



Department of  
**CHEMICAL AND  
BIOMOLECULAR  
ENGINEERING**  
*Clemson University*

EARLE HALL

CHEMICAL ENGINEERING

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# MESSAGE FROM THE CHAIR



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Stay in touch.

We want to hear from you!

E-mail: [cac4@clemson.edu](mailto:cac4@clemson.edu)

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Greetings, Alumni and Friends!

There are several news items I hope to share with you, many of which are exciting. However, other trends generate a major concern as we continuously seek ways to support and care for our students during unprecedented times. This is a serious matter that requires everyone's attention and immediate support.

For now, I will begin with exciting news as the Clemson Board of Trustees recently approved the design phase of the Advanced Materials Innovation Complex (AMIC), which will add research space for six new ChBE faculty and their graduate students in a four-story facility across the street from Earle Hall. It will be the new home for Materials Science & Engineering and will also include modern organic chemistry labs for undergraduates. This new facility is projected to open in early 2025, and at a projected cost of \$130 million, the 140,000 square foot building will be home to several cutting-edge engineering and teaching facilities focused on advanced materials. In addition to the new AMIC facility, the unit operations lab, corridors and bathrooms in Earle Hall will also receive upgrades. These renovations are scheduled to be completed this summer, and I encourage everyone to visit the building next fall to see the changes.

Throughout the previous semester, the Delta and Omicron variants of COVID-19 presented more unique challenges for our Clemson community. I am truly saddened that some Clemson employees lost their battle with the Delta variant of the disease in the previous semester, but thankfully the ChBE department fared well as no one has experienced severe illness due to COVID-19. I am experiencing déjà vu as I write this letter because it was about this time last year that the spread of COVID-19 virus was decreasing. My hopes were high for it to become a story in the past. Time will tell what happens moving forward, but I remain optimistic as it appears that everyone is learning to be more proactive in dealing with the virus.

The issue of concern I wish to share with everyone is that of mental illness and anxiety. Annual surveys of college students' health across the country suggest that the rate of depression and thoughts of suicide have doubled among college students in the last decade. Sadly, Clemson's students are not immune to the factors that have led to this increase, including pandemic related restrictions, racial and political unrest, and very recent stress regarding warfare between countries abroad. Thankfully, the Counseling and Psychological Services (CAPS) group at the university has added several more full-time counselors and increased their efforts to help students in need. Given that many of you know college aged students, I encourage you to reach out and seek counseling help for anyone showing signs of depression or distress. The university maintains a webpage with many useful resources: [www.clemson.edu/campus-life/healthy-campus/suicideprevention/get-help.html](http://www.clemson.edu/campus-life/healthy-campus/suicideprevention/get-help.html).

Finally, this academic year has yet again taught me that life goes in cycles. In addition to the usual arrival and graduation of students, we also welcomed Ana Alba-Rubio to the faculty as an associate professor from the University of Toledo and said goodbye to a long-serving staff member, Diana Stamey, who retired after 35 years of service at Clemson University. We are excited about the research and teaching expertise Alba-Rubio brings to the faculty and wish Diana well as she and her husband travel and camp across the country.

Stay Safe and Go Tigers!  
David A. Bruce  
Professor and Chair, Chemical and Biomolecular Engineering

# Scott Husson receives NIGMS Grant for Fast-Track SBIR project



Left to Right: Joshua Osuofa, Ph.D. student, Scott Husson, professor, Jaime Idarraga-Mora, Ph.D. graduate



Scott Husson, Ph.D., distinguished professor in chemical and biomolecular engineering, received a grant from the National Institute of General Medical Sciences, entitled: “Fast-Track: Improving therapeutic protein purification with new, high-productivity multimodal membranes.”

In this Fast-Track SBIR project, Husson will work with Purilogics, LLC to develop a new class of membrane chromatography columns that can rapidly and selectively purify therapeutic proteins produced by cell culture technologies. Therapeutic proteins are among the most effective treatments for severe and chronic conditions such as cancers and autoimmune disorders.

There is tremendous demand for new therapeutic molecules and personalized medicines. Biomanufacturers are moving towards multidrug facilities to meet this demand, and many are moving to small batch production runs to increase manufacturing flexibility and counteract market risks. The proposed research is expected to have a significant impact on the industry and contribute to improving human health by designing membrane products that support faster changeovers in these multidrug facilities.

# Eric Davis & Christopher Kitchens receive promotion

Our department is proud to announce the promotions of Eric M. Davis to associate professor with tenure and Christopher L. Kitchens to professor.

Eric Davis joined the department in Fall 2015, after receiving his doctoral degree from Drexel University (2013) and completing a National Research Council Postdoctoral Fellowship at the National Institute of Standards and Technology (2015).

Davis's research focuses on the development of fundamental structure-processing-property relationships for polymers utilized in a wide variety of applications, including energy storage and delivery, as well as materials for aqueous-based separations.

Also, Davis is an alumni of the department, having received his bachelor's degree from Clemson in 2008.



Eric Davis and a previous Ph.D. advisee, Allison Domhoff, working on a project in the Davis lab.



Davis Research Group, Front Row: Xueting Wang, Jaden Stutts, Alana LeSuer, Missouri Lytle. Back Row: Prof. Eric Davis, Keturah Bethel, Nicholas Gregorich



Christopher L. Kitchens has been promoted to the rank of professor. Kitchens' research spans the areas of nanotechnology and sustainability with applications pertaining to catalysis, drug delivery, sensing and resilient building materials. Kitchens joined the department in 2006, after receiving his doctoral degree from Auburn University (2004) and conducting his postdoctoral studies at Georgia Tech.

Currently, Kitchens is the principle investigator for an NSF Research Traineeship (NRT) program at Clemson that is focused on resilient infrastructure and environmental systems (<https://www.clemson.edu/academics/programs/ries>).

Kitchens is also the principle investigator and director for an NSF S-STEM program at Clemson which is a research and scholarship program titled Student Pathways in Engineering and Computing for Transfer Students or SPECTRA (<https://www.clemson.edu/cecas/prospective-students/undergraduate/spectra.html>).

More recently, Kitchens was appointed as the Director for the Clemson Institute for Sustainability and Resilience (CISR – pronounced “scissor”). Prof. Kitchens' promotion to the rank of professor is an achievement that has not been achieved in the department for more than a decade and is a testament to his achievements and dedication to the Department of Chemical and Biomolecular Engineering.



**Christopher Kitchens** mentoring chemical engineering Ph.D. student, Chinmay Joshi, as he works towards graduation.



**Christopher Kitchens** attending a meeting to gain support for the Spectrum program at Clemson University that supports transfer students.



# Rachel Getman goes ABOVE AND BEYOND for students

When COVID-19 swept the globe, Sachi Hilliard canceled plans to visit family in Japan and began hunting for a way to use her time wisely while quarantining in her Los Angeles apartment.

Rachel Getman of Clemson University helped save the summer. Hilliard was among 11 interns to go to work in Getman's lab after watching other plans fall apart because of the virus.

"It was like a lifesaver," Hilliard said. "I was able to remain connected to people, and I got to learn a whole new field of chemistry."

Getman, the Murdoch Family Endowed Professor of Chemical and Biomolecular Engineering, was in a position to help so many interns because all the research her team conducts is computational. Research can be done anywhere there is an internet connection.

It has been an extraordinary time in more ways than one for Getman and her students since the pandemic began. The lab hosted about five times as many interns as usual in summer 2020, Getman was appointed to the Murdoch professorship, and two of the lab's members won awards recognizing their excellence.

David Bruce, chair of the Department of Chemical and Biomolecular Engineering, said the lab's success underscores how Getman practices what she preaches.

"Dr. Getman not only conducts nationally prominent research, she goes above and beyond to mentor high school, undergraduate and graduate students," he said.

"The laudatory reviews she receives from her students are well-deserved. Dr. Getman has played a leading role in ensuring that the department and the college come out of COVID-19 stronger."

The research Getman and her students conduct helps lay the groundwork to create more efficient, more effective and less expensive catalysts. Catalysts accelerate the rate of chemical reactions and are crucial to mass-producing a vast range of products from gasoline and diesel fuel to fertilizer and plastic.

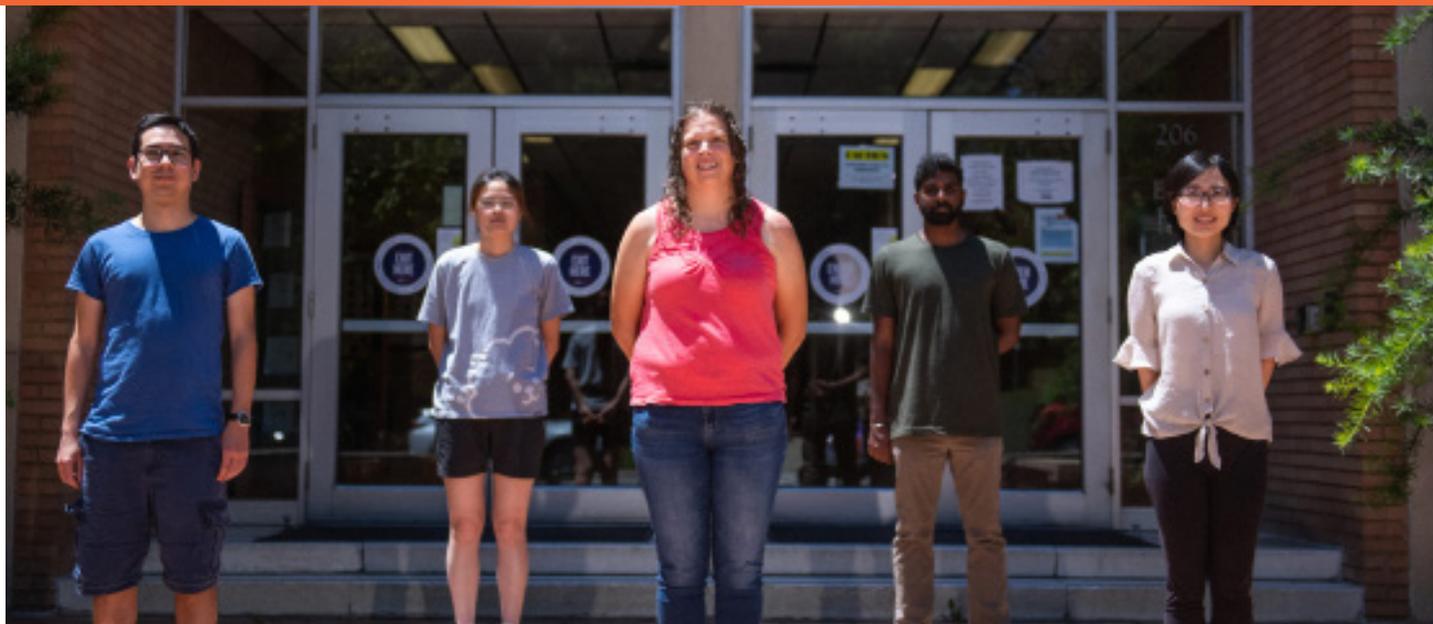
Much of the group's work involves creating models of chemical reactions on computers and can be done virtually.

When the pandemic hit, many experimental labs, where research must be done in person, were no longer able to accept high school and undergraduate interns. That left many unable to work the internships they had been counting on.

"We decided to take as many as we could from various programs," Getman said. "Since computational work can be done virtually, at least we could provide the experience."

The 11 interns included high school students from the Governor's School for Science & Mathematics, rising first-year college students from Clemson's EUREKA! program and students from other universities who were part of a National Science Foundation program called Research Experiences for Undergraduates (REU).

Hilliard, who found the opportunity on a website, had recently graduated from the University of California, Los Angeles with a Bachelor of Science in chemistry. She is now pursuing a Ph.D. in chemistry at Johns Hopkins University.



**Getman Research Group:** Richardo Garcia, CHE Ph.D. student, Xiuting Chen, CHE Ph.D. student, Rachel Getman, Rohit Punyapu, CHE Ph.D. student, Xiaohong Zhang, CHE Ph.D. Alumni.

Before they could get to work, the interns had to be brought up to speed. They started collaborating closely with the Getman lab's four Ph.D. students and two postdoctoral researchers. Each took one to three interns and served as mentors, meeting with them regularly over Zoom.

While graduate students are well positioned to do the hands-on work in research labs, the point of having high school and undergraduate interns is to provide them the experience, even if tasks tend to take them a little longer.

"These are training positions," Getman said. "You have to teach the methods, what you expect to get in the results and how to analyze, present and communicate results. That's why these interns want to do the internship in the first place – to garner these skills – and someone has to teach them."

Ricardo Garcia, a Ph.D. student in Getman's lab, stepped up to help, working with two high school students.

"Once they lose the fear to talk, they get engaged," Garcia said. "It's very nice to see how someone from high school can understand, roughly speaking, highly technical terms and science."

Also in the 2020-21 academic year, the Getman lab produced two student researchers who won major awards.

Anish Chaluvadi, who graduated in May, became the first Clemson student to receive the internationally competitive Gates Cambridge Scholarship and is headed to the University of Cambridge for graduate school.

He also won Clemson University's Norris Medal for scholastic achievement and leadership and the J. Wesley Davis Leadership Award from Clemson's College of Engineering, Computing and Applied Sciences.

"Dr. Getman has been influential in shaping my understanding of what research truly is," Chaluvadi said. "She showed me how to pivot and how to learn from my mistakes. She has been a great mentor and a support system when the class load and extracurriculars were getting too heavy. She was understanding about who I am as a person. She was inclusive. And she was a woman in STEM and showed how she can be a leader."

Xiaohong Zhang, a Ph.D. student in the Getman lab, won the college's Outstanding Graduate Researcher Award. Zhang was set to graduate in August and was poised to start a career as a data scientist with an Atlanta marketing firm, where she will use the same computational techniques she learned in Getman's lab.

"I think the trust built between Dr. Getman and I helped me succeed in my graduate studies," Zhang said. "She's a very good mentor."

Getman said she has enjoyed seeing her students' hard work and vision garner some recognition.

"I know how highly I think of them, and it's another step to getting other people to recognize how amazing these people are," she said. "When they are getting this recognition at the University and college levels or beyond, it's really good to see."



From left to right: **Bipin Paruchuri**, Ph.D. student, **Jessica Larsen**, assistant professor, and undergraduate alumni, **Lauren Maghak**

# Jessica Larsen receives Dean's Professor Award

Jessica Larsen received the College of Engineering, Computing and Applied Sciences Dean's Professor Award in Chemical and Biomolecular Engineering on October 1, 2021. This award recognizes a sustained record of excellence in teaching, research, scholarship and service to the College of Engineering, Computing and Applied Sciences.

Larsen has excelled as a professor, mentor and researcher despite the difficulties of the COVID-19 pandemic. She has mentored 63 undergraduates and graduate students on impactful research projects, earning her the 2020 Phil

and Mary Bradley Faculty Award for Mentoring. Larsen also received the 2021 Faculty Outstanding Woman Award by the Clemson University's Commission on Women and published four papers throughout 2021. She also received a \$515, 998 grant through the NSF CAREER Award Program to pursue further research opportunities.

The Department of Chemical and Biomolecular Engineering is proud to have Jessica Larsen as a part of the faculty and extend congratulations for her continued accomplishments as she brings much pride to the faculty, staff and students.



**"I am honored to have been selected for the Dean's Professor Award due to my efforts to support the goals of the Department of Chemical and Biomolecular Engineering, sustain a strong research program in Advanced Materials and Health Innovation, and consistently provide high quality engineering education to all of our students."**

**- Jessica Larsen**



# Welcome, Ana Alba-Rubio

**The department is proud to welcome Ana C. Alba-Rubio to Clemson University as an associate professor.**

Alba-Rubio is joining us from the University of Toledo, where she worked as an assistant professor for six years and was recently promoted and received tenure.

Alba-Rubio is originally from Spain and received her B.S. degree in chemical engineering from the University of Malaga (2007) and her Ph.D. in applied physical chemistry from the Autonomous University of Madrid (2011).

Before becoming a faculty member, she spent three years at the University of Wisconsin-Madison as a postdoctoral researcher. Her research focuses on the rational design and synthesis of nanomaterials for catalysis and sensing applications with a special interest in producing fuels and materials sustainably and developing technologies to improve the human condition.

In her spare time, you can find her listening to music, dancing, crafting, reading, scrolling on Twitter (@AlbaRubio\_group) or hiking with her husband and silver labs.





# LARSEN LAB ATTENDS BMES

Jessica Larsen's research team arriving at the Biomedical Engineering Society meeting. **Front Row:** Chlo Forenzo, Danielle LaVigne, Kayleigh Trumbull, Vaishnavi Kanduri, Joey Lavalla, Taylor Hamas, and Morgan Ethridge. **Back row:** Conner Lumb, Chris Pierce, Emmeline Bagwell, Jess Jager, Jessica Larsen, Mark Pitman and Bipin Paruchuri

The Biomedical Engineering Society (BMES) is an organization focused on advancing human health and well-being. Each year, they host an annual meeting where students, faculty and industry have the opportunity to connect and present their scientific work. This year, the meeting was hosted in Orlando, Florida from Oct. 6 to 9.

The Larsen Lab submitted abstracts that were selected for two podium presentations and six poster presentations. Through funding from Creative Inquiry and Larsen's grants, a team of 14 students were able to attend. The projects that received a coveted podium presentation were led by Ph.D. Student Bipin Paruchuri and the undergraduate students Chlo Forenzo, Danielle LaVigne and Vaishnavi Kanduri.

Not only was great science presented, but the team was able to take a day away from the conference and enjoy their hard work with a trip to Disney's Animal Kingdom on Thursday, Oct. 8. On Friday, BMES shut down part of the Universal Islands of Adventure park for their big BMES bash where the team got to enjoy countless rides with no line!



**Bipin Paruchuri**, 5th year Ph.D. student in ChBE, presented on his work to develop pH and enzyme responsive polymersomes to enhance enzyme replacement therapy in neurodegenerative disease GM1 gangliosidosis on Saturday, Oct. 10. His results were a significant part of Larsen's NSF CAREER proposal that was funded earlier this year.

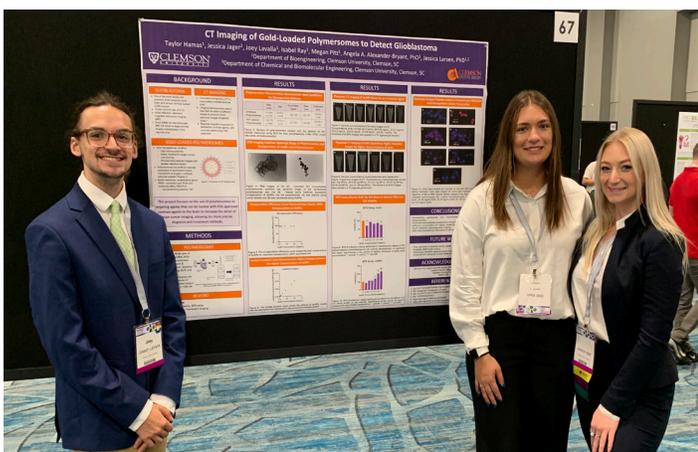
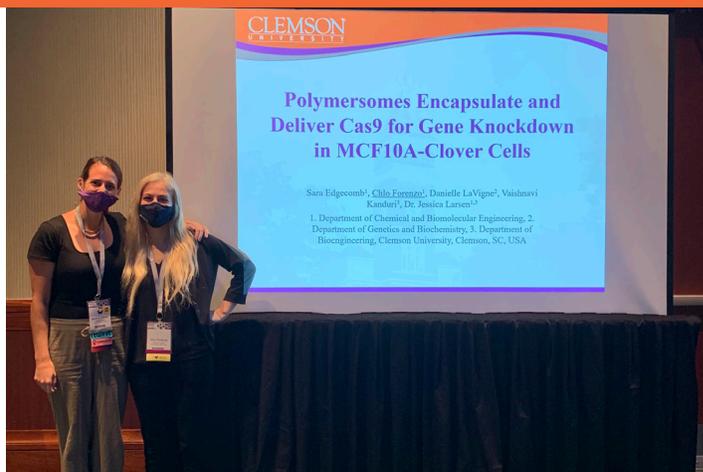
**Minhyun Shin**, junior BioE, and **Emmeline Bagwell**, senior biochemistry major, presented their work on the development of a zebrafish model of Parkinson's disease and the characterization of new treatment modalities on Friday, Oct. 9

**Christopher Pierce**, ChBE senior, gave a virtual poster on his work modulating polymersome shape to enhance cellular uptake, leading towards delivery of drugs through the blood-brain barrier.

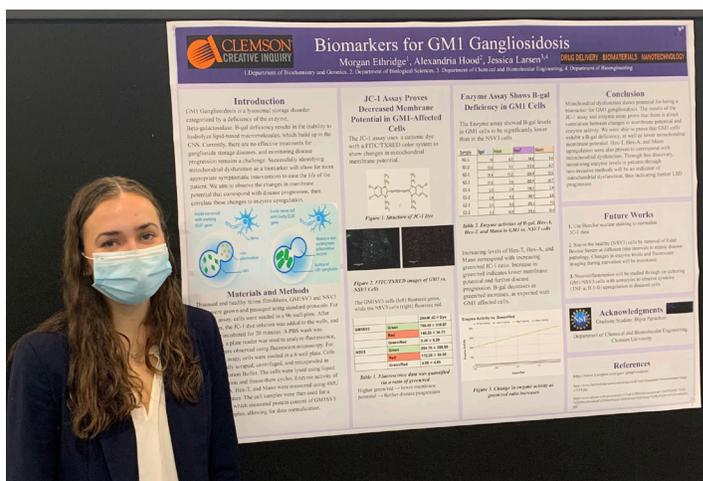
# PRESENTATIONS

The first in-person podium presentation ever given by the Larsen Lab was presented by senior ChBE **Chlo Forenz** (right), pictured with **Jessica Larsen** (left).

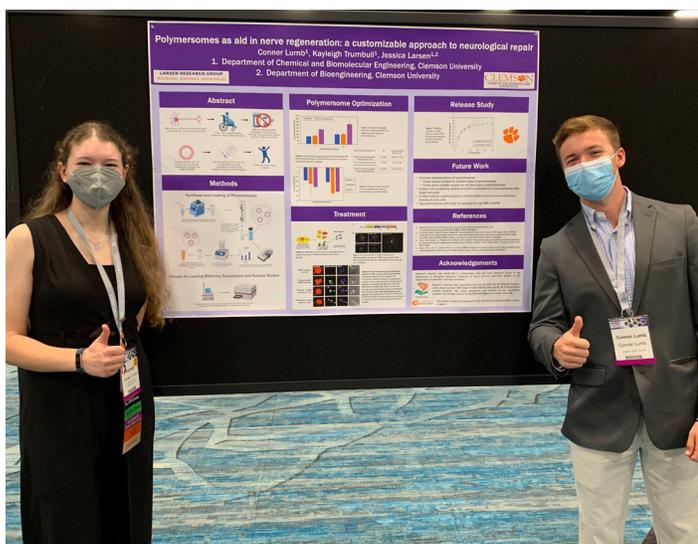
This opportunity is a significant honor for an undergraduate researcher. Her team, comprised of **Danielle LaVigne** (not pictured), junior genetics major, **Sara Edgecomb** (not pictured), recent ChBE graduate, and **Vaishnavi Kanduri** (not pictured), sophomore BioE, looks at the use of polymersomes as Cas9 delivery vehicles as gene knockdown tools to create therapeutic edits.



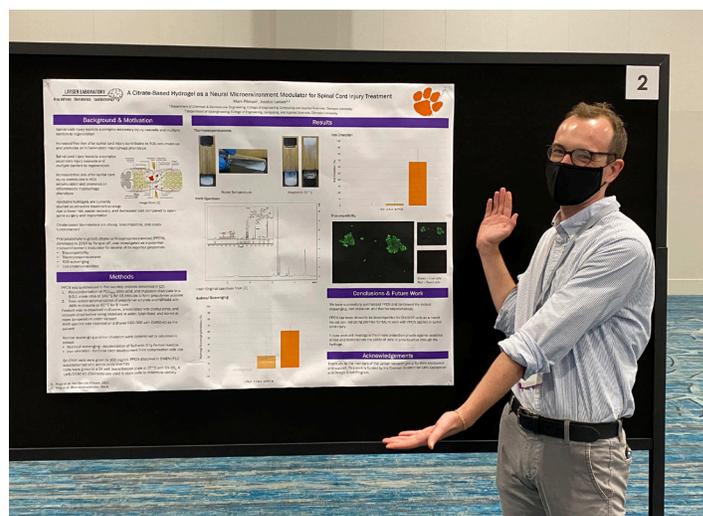
A creative inquiry team, **Taylor Hamas** (middle), senior BioE, **Jess Jager** (right), senior ChBE, and **Joey Lavalla** (left), senior BioE, co-advised by **Angela Alexander-Bryant** in Bioengineering and her Ph.D. student **Megan Pitz**, presented their work on novel CT imaging agents to enhance glioblastoma detection in a poster on Friday, Oct. 9.



**Morgan Ethridge**, junior biochemistry major, presented on behalf of her creative inquiry team on their SC INBRE funded work to determine the validity of enzyme activities as biomarkers of neurodegenerative disease GM1 gangliosidosis on Saturday October 10th.



Two ChBE undergraduate students, **Kayleigh Trumbull** (left), sophomore, and **Conner Lumb** (right), junior, presented on their SC EPSCoR funded work to characterize most appropriate polymersomes for nerve regeneration applications on Friday, Oct. 9.



**Mark Pitman**, fourth year Ph.D. student in ChBE, presented on his work, funded through the CU SEED program, on the development of thermally-responsive, citrate-based hydrogels, as iron chelating biomaterials to improve microenvironment after nerve injury, promoting nerve regeneration on Saturday, Oct. 10.



Graduate students of the Davis Lab taking a group photo. From left to right: Nick Gregorich, Keturah Bethel, Xueting Wang. Not pictured: Missouri Lytle

# Graduate Students Attend Annual AIChE Meeting

The American Institute of Chemical Engineers (AIChE) annual fall meeting occurred at the John B. Hynes Veterans Memorial Convention Center in Boston, Mass., Nov. 7-11, 2021.

Several graduate students from the Department of Chemical & Biomolecular Engineering were in attendance, presenting their research in various poster and oral presentation sessions.

Among those in attendance included Keturah Bethel, Xueting Wang, Missouri Lytle, Nick Gregorich, Caleb Arp, Zach Pittman, Carter Fitzgerald and Ricardo Garcia. There was also the option to present virtually for those that could not attend in person. Among those that presented virtually at AIChE were Graham Tindall, Dyllan Rives, Chengjun Wu.



Keturah Bethel, Ph.D. student, presenting her research in the Hydrogel Biomaterials: Design and Characterization session.



Missouri Lytle, Ph.D. student, presenting her research in the Polymer Networks and Gels session.



Ph.D. students enjoying dinner together in Boston. From left to right: Nick Gregorich, Carter Fitzgerald, Zach Pittman and Caleb Arp.



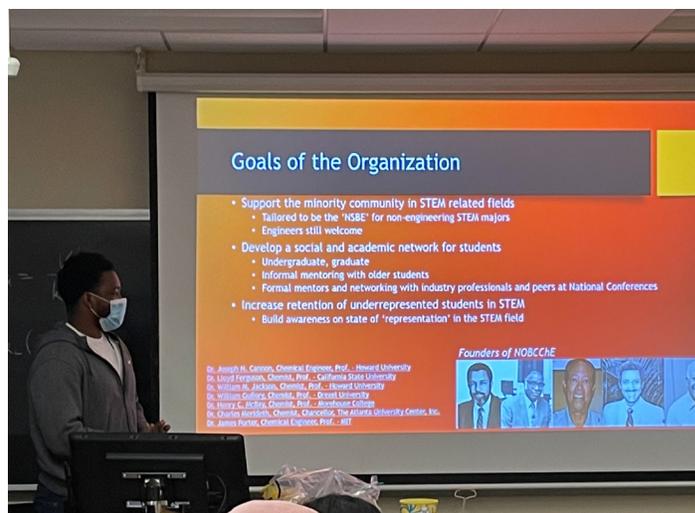
From left to right: Oreoluwa Agede, Friendship Edioma, Ewa Chukwu, Breha Fulfor, Jessica Glover, Keturah Bethel, Abena Williams, Joshua Osuofa, Abenazer Darge and Jaden Stutts.

Clemson University welcomes its very own chapter of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers as the student-led organization obtains official student organization status. The organization is revamping its membership and activities after the difficulties brought on by the COVID-19 pandemic.

The organization is led by Ph.D. students Keturah Bethel, who serves as president, and Joshua Osuofa, who serves as vice president. The executive board also consists of Abena Williams, secretary, Ewa Chukwu, treasurer, and Jessica Glover and Taemaisha Collins, who serve as co-chairs over public relations. The Clemson chapter is advised by Eric Davis and Caitlin Clark.

In the fall semester, NOBCCChE was able to host several events that brought both social and professional development opportunities to chemistry and chemical engineering students of all standings. Students were able to bond during a Meet and Greet Game Night, network at a seminar presented by Sam Lukubria, P.h. and attend an Eastman Chemical Recruitment event.

Before the holidays, the organization was also able to encourage and support students through Exam Week with food and goodies in collaboration with Women in Chemical Engineering



Joshua Osuofa, chapter vice president, presenting at the NOBCCChE Meet and Greet Game Night.

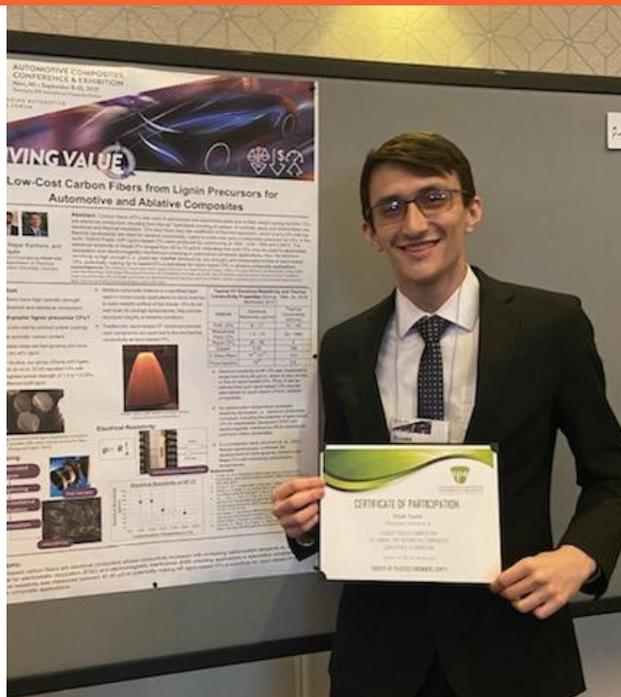
and host a collection drive for Helping Hands of Clemson. A future goal for the upcoming semester is for the organization to attend the Annual NOBCCChE Professional Conference in 2022 and continue to provide opportunities for students to grow as professionals.

## ELIJAH TAYLOR WINS BEST STUDENT POSTER AWARD

At the Automotive Composite Conference and Exhibition, ACCE 2021, organized by the Society of Plastics Engineers (SPE) in Detroit, Nov. 1-4, 2021, Elijah Taylor won the Best Student Poster Award. He presented research results on “Low-Cost Carbon Fibers from Lignin Precursors for Automotive and Ablative Composites”. The poster was co-authored with his Ph.D. mentor, Sagar Kanhere, and their faculty advisor, Prof. Amod Ogale. Graham Tindall and Prof. Mark Thies are collaborators on the project and provide purified lignin precursors.

Taylor is a junior in chemical engineering and has been working as an undergraduate assistant in Prof. Ogale’s group under the mentorship of Sagar Kanhere (Ph.D. student). Taylor works closely with Kanhere to conduct dry-spinning of lignin fibers followed by their stabilization and carbonization. They measure various structural and transport properties of the resulting carbon fibers. They are advised by Prof. Amod Ogale, who is a Fellow of the American Carbon Society and has been a recipient of the Graffin Lecturer Award from ACS. The

**Elijah Taylor** receiving his poster award from **David Jack**, technical program chair of the conference, of Baylor University.



## OWEN CHAMNESS AWARDED FOR ACADEMIC EXCELLENCE

**Owen Chamness** at Eastman, where he is currently gaining industry experience through the Clemson Cooperative Education program.

Not long ago, Chamness was notified by Joy Rodatz that he had been selected to receive the Donald F. Othmer Sophomore Academic Excellence Award for the 2020-2021 academic year. Chamness was taken by surprise, but he was excited to be recognized for all of the hard work that he’s put in over the first two years of his time in chemical engineering.

“This award is the culmination of many long nights of staring at steam tables and pressure-enthalpy charts. I know every student in this major has put in just as much work as I have, but I am nonetheless honored to be recognized for it. This achievement wouldn’t have been possible without the support of my classmates, professors and my amazing study group, and to all of them I am very grateful,” says Chamness.

And with this award came the opportunity to be recognized at the 2021 AIChE Annual Student Conference in Boston. Unfortunately, Chamness was unable to attend as he was currently on a coop rotation with Eastman on their environmental operations team in Kingsport, Tennessee. Chamness says this has been the most rewarding semester of his chemical engineering career by far, and he is excited to return to Eastman for two more rotations over the next year and a half.



**From Left to Right: Prof. Amod Ogale**, director, CAEFF and Dow Professor, **Jasmine McTyer**, undergraduate senior, **Michael Green**, undergraduate senior, and **Antonia Craig**, undergraduate senior.

## HEARST SCHOLARSHIPS AWARDED TO MCTYER, GREEN AND CRAIG

Jasmine McTyer, Michael Green, both chemical engineering seniors, and Antonia Craig, a senior Materials Science and Engineering major, are the recipients of the Hearst Scholarships for the academic year 2021-22. Hearst Scholarships worth about \$ 3,500/year are awarded to outstanding undergraduate students involved in research at the Center for Advanced Engineering Fibers and Films (CAEFF). Students are selected on a basis consistent with promoting diversity among the student body.

Craig is conducting research on plant-derived polymers for packaging materials under the advisement of Prof. Igor Luzinov of the Department of Materials Science and Engineering. She is being mentored by a Ph.D. student of the Materials Science and Engineering program, Najah Mhesn.

McTyer is conducting research on microtextured films ,whereas Green is involved with UV-radiation based stabilization of lignin fibers. McTyer and Green are being mentored by a Ph.D. student Sagar Kanhere of the Chemical Engineering program under the advisement of Prof. Ogale (Dow Professor, ChE and director, CAEFF).



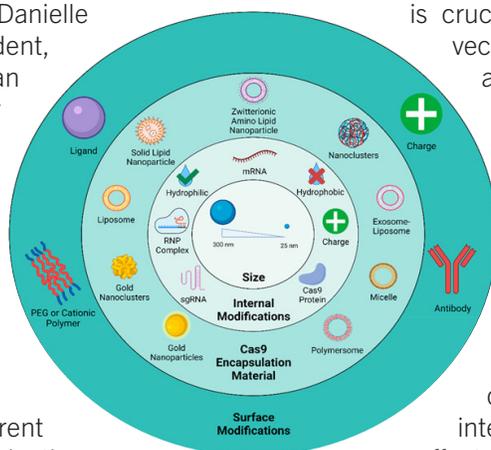
**Prof. Amod Ogale** discussing with **Jasmine McTyer** and **Michael Green** the principles of transient heat transfer in films using Netzsch thermal conductivity instrumentation.





## LAVIGNE & KANDURI PUBLISH ARTICLE IN TOP JOURNAL

Two undergraduate students, Vaishnavi Kanduri, a senior bioengineering student, and Danielle LaVigne, a senior genetics student, worked in Jessica Larsen’s lab on an NSF REU throughout the summer of 2021, which Larsen served as the thrust leader for materials in human health. With Larsen’s mentorship, these bright young women were able to publish a paper in a top polymers journal, ACS Macro Letters, titled “Current Advances Toward the Encapsulation of Cas9.”



The paper provides an overview of current advancements being made toward the encapsulation and delivery of Cas9 to desired areas of the body through encapsulating nanoparticles. This will assist in finding ways for scientists to utilize the clustered regularly short palindromic repeat (CRISPR)-associated protein, known as Cas9, to treat the root of problems relating to genetic diseases. The Cas9 protein is often codelivered with guide RNA or in ribonucleoprotein complexes (RNP) to ensure targeted delivery of the genetic tool as well as to limit off-target effects. Several factors must be considered when employing the Cas9

system to allow gene editing to occur. Material selection is crucial to protect the payload of the delivery vector. Current literature indicates that lipid- and polymer-based nanoparticles show the most potential as delivery vessels for Cas9. The proper functioning of Cas9 is dependent on maintaining a proper internal environment; however, there are gaps in the literature regarding these optimal conditions. Interactions between charges of the Cas9 protein, codelivered molecules, and delivery vehicles could impact the effectiveness of the gene editing taking place. While the internal charges of nanoparticles and their effects on Cas9 are presently undetermined, nanoparticles currently offer the ideal delivery method for the Cas9 protein due to their adequate size, modifiable external charge and ability to be modified.

Overall, a cationic lipid-/polymer-based nanoparticle system was found to have the most prospects in Cas9 delivery thus far. By understanding the successes of other systems, translatable, polymer-based delivery vehicles may be developed.



**Danielle LaVigne,**  
senior genetics student, Larsen Lab



**Vaishnavi Kanduri,**  
senior bioengineering student, Larsen Lab

# PIERCE AND KATTERMAN PUBLISHED VIDEO IN JoVE

Chris Pierce, a CHE senior, and Cara Katterman, a CHE 2021 graduate, both advised by Jessica Larsen, were published in JoVE. JoVE is a leading producer in scientific research videos and the students were able to showcase their recent research on drug delivery.

The blood brain barrier (BBB) creates a significant obstacle for drug delivery. Systems like tight cell junctions and P-glycoprotein efflux transports create a unique problem to delivering drugs to the brain. Current approaches to bypass the BBB either involve methods that have the potential to expose the brain to blood borne pathogens or use targeted nanoparticles.

Although targeted nanoparticles have had some pre-clinical success, the treatment is highly specialized requiring a disease-by-disease basis to identify the appropriate target and ligands. The novel solution we propose to create a more robust treatment that uses elongated polymersomes with greater surface to mimic native uptake,

thus increasing the uptake of polymersomes into the brain. Polymersomes are an advantageous drug delivery device due to their high customizability. Polymersomes can be stimuli-responsive, long circulating and protect hydrophobic and hydrophilic payloads. Elongated polymersomes will have greater surface area contact with the cell in comparison to spherical particles, allowing for greater uptake. The approach for bypassing the BBB is universal and would allow for the delivery of a variety of payloads carried by the polymersome, including proteins, gene editing technologies and small molecule drugs. Pierce, Katterman and Larsen hypothesized a salt-based method would be able to elongate polymersomes by taking advantage of the osmotic pressure gradients across the hydrophobic bilayer membrane.

The full video can be found at <https://www.jove.com/v/62548/modulating-shape-polyester-based-polymersomes-using-osmotic>

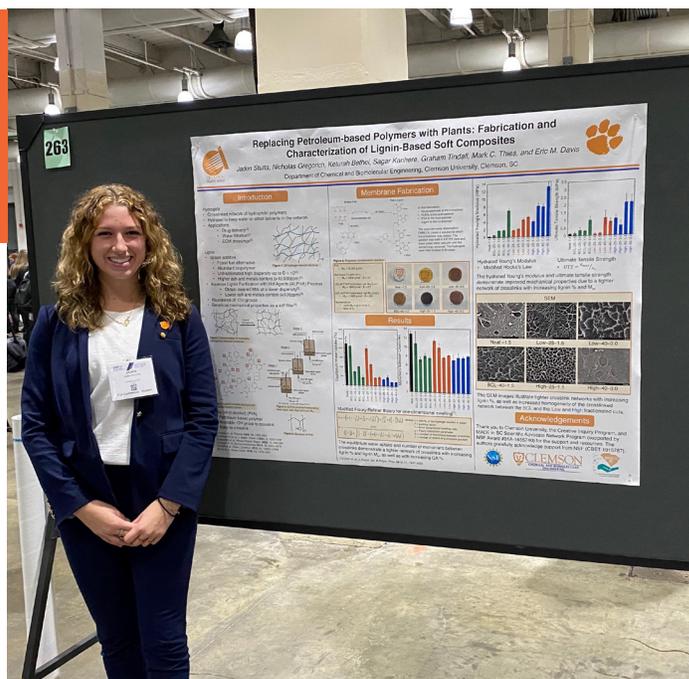
**From Left to Right: Cara Katterman, chemical engineering graduate, unknown, and Chris Pierce, senior Chemical Engineering student**



# JADEN STUTTS ACHIEVES THIRD PLACE IN AICHE POSTER SESSION

Jaden Stutts, an undergraduate student in the Chemical & Biomolecular Engineering department, has been an active member of the Eric Davis Research Group since joining in the Spring '20 semester. Her research involves the incorporation of lignin into hydrogel soft composites tailored for membrane-based separations. While in attendance at the AICHE 2021 November meeting, she competed in the Materials Science & Engineering Division undergraduate poster session where she placed 3rd for her session.

Her poster was titled: "Replacing Petroleum-based Polymers with Plants: Fabrication and Characterization of Lignin-Based Soft Composites." Congrats to her, well deserved!



# Diana Stamey retires after 35 years of service in 2022



In 2001, she moved to the Center for Advanced Engineering Fibers and Films, an NSF Engineering Research Center. Chemical Engineering was one of the multiple-research departments associated with the CAEFF. Therefore, she was able to maintain a great working relationship with Chemical Engineering.

In 2009, CAEFF moved from Rhodes to Earle Hall as it completed its 10-year program to become a graduated NSF-ERC program. Chemical Engineering was in need of expanding its office staff count, as more jobs duties needed to be removed from faculty.

In 2015, Stamey's position changed to part-time administrative assistant with CAEFF and graduate student services coordinator of chemical and biomolecular engineering.

One of her major accomplishments with the department was to uncover the hidden gems in Earle's documents, that dated back to Charles Littlejohn, to find what needed archiving.

"Earle Hall has a lot of history attached to it," Stamey said. "I love learning little pieces of information each time I scan the documents for history. I will miss the people most of all. Watching the students mature with each year as they approach graduation, has the greatest rewards with a little heartbreak. You miss them when they leave. Occasionally, you get a big surprise when they return. This brings sunshine back into Earle Hall with every visit."

Stamey looks forward to traveling after her husband, Jimmy Stamey, retires. They plan to camp and travel to places they have talked about for years.

The Department of Chemical and Biomolecular Engineering is excited to announce the retirement of Diana Stamey.

Diana Stamey began working for Chemical Engineering in March 1987 as the typist for the faculty before personal computers were introduced. She had to "re-invent" herself when personal computers arrived to Chemical Engineering.

Stephen Melsheimer was able to provide her with direction by reassigning her position to meet the demands and needs of the undergraduate students related to registration and the course scheduling. In 1996, her job duties expanded to include graduate student services support.



# Welcome, Adair Andreasson

Adair Andreasson joins us from a IVD Biomedical company, where she worked as an associate product manager. She is now currently working as our office manager, taking on the responsibilities such as developing office communication protocols, streamlining administrative procedures, assist graduate students, office staff supervision, and task delegation. Andreasson is an alumni of Clemson University, receiving a Bachelor of Arts in biological sciences upon her graduation.

As a South Carolina native, she enjoys being at Clemson where she hopes to make a positive and lasting impression, while also furthering her educational experience.

## FALL GRADUATES



### MAX HILBERT GRADUATES IN 2021 WITH HIS Ph.D.

The Department of Chemical and Biomolecular Engineering is proud to announce the graduation of Ph.D. student Max Hilbert.

Hilbert successfully defended his dissertation entitled "*Towards Understanding Protein Immobilization Rules Through Site-Specific Covalent Immobilization of T4 Lysozyme*" in Fall 2021 and walked across the stage with other Clemson graduates in December of 2021. We are excited to see what he accomplishes next! Hilbert was advised by Mark Blenner.

### CALEN RAULERSON GRADUATES IN 2021 M.S.

The Department of Chemical and Biomolecular Engineering is proud to announce the graduation of M.S. student Calen Raulerson. Their research was in Water Recovery from Bioreactor Mixed Liquors using Forward Osmosis with Polyelectrolyte Draw Solutions.

### RAYMOND LIQUOIS GRADUATES WITH HIS UNDERGRADUATE DEGREE IN CHEMICAL ENGINEERING



Department of  
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BIOMOLECULAR  
ENGINEERING**  
Clemson University

127 Earle Hall, Box 340909  
Clemson, SC 29634-0909  
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