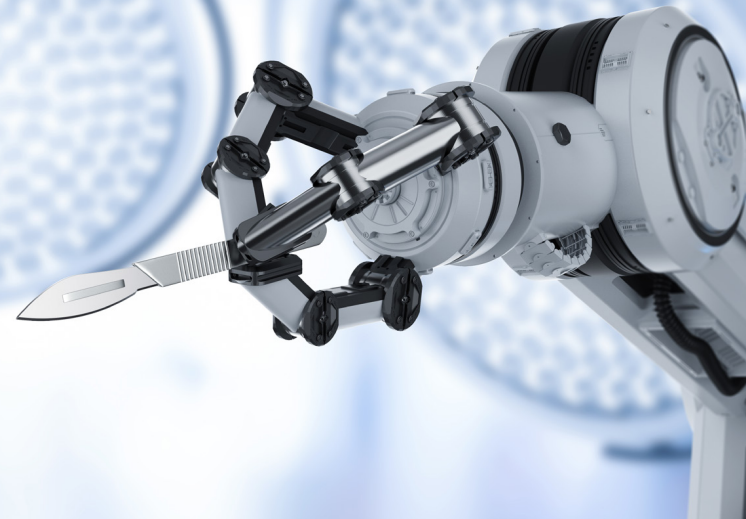
BIOE NEWS

Fall 2021





GREEN MD



CLEMSON

BIOENGINEERING

Educating Thinkers, Leaders and Entrepreneurs

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M.S. in Medical Device Reprocessing

Offered as an online degree by
the Department of Bioengineering
in collaboration with
the Department of Industrial Engineering



Overview:

The Master of Science in Medical Device Reprocessing, designed by industry experts, educates students from across the STEM disciplines to optimize and validate biomedical technologies supporting safe reuse of medical devices and healthcare products.

- The first advanced engineering degree program in medical device reprocessing in the U.S.
- **“GreenMD”** signifies the medical device industry’s aim to achieve sustainability in production and use of healthcare products.

Reprocessing is a regulated practice that involves cleaning, disinfection and sterilization of both reusable and approved single-use medical devices. Specialists must know advanced technologies and specialized process control systems for handling contaminated medical devices and rendering the reprocessed devices safe for reuse.

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Program Goals:

Enhance the readiness of globally engaged students to be innovative industry leaders in sustainable biomedical technology through training in modern reprocessing and sterilization technologies, quality science and human factors in healthcare

Program Outcome:

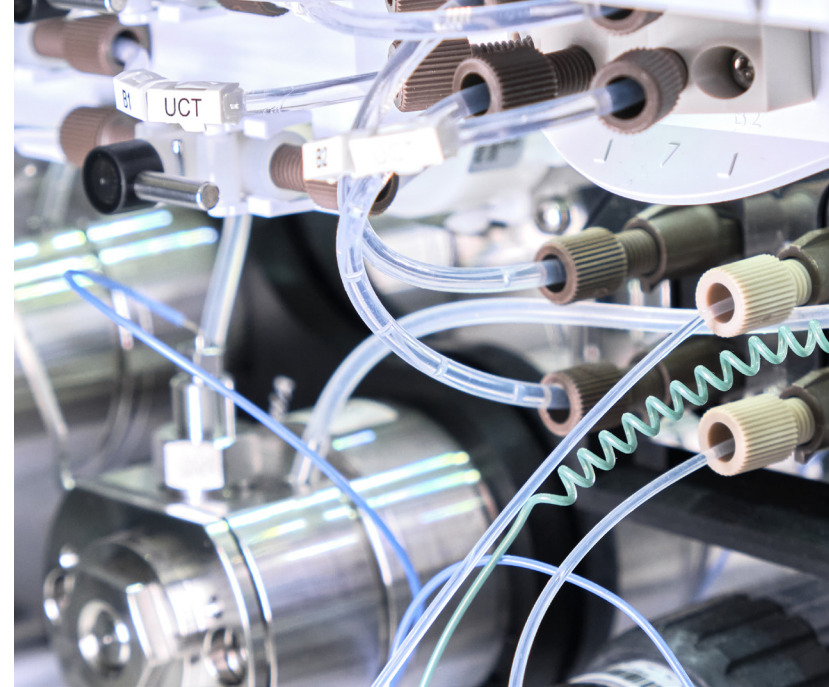
- Earn a graduate M.S. non-thesis degree online
- Complete experiential learning through an industry internship (BIOE 8900) or mentored medical device reprocessing research (BIOE 8510)



Department of
BIOENGINEERING
Clemson University

Cover illustration — “In Collaboration with Industrial Engineering, BIOE offers a first in the U.S.: The Master of Science in Medical Device Reprocessing.” (Page 2)

IN COLLABORATION WITH INDUSTRIAL ENGINEERING, BIOE OFFERS A FIRST IN THE U.S.: The Master of Science in Medical Device Reprocessing!



Graduates of this program will be in great demand by original equipment manufacturers, who must comply with FDA regulations for reprocessing.

Erin Ford, Interim CEO, SCBIO

Clemson's new Master of Science in Medical Device Reprocessing, the only degree of its kind in the U.S., is open to graduates holding a bachelor's degree in STEM disciplines. Designed by industry experts, the yearlong, 30-credit-hour program emphasizes optimizing and validating biomedical technologies to support safe reuse of medical devices and healthcare products. Integrating fundamental principles of bioengineering, industrial engineering, medical device design and quality science, the curriculum is eleven graduate-level courses and an immersion/training experience in research or industry. Students enter the asynchronously offered online program in the fall semester and graduate the following summer after an industry internship or mentored research on a medical device reprocessing team.

GOAL AND OUTCOMES

The goal is to prepare globally engaged students to be innovative industry leaders in sustainable biomedical technology through training in modern reprocessing and sterilization technologies, quality science and human factors in healthcare. Graduates will be able to integrate and apply knowledge of

- medical device design principles to enable reprocessing
- human factors engineering
- the science of sterilization and its impact on materials
- microbiology and the role of process validation and controls
- systems engineering
- supply chain management and
- Six Sigma quality control and regulatory science.

EDUCATING THINKERS, LEADERS AND ENTREPRENEURS

Medical device reprocessing, now an essential practice in healthcare delivery, is key in the 100 million+ surgical procedures performed annually in the U.S. The FDA recognizes medical device reprocessing among its top 10 regulatory science priorities, stating, "From the earliest stages of device design and engineering, manufacturers should consider alternative designs to facilitate effective reprocessing."

Our new M.S. strategically fills large gaps in public health and workforce development. According to Erin Ford, interim CEO of SCBIO, the degree's integration of industrial engineering and bioengineering will provide a skillset that no single employee currently can offer. "Graduates of this program will be in great demand by original equipment manufacturers, who must comply with FDA regulations for reprocessing. SCBIO has already recruited many companies who will benefit from this workforce."

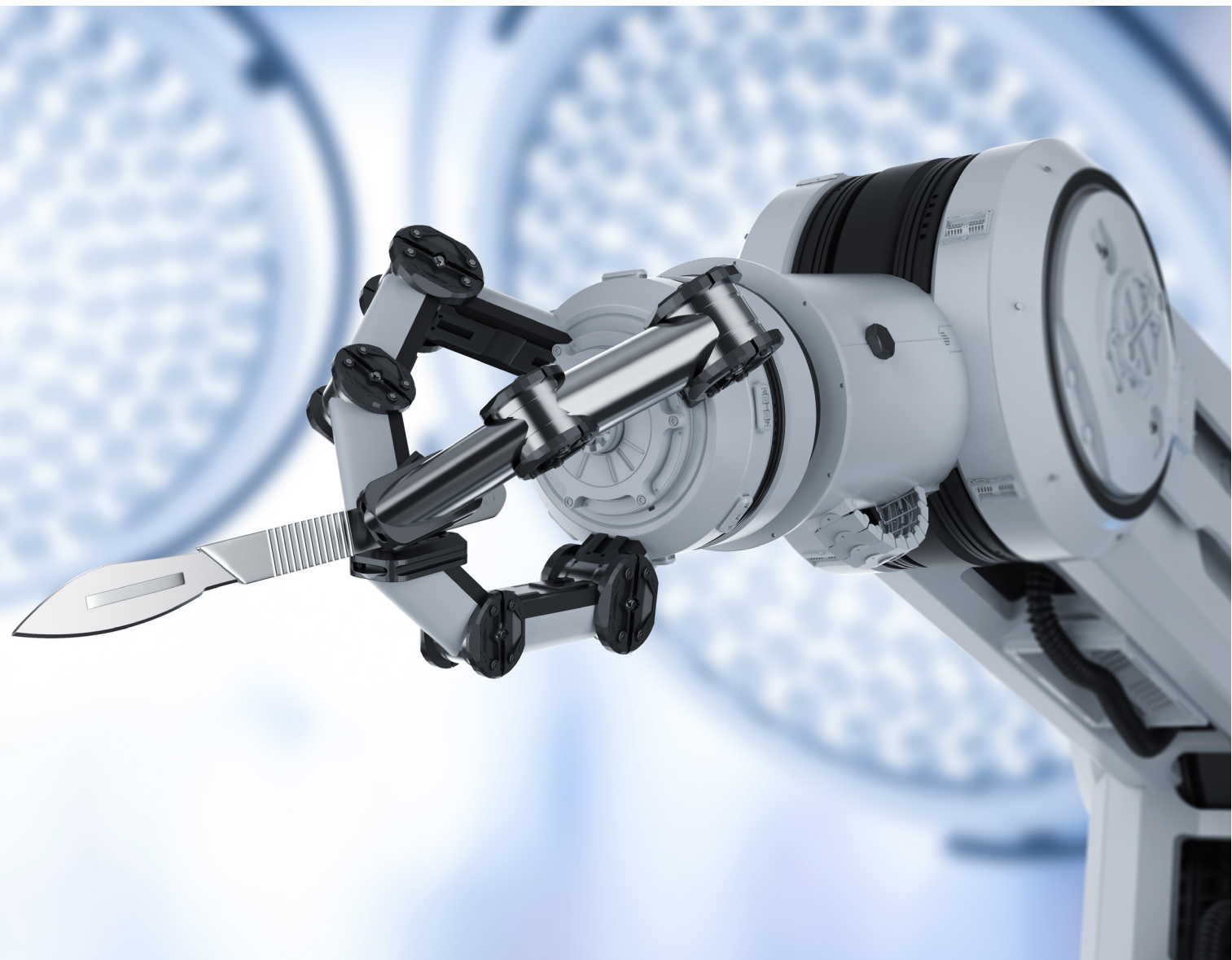
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Two faculty members recognized for extraordinary mentoring of graduate students

Clemson News

Two faculty members were recently recognized with the first Clemson University Distinguished Doctoral Mentoring Awards for their commitment to doctoral student success.

Lori Dickes, an associate professor of political science and the director of the Master of Public Administration (MPA) program, and Hai Yao, the Ernest R. Norville Endowed Chair in Biomedical Engineering and a professor in the bioengineering department, were honored at the May 2021 doctoral hooding ceremony.

When a faculty member agrees to serve as the dissertation committee chair (also known as the major adviser) for a doctoral student, they make a commitment to mentor that student for the next several years. As the student progresses through coursework, to dissertation

He encouraged me to become a well-rounded academician and researcher by motivating me to excel in academics and community service while maintaining the work-life balance.

A mentee speaking of Hai Yao



research and writing, to receiving their Ph.D., the major adviser nurtures their growth as a researcher, educator, writer, scholar and eventual colleague. This important relationship lives on long after the student graduates and moves into the professional stage of their lives.

Dickes has chaired the majority of recent dissertation committees in the policy studies Ph.D. program. One of her colleagues said in support of her award nomination that “thanks to Dickes’ advice and encouragement, students don’t just... finish their degrees; they also forge connections across campus, the state of South Carolina and broader communities of scholars and practitioners. Above all, they learn how to think for themselves and apply their expertise to solving pertinent problems in the real world.”

In his time at Clemson, Yao has graduated 12 Ph.D. students in bioengineering and mentored 12 postdoctoral trainees, in addition to many master’s students and summer interns. He has served as the major research adviser to 12 MUSC graduate researchers and 37 summer trainees as well. With his students as first authors, he has co-authored 96 conference proceedings and more than 72 peer-reviewed publications in top journals, resulting in 23 prestigious fellowships and 26 awards for the students involved.

One former student mentored by Yao from her undergraduate days to her current role as a professor says, “Dr. Yao puts the mentee at the center, and it is his expectation that his mentees surpass

Thanks to her support, students learn how to think for themselves and apply their expertise to solving pertinent problems in the real world.

A colleague speaking of Lori Dickes

him.” Another says, “Dr. Yao was extremely dedicated to working with me and passing on all he knows in terms of knowledge, research tradition, the academic network and so much more.... His mentorship helps the mentees explore their inner strength and leverage it to seek their own destinies.”

Dickes and Yao will each receive a \$1,000 cash award. In addition, a separate \$500 cash award will be granted to each recipient’s department to support mentoring activities for doctoral students. The recipients will also be asked to share their mentoring practices with others through the GRAD 360° professional development series in collaboration with the Graduate School.





Martine LaBerge named Clemson University's inaugural Gender Equity Champion

Clemson News

Martine LaBerge said that when she added the Gender Equity Champion Award to the list of honors she has received in her distinguished, 31-year career at Clemson University, she didn't consider it her own, but accepted it on behalf of her colleagues and Department of Bioengineering. She repeatedly emphasizes that the department works not as individuals but as a team, an ethos captured in its hashtag, #BIOSTRONG, and its motto, "Exemplifying Collegiality."

The Clemson University Commission on Women named LaBerge its inaugural Gender Equity Champion during an April 26 ceremony at the Madren Center. LaBerge has served as chair of the Department of Bioengineering for 19 years, making her the longest-serving chair in the College of Engineering, Computing and Applied Sciences.

Anand Gramopadhye, the college's dean, said that LaBerge's award is a testament to the 31 years she has put into promoting and advocating for general equity.

"Dr. LaBerge has played a leading role in shaping the department into a diverse and inclusive environment, a powerhouse of research and an incubator for top talent," he said. "I offer her my wholehearted congratulations on this well-deserved honor."

When asked about who she took inspiration for her professional life, she replied, "I took inspiration from a lot of men and women. My Ph.D. advisor (Gilbert Drouin) inspired me most. He was the kindest man. There were many women in my research lab, and they all did so well in their careers. We had more women than men in that lab. My professional role model is (former University of Alabama at Birmingham Provost) Linda Lucas. I met her at the Society for Biomaterials. I love her leadership. She took time to talk to me and led me in the administrative path."

Her advice to young women is, "You have invested so much and now you have to give back to others. These are two essential elements of leadership: perseverance and persistence. Don't ever believe it if someone tells you cannot do it."

These are two essential elements of leadership: perseverance and persistence. Don't ever believe it if someone tells you cannot do it.



Renee Cottle Wins Pinnacle Research Award in Liver Disease

The American Association for the Study of Liver Diseases Foundation (AASLD) selected Renee Cottle, associate professor, to receive a 2021 Pinnacle Research Award. This three-year, \$300,000 award funds Cottle's work on nonviral delivery of CRISPR-Cas9 into hepatocytes for liver repopulation using acetaminophen selection. According to AASLD, the three-year basic science award provides young scientists with support for their research to bridge the gap between completion of research training and attainment of status as an independent research scientist. The additional research experience provided by this award is intended to enable young scientists to successfully compete for research awards from national sources, particularly the National Institutes of Health. The Pinnacle Research Award is intended to develop the potential of outstanding young scientists and encourage research in liver physiology and disease. Individuals who are already well-established in the field are not eligible for this award.

Building *a Better You* 2021

In associate professor Alexey Vertegel's introduction to bioengineering, Building a Better You, students learn basics of bioengineering and practice them during week-long sessions sponsored by Clemson University Summer Scholars. Experts in lab safety, cell growth, tissue dissection, microscopy, engineering and medical technology lead classroom learning, which students then apply in the lab.

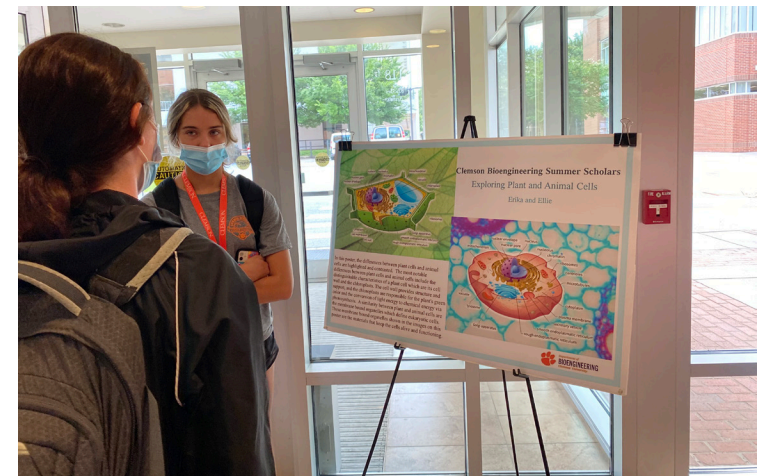
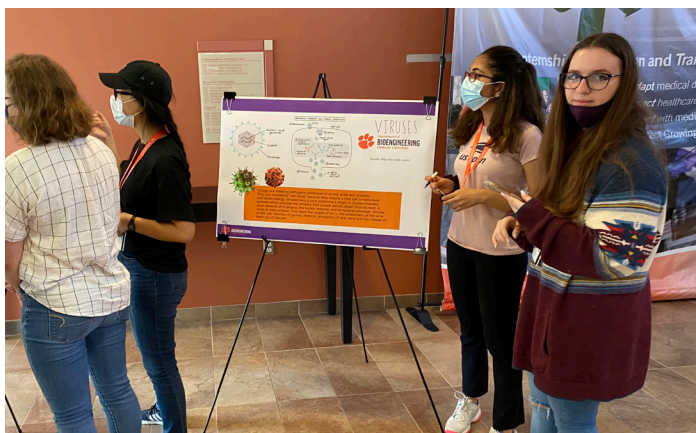
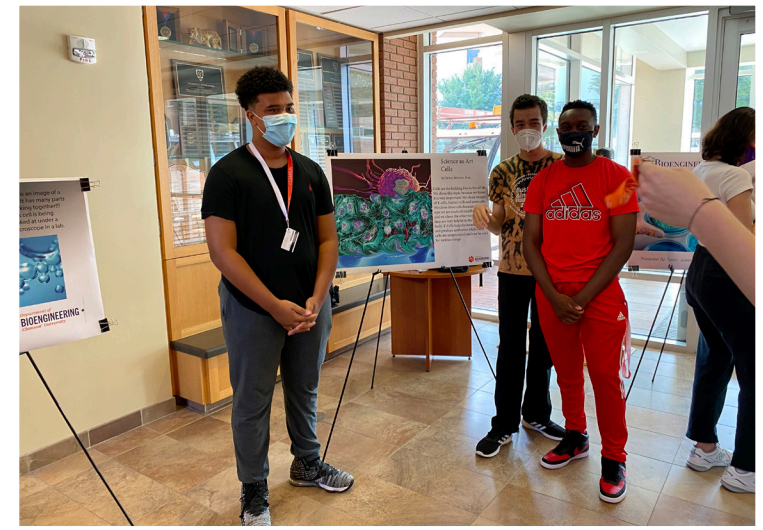
This year, each session included three hours of instruction and guided practice in science as art followed by a poster session. According to Olga Reukova, BIOE's publication director, students chose a topic, created a scientific illustration in Adobe Photoshop, wrote about their choice and process and developed an illustrated poster. She said, "Absolutely fantastic illustrations and posters were created! Studying science as art helps students touch science even if they yet have little scientific knowledge. Our students were thrilled with the appealing and engaging outcomes of their work."

For most of the students, everything was new — they had never worked in Photoshop and were amazed at the fantastic results that were achieved.

Olga Reukova

In science, art and design help us to execute our ideas in a more balanced way.

Olga Reukova





Our New Cellular and Molecular Engineering Graduate Track

Interview with Renee Cottle, associate professor

Why create a Cellular and Molecular Engineering Graduate Track?

Over the last 10 years, the department has grown rapidly, adding seven faculty members, some of whom conduct research that expands the department's emphasis areas. The foundation of the

new Cellular and Molecular Engineering track is the expertise of faculty members who study manipulating cellular behaviors and developing new approaches to treat, repair and replace diseased tissue. Research in the track spans multiple scales, including synthetic biology and nanoscale engineering to cells, tissues and organ systems, toward development of biomaterials, gene

therapy, biopharmaceuticals, alternative fuels, microbiomes and replacement organs. Graduate students conducting research with core faculty from the Cellular and Molecular Engineering track can select electives that are aligned with their dissertation projects.

What are the anticipated outcomes in employment?

We are witnessing revolutionary technologies like CRISPR/Cas9 emerge and enter clinical use. An increasing number of biotechnology and pharmaceutical companies and academic laboratories are pioneering transformative gene-based medicines and hiring bioengineers with expertise in gene therapy, gene editing, drug delivery and computational tools. A growing number of startup companies are dedicated to exploring synthetic biology for diverse applications including agriculture, renewable chemicals and gene therapy. The jobs of tomorrow will require our students to have strong fundamental knowledge in the life sciences and the capacity to work in interdisciplinary teams to address challenging medical and biological problems.

Who would benefit from this program?

Our current and incoming graduate students who are pursuing a master's degree or Ph.D. in bioengineering.

We are witnessing revolutionary technologies like CRISPR/Cas9 emerge and enter clinical use.

What are the program requirements?

The departmental core requirements are the same regardless of the research track. For M.S. students, we recommend the track electives BIOE 6470 Synthetic Biology and BIOE 8730 Translational Cellular Therapy and Regenerative Medicine. Ph.D. students take 26 credit hours from a list of track electives including BIOE 6420 Biomedical Applications of Gene Regulation and Editing and GEN 8100 Principles of Molecular Biology. Students are encouraged to take diverse electives for knowledge that will ensure their success in conducting their own research and future careers.

Sophia Hennessy wins Almeda R. Jacks Outstanding Undergraduate Student Award

Clemson's Division of Student Affairs presents this award in honor of Clemson's former vice president for student affairs. The award is given to the best "all around" junior or senior who upholds Clemson's core values, maintains high scholarly achievement and who shows a cross-section of involvement in university departments, clubs or organizations.



LaShan Simpson '10 named 2021 BMES Diversity Lecture Award winner

C. LaShan Simpson, Ph.D.
Associate Professor
Mississippi State University

The Biomedical Engineering Society Diversity Lecture Award honors an individual, project, organization or institution for impactful contributions towards improving gender and racial diversity in biomedical engineering. The award seeks to recognize lifetime achievements and high-impact activities (i.e., research, academia and service) that are innovative and improve equity among biomedical engineering academia and industry.

Please tell us about the ways you work to improve gender and racial diversity in biomedical engineering.

I have always been passionate about diversity in STEM. Even as an undergraduate and graduate student at Clemson, I was very active in WISE: Women in Science and Engineering and the Project WISE summer camp for rising 8th grade girls. I have taken this passion into my role as a faculty member. I am co-advisor for Society of Women Engineers (SWE), and I collaborate with the TRiO program that serves first-generation low-income students. My research lab is very diverse, and my teaching motto is one of inclusive teaching. I make a conscious effort to make each student feel seen and heard in my classroom.

I had noticed an increasing number of Black women attending the annual BMES meeting, and I wanted to create a space for them. Four years ago, I hosted the first annual Black Women in Biomedical Engineering session at BMES with my colleagues Drs. Princess Imoukhede and Gilda Barabino. This event has grown each year and is now a permanent event for the conference. We have created a safe space for Black women at all stages from undergraduate to university president to network and encourage each other. Even though there are many of us in attendance at the conference, we are siloed at our institutions. For example, I am the only Black woman in my department and one of two in my college of engineering.

What would you like to accomplish in the future?

I have accomplished so much in my career thus far including winning this distinction from BMES. I have also been awarded Teacher of the Year by the College of Agriculture and Life Sciences and inducted into the Academy of Distinguished Teachers by the Bagley College of Engineering at Mississippi State University. I was recognized for my commitment to diversity by the Mississippi Institutions of Higher Learning in 2020 and the President's Council on the Status of Women at MSU in 2019. My greatest joy as a faculty member is mentoring students. My goal for the next phase of my career is to work more in the area that brings me joy. I want to expand my Black Women in Biomedical Engineering initiative. I also want to continue working with first-generation low-income students. At MSU, a large percentage of our student body fits into this category, and I want to motivate this group to chase their dreams.

You have everything necessary to succeed within you.

Is there anything you learned at Clemson that has been especially useful in your career?

My experience at Clemson has without a doubt shaped who I am today. I evolved through many stages while at Clemson. I learned the value of having a supportive network while at Clemson. The relationships that I established with my fellow graduate students, staff and faculty while at Clemson continue to this day.

What would you like to say to current students?

This is a great question. I would like to give current students one piece of advice. Anything is possible! I know how it may feel as if your goal is unattainable at times and you may feel as though you are not qualified. Remember that anything is possible. You have everything necessary to succeed within you. Find a mentor or a circle of friends to help bring out your greatness, but never count yourself out.

Remember that anything is possible.



Michael J. Kern recipient of the 2021 Samuel F. Hulbert Award

Martine LaBerge, chair, Department of Bioengineering

The Samuel F. Hulbert Award acknowledges individuals providing outstanding support to the Department of Bioengineering. Michael J. Kern, professor of regenerative medicine and cell biology and professor of oral health sciences at the Medical University of South Carolina, is a longstanding advocate for the Clemson University Department of Bioengineering. Over the past 15 years, Kern has made significant contributions to the success of multiple Clemson bioengineering faculty members and students. Contributing his expertise in mentoring and in developing and leading NIH training programs designed to foster new generations of NIH-funded scientists, he has substantially increased his involvement with BIOE over the past decade and has had a direct positive impact upon the department's success. Kern has assisted faculty members in the Clemson-MUSC Joint Bioengineering Program in their development and research efforts and has been highly supportive of many BIOE trainees (pre- and postdoctoral) over the years.

A member of Clemson's bioengineering department in the capacity of adjunct professor since 2011, Kern was appointed professor of the Clemson University School of Health Research in 2015. He has served as associate director for nine years and for the MUSC NIH Oral Health T32 training grant, interim PI for three years. During this time, the program has given multiple (10+) two-to-three-year fellowships to bioengineering students and postdoctoral trainees on the MUSC campus. Kern devotes numerous hours to mentoring these trainees. Additionally, he has co-mentored bioengineering department T32 participants in the MUSC Cardiovascular T32 program and for years has served on student thesis committees. The MUSC Oral Health T32 program, one of only 14 institutional dental research training programs funded by NIH, was recently renewed for five years. This initiative will continue to foster opportunities for BIOE trainees and faculty for years to come.

Kern continues to provide significant effort and support to the bioengineering department and Clemson University through the NIH COBRE South Carolina Center for Translational Research Improving Musculoskeletal Health (SC TRIMH) program, for which he serves as an executive committee member and faculty mentor. The devotion,



wisdom and guidance that he has brought to the development, grant writing and executive leadership of SC TRIMH since its 2018 inception have been critical for program success. These efforts have led to funding support for four bioengineering faculty as targeted COBRE faculty members, one NIH-Funded Pilot Project Leader, and seven SC TRIMH Center Funded Pilot Project Leaders. Kern is director of the SC TRIMH Mentoring Program and devotes much time to mentoring project leaders in one-on-one sessions. He also leads institutional efforts in creating an NIH culture on campus through focused workshops and recurring NIH 101 presentations.

Kern is an outstanding research scientist, educator and leader. His long-term support of the bioengineering department and its faculty and trainees has been recognized as exceptional and exemplary.

Rene Cottle: ASGCT Underrepresented Population Fellowship Award in Gene and Cell Therapy for Any Indication

American Society of Gene and Cell Therapy gave its Underrepresented Population Fellowship Award in Gene and Cell Therapy for Any Indication to Rene Cottle, associate professor of bioengineering. According to ASGCT, the awardee is chosen from groups underrepresented in the scientific workforce, including racial and ethnic minority groups, people with disabilities and those from disadvantaged backgrounds. ASGCT is committed to addressing workforce disparities by providing opportunities for professional development in biomedical research for underrepresented groups.

The award supports research for a year. Applications were evaluated on the following criteria:

- Significance, innovation and originality of the proposed project
- Appropriateness, feasibility and adequacy of proposed project within the award timeline
- Focus on basic, translational or clinical research of gene and cell therapy for oncology indications
- Applicant's qualifications, experience and commitment to a career in gene and cell therapy
- The contribution the project results will offer to the field



Nature's Gift wins CECAS Spark Challenge

Clemson News



Claudia Sisk

Marissa Jansen

A

Clemson University student and recent graduate are developing a reusable tampon applicator they said will be cheaper and more comfortable to use than its competitors and help keep waste out of landfills. Claudia Sisk and Marissa Jansen won \$2,500 after their product, Nature's Gift, took first place in this year's CECAS Spark Challenge, an annual competition sponsored by Clemson's College of Engineering, Computing and Applied Sciences.

Nature's Gift would include an insertion sheath and rod made of hygienic material. The product would cost \$25 and come in two sizes to accommodate cotton inserts with various levels of absorbency, ranging from light to ultra.

About 7 billion tampons and their applicators are thrown out every year in the United States, and Nature's Gift would be aimed at helping reduce waste, Sisk and Jansen said. Each device would last about two years, bringing its average monthly cost to about \$1.04. The cotton inserts, sold separately, would run another \$3.50 a month.

About 7 billion tampons and their applicators are thrown out every year in the United States, and Nature's Gift would be aimed at helping reduce waste.

Marissa Jansen, Claudia Sisk

Nature's Gift customers could expect to spend a grand total of \$4.54 a month on menstrual health products, Sisk and Jansen said. The average woman now spends \$159 a year, or \$13.25 a month, they said. Sisk and Jansen are trying to take their reusable tampon applicator to market. The team is targeting anyone who menstruates, especially young women who are concerned with their ecological footprint.

In the CECAS Spark Challenge, student teams work with mentors to develop a product and then build a business plan to bring it to market. Each team selected for the competition gets \$500 in seed money. Teams pitch their ideas to a panel of judges each spring. The challenge is organized by John DesJardins, the Robert B. and Susan B. Hambright Leadership Professor of Bioengineering and CECAS faculty director for entrepreneurship.

"The competition hits so many of the high points we emphasize in the college," DesJardins said. "It teaches entrepreneurship and how to work across disciplines. This year's winning project underscored the importance of having underrepresented voices at the table. I congratulate Claudia and Marissa on their well-deserved victory."

The idea for Nature's Gift came out of the Homeless Period Project, a national nonprofit that provides menstrual products to people in need. Jansen was a co-founder, and Sisk was a member. Sisk, a bioengineering major, will be a senior in the fall, and Jansen received her Bachelor of Science in health science last year. Their advisor on Nature's Gift was Sarah Harcum, a professor of bioengineering.

Nature's Gift was selected to represent Clemson University in the 2021 ACC InVenture Prize Competition and competed in March against entrepreneurial teams from across the ACC.

Sisk and Jansen plan to go out for dinner with some of the prize money from the CECAS Spark Challenge and use the rest to figure out what comes next for their business. "We've been thankful to get a lot of feedback and a lot of positive critiques about how we could make this a reality," Sisk said.

Next steps will include developing a prototype and applying for a provisional patent, Jansen said. "Finding a design and getting it patented — if we can get it through that hurdle, I think we'll have a really good shot at taking it further," she said.

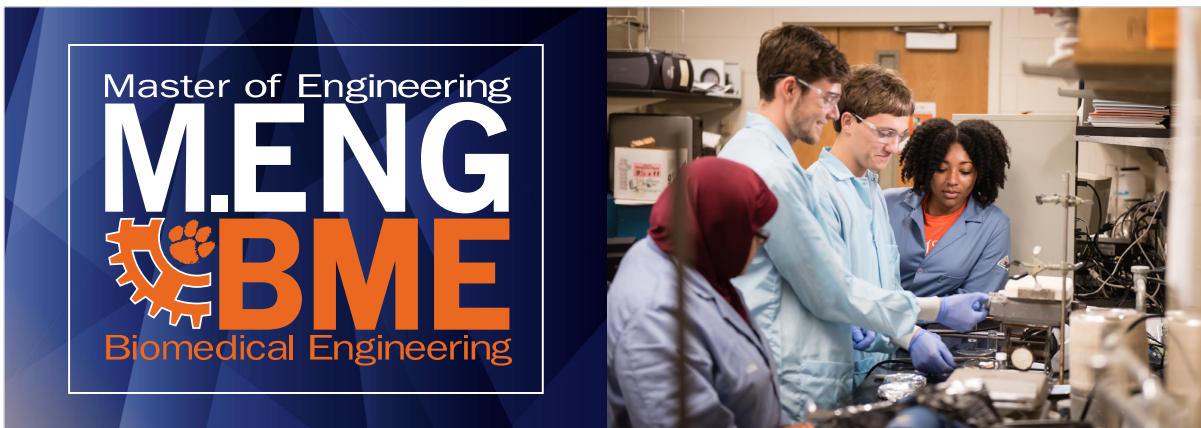
Faculty Appointments

Marc R. Birtwistle, associate professor of chemical and biomolecular engineering, has been named associate professor of bioengineering.

Heather Dunn has been named research assistant professor of bioengineering.

Margarita Bruce, Ph.D., has been named lecturer in the Department of Bioengineering.

Clemson University
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Clemson, SC 29634



QSE

Quality Science Education Program

Offered through:
THE DEPARTMENT OF BIOENGINEERING AT CLEMSON UNIVERSITY
in partnership with
Pathway for Patient Health

Overview:

The Quality Science Education Certificate Program, designed by industry experts, provides a holistic curriculum focused on the multifaceted area of quality assurance. The program delivers a cooperative education including:

- Conferences with subject matter experts
- Immersive educational experiences and
- Opportunities for internships and employment.

Students will be able to address the scientific and business challenges of today in the medical device and pharmaceutical industries, paving a pathway for fulfilling careers.

Upon successful completion of QSE, students will receive credit towards their graduate degrees and industry-recognized certification as a “Certified Quality Science Professional (CQSP).”

Program Goals:

Enhance the readiness of students entering industry through immersion in science-based education and real-world experiences in Quality Science for the 21st century

Program Outcome:

- Credit toward a graduate degree
- Industry-recognized certification as a Certified Quality Science Professional (CQSP)