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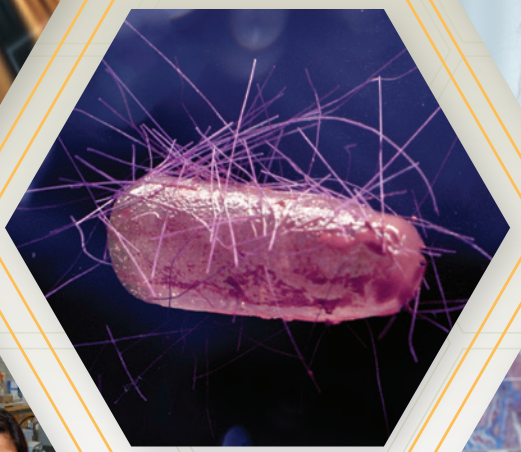
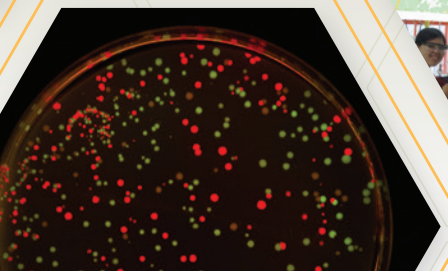
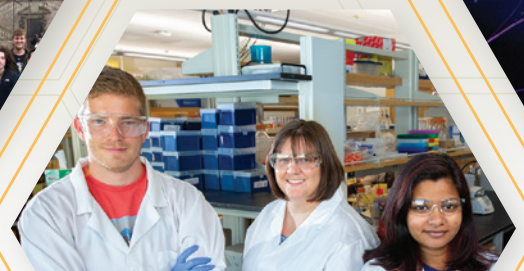
ISU Chemical and Biological Engineering

IOWA STATE UNIVERSITY
Department of Chemical and Biological Engineering







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Dear Alumni and Friends,

Hello from Iowa State University's Department of Chemical and Biological Engineering. We hope you enjoy this year's installment of *Active Site*, our annual departmental newsletter. You may notice that this edition has a slightly different look and feel than previous versions. I hope you like it. Thanks to the efforts of the communications team in the department and the College of Engineering for doing such a wonderful job with this document.

Inside this issue you will find a variety of stories, information, and updates from various aspects of the department. Read about the future of faculty-led research center efforts (**CBiRC**), accomplishments of our graduate students involved in research (**Nanovaccine**), exciting faculty research projects (**Jarboe**, **Panthani**), efforts to promote lab safety (**Beckman**), new leadership roles (**Cochran**), words of wisdom from prominent alumni (**Ryerkerk**), highlights from undergraduates participating in international adventures (**Oviedo**) and competitions (**Chem-E-Car**), tales of career passions (**Jolls**), and new alumni adventures (**Baxter**). Those alumni currently serving on the department's Advisory Council are highlighted, along with a selection of recent publications from our faculty's research efforts. As always, we recognize the scholarships and fellowships awarded to our students, and also acknowledge the generosity of our donors for making these awards available.

Let me take this opportunity to express my sincere thanks and appreciation to our many friends who have supported our mission. The generosity of our alumni and other donors has allowed us to support a great many efforts in the department, ranging from undergraduate scholarships and named faculty positions to building renovations and research facilities. Thanks all of you for your generosity and friendship. You are a major factor in the success of Iowa State and the Department of Chemical and Biological Engineering.

I hope you enjoy reading this issue of *Active Site*. Please send me any comments, updates or suggestions you have for future issues (hillier@iastate.edu), or to just send a greeting. Let me also take this opportunity to invite you back to campus. If you get a chance to stop by Sweeney Hall, please come in and say hello. I would be delighted to visit with you and give you a tour.

My warmest wishes to all of you for a happy, healthy and productive year.

Go Cyclones,

Andrew C. Hillier

Andrew C. Hillier
Professor and Reginald R. Baxter Endowed Department Chair

CBE By The Numbers

Bachelor's Degrees
158
Awarded in 2018

Master's Degrees
5
Awarded in 2018

Ph.D. Degrees
10
Awarded in 2018

Research Expenditures

- Advanced & Nanostructured Materials
- Biorenewables
- Catalysis & Reaction Engineering
- Computational Fluid Dynamics
- Health Care Technology & Biomedical Engineering
- Renewable Energy

2014 **$8.9M**

2015 **$8.0M**

2016 **$9.4M**

2017 **$8.6M**

$9.9M
2018

Average Funding per Faculty Member
$469,698

231 undergraduate scholarships worth $465,000 impacting 163 students

7 graduate fellowships worth $120,000 impacting 7 students

CBE donor Mike Steffenson (center) with recipients of the Mike and Jean Steffenson Scholarship at the fall 2018 awards banquet.

New chapter, same mission for Iowa State's CBiRC

Center for Biorenewable Chemicals

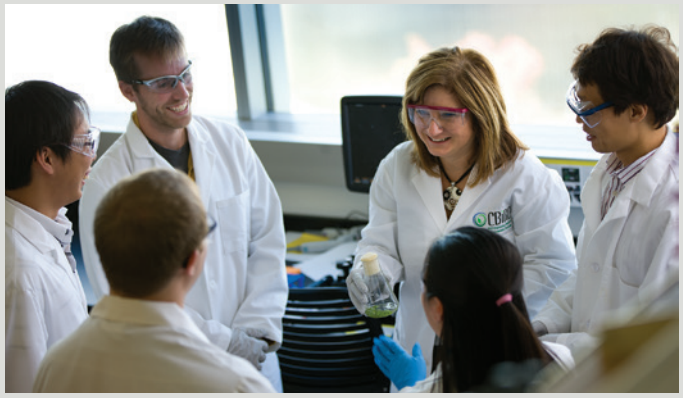
There's one thing **Brent Shanks** (pictured) wants you to understand about the future of the Center for Biorenewable Chemicals, better known as CBiRC: "We have no intention of going away. We have a different way of looking at biobased chemical problems and how to address them, and there is a big demand for it."

Founded in 2008 with funding from the National Science Foundation, CBiRC has become a world leader in producing chemicals derived from biomass resources as a viable alternative to chemicals derived from petroleum. By design, the 10-year funding program from NSF has now come to an end. But that doesn't mean there's an end in sight for CBiRC.

"It's important to note that CBiRC is coming to an end as an NSF Engineering Research Center. The NSF designation will disappear from our name. But we are working with other funding sources and our mission will continue," says Shanks. One big change: Instead of performing all work through NSF support, CBiRC is now reaching out to other agencies and facilities in collaborative ventures. For example, CBiRC has become a subcontractor for work done by the Joint BioEnergy Institute led by Lawrence Berkeley National Laboratory, and there is a grant from the Department of Energy that is being employed. Shanks says even the Department of Defense is interested in the kind of projects CBiRC is involved in.

Shanks, Anson Marston Distinguished Professor in Engineering and Mike and Jean Steffenson Chair, came to Iowa State from a petrochemical background. "So, I had biases," he admits. "When CBiRC started I said, 'We must create biomass-derived molecules that are direct replacements for molecules from petroleum.' In retrospect, that may have been short-sighted on my part."

When the price of crude oil tanked, there was suddenly little economic justification for creating bio-derived molecules that would simply replace what is produced from crude oil. It led to the most pivotal change in CBiRC's research, and one that still guides its mission today – the development of what Shanks dubbed "bioprivileged molecules." Instead of the conventional way of tweaking one molecule at a time to do single things, the concept of bioprivileged molecules involves creating all-new molecules from which different variations can be easily crafted. This opens up a whole new avenue of options for industry. Shanks makes a quick drawing on a white board to illustrate. He basically draws a "hub and spoke" design, in which the bioprivileged molecule sits in the center and the spokes each lead to a differently-tuned variation of that molecule. "We can create this entire library of new molecules and send them to an industrial collaborator all at once. Then they have a wide variety of molecules they can test to see which performs best for their specific consumer product."



Manley R. Hoppe Professor Jacqueline Shanks talks research with graduate students in a CBiRC lab.

The ramifications are huge: "This has reframed our entire mission," says Shanks. "And through this we've connected CBiRC to new partners and that has resulted in grants to allow development of new concepts."

Out of necessity, Shanks often takes off the "scientist" hat and replaces it with that of "economist/business analyst." He says, "We are creating and searching for new bioprivileged molecules all the time. The last time the petroleum industry commercialized a new molecule was 25 years ago." Like any good businessman, he also examines the competition. He points out there are facilities called biological foundries that are also creating molecules for industry – but with a big difference. "These are based exclusively on biology. You have to manipulate an organism – a life form – to get what you want. To do this, you need to have a living organism for each and every molecule you want to make. While elegant, it's an inefficient way of searching for new molecules. With bioprivileged molecules, all you have to create is one key intermediate molecule, and then you test variations of it from there. Much more practical."

During the past several years, CBiRC added two new Iowa State Department of Chemical and Biological Engineering faculty members to its research team: Associate Professor **Zengyi Shao** (a recipient of the NSF CAREER Award in 2018) and Associate Professor **Jean-Philippe Tessonnier**. Other members of the department have also played integral roles within CBiRC. Manley R. Hoppe Professor **Jacqueline Shanks** was part of the original CBiRC leadership team and was responsible for organizing research efforts in microbial metabolic engineering. Associate Professor **Laura Jarboe** has been a member of CBiRC from its inception and was co-leader of the microbial metabolic engineering area during the second five-year period of the center.

In Shanks' opinion, the quest for new bio-based molecules isn't about to subside. "Do we have all the new organic molecules we need? Are we done? The answer is no. There is a huge market out there. Pharmaceuticals. Antimicrobials. Insecticides. Herbicides. Polymers. Lubricants. Some of the traditional chemical substances in products like these are being shown to have significant environmental impacts. There is a great desire to develop environmentally friendly and effective new molecules for use in many consumer products. We're ready to address that."

93 patent applications

18 licenses issued

250 peer-reviewed technical publications

99 doctoral students

133 undergraduate researchers

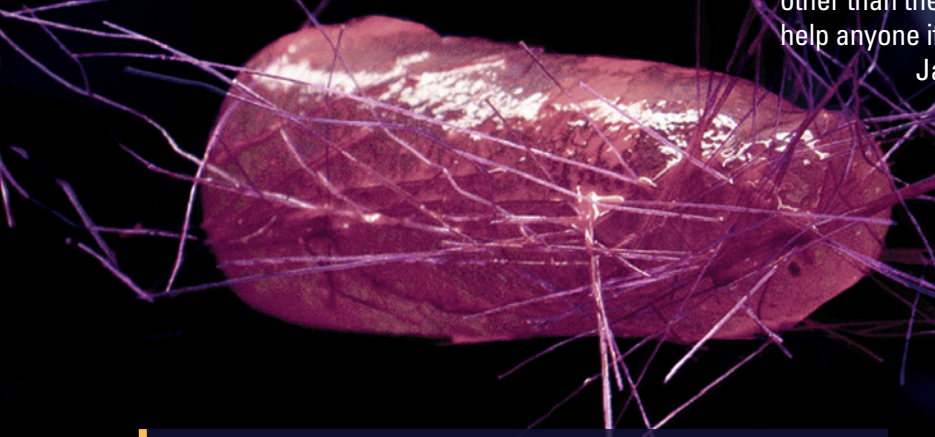
9 startup companies spun out

Robust microbes – *with business potential* – is the mission in the Jarboe Research Group

To the average outsider looking in at scientific research it's easy to think that "science is science." But in reality, especially in today's world, scientific researchers need a partnership with something else – a good head for business.

"At the university level, it's one thing to do great science, but to help people, you have to engineer the economics." Those words come from CBE associate professor **Laura Jarboe**, whose work, at its core, deals with making microbes more robust – so they can create better, more desirable, more durable products, that, yes, have a better potential for helping people and of being sold to end users. "There are a lot of good ideas out there," Jarboe says, "but what counts is economic viability."

Jarboe can point to a great deal of history where chemical engineering has made this difference through engineering of microbes and organisms, and how this impacts her own research.



Changing the composition of cell membranes to make them more functional – and more economically viable – is a priority of the Jarboe lab.

Insulin: Jarboe points to the development of consumer-friendly insulin as a prime example of modifying organisms to achieve an end. When insulin was introduced as a medical product in the early 1900s its therapeutic value was readily apparent. But being extracted from animal pancreases, it was hard to harvest, was expensive, and caused an allergic reaction in some patients. The genetic modification of the bacteria E. coli to produce insulin, via the introduction and expression of a non-native gene, enabled the production of safe and affordable insulin at scale. It was a landmark development, as it was the first time that bacteria had been explicitly modified to enable production of a non-native compound.

Penicillin: The world's first true antibiotic, credited as one of the most important developments in the history of medicine, was initially prohibitively expensive and could not be used at anything other than the proof-of-concept level. "It couldn't help anyone if no one could afford it," says Jarboe. It was the development of improved fermentation methods and identification of more robust production organisms that helped spur large-scale commercial production by the mid-1940s.

Petroleum: The champion of providing power and heat, Jarboe is quick to state that many people are unaware of the role petroleum also plays in production of commodity goods. And after decades of the growth of fossil fuels in the petroleum industry, she points out there is now a move toward biomass-based energy that can supplant or replace petroleum; but again, the mantra of needing to be economically feasible rears its head. "Engineers are trying to develop and improve processes that use microbes to produce compounds we currently get from petroleum, while being economically competitive with these petroleum-based processes."

It's the mission of developing microbial organisms that are more robust in industrially-relevant conditions that is the primary focus of Jarboe's research group. In short, cells that can be used in large numbers and can stand the rigors of industrial-scale production. A substantial concern here is the fact that many of these biorenewable products are toxic to the production organism, just as ethanol is toxic to humans at high concentrations. This toxicity plays a key role in the economic viability of the development of some products, as a low product concentration increases the cost of product recovery.

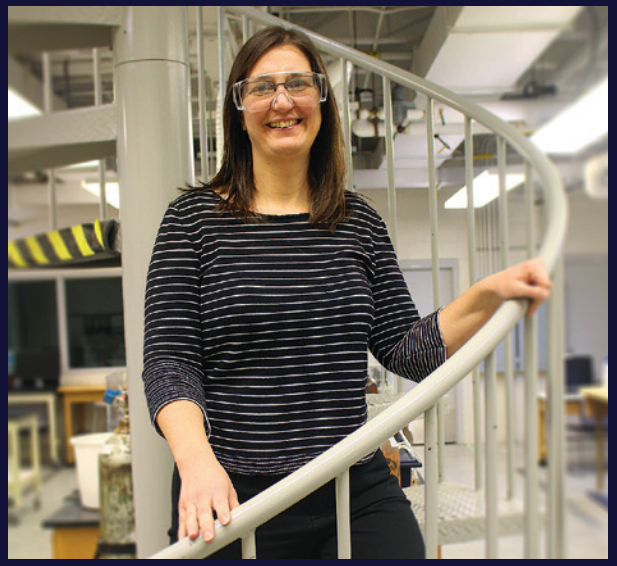
In many cases, this toxicity is due to damage to the microbial cell membrane by these fuels and chemicals. The membrane of a cell acts as a protective barrier between what's outside the cell and what's inside it. "Lots of materials can damage the membranes of cells," Jarboe explains. "Cell membranes are very important and must be durable," she says, and uses human skin as a metaphor for this. "It's like a proper cell membrane – good in, bad out."

"There are several important metrics here to indicate that the membrane is functioning correctly. Membranes must remain intact – they cannot have holes. They have to have integrity – they can't be leaky. And they need to have proper

fluidity." (She uses an example of butter vs. olive oil in the kitchen. Butter melts quickly under heat, where olive oil stays fluid.) Jarboe and her group are countering membrane damage by changing the composition of the cell membrane.

"We want to change the composition of the membrane to counter balance these effects and make the membrane more functional – so things can be made in higher concentrations and be more economically viable. We're changing the genetics of the organism to make a more functional membrane. We've seen that this approach can improve production of a variety of attractive products, including styrene."

Jarboe is the former chair of Iowa State's Interdepartmental Microbiology Graduate Program and in 2018 was selected as a College of Engineering representative of the Iowa State Biotechnology Council.



CBE labs and safety are the priority for returning ISU alumna

Sarah Beckman has returned to Iowa State to join the Department of Chemical and Biological Engineering as a laboratory supervisor. Beckman graduated from Iowa State in 1999 with a concurrent B.S. in ceramic engineering and M.S. in materials science and engineering.

"I've enjoyed being back at Iowa State University," Beckman says. "The energy of the students and the timelessness of the campus make it feel like a lot less than 20 years since I graduated."

Beckman will work with CBE faculty and students in the areas of teaching laboratories, shared research laboratories and lab safety.

"If the students can cultivate an awareness of the risks inherent in the activities around them, feel compelled to stop and speak up when things don't seem right, and are trying to continuously improve their safety practices, I will feel like we have successfully trained them for future employment," Beckman said.

Tiny components, big accomplishments for Nanovaccine Institute's young scientists

From left: **Sean Kelly**, **Kathleen Ross** and **Sujata Senapati** are part of a team of graduate students and scientists helping to revolutionize vaccines through the Nanovaccine Institute, based at Iowa State.

The headlines and feature stories have become frequent for the Iowa State University-based Nanovaccine Institute, a multidisciplinary network of scientists devoted to transforming the development and delivery of vaccines and therapeutics that will fight deadly diseases worldwide.

Led by Iowa State Chemical and Biological Engineering Anson Marston Distinguished Professor and Vlasta Klima Balloun Faculty Chair ***Balaji Narasimhan****, it's composed of researchers from 20 institutions nationwide.*

Nanovaccines are composed of tiny particles that encapsulate a multitude of payloads and/or medicines which can be delivered to targeted areas of the body to address specific problems. They will be used to treat everything from flu to cancer in a revolutionary way to tackle daunting diseases.

But there is another component to the story: a group of chemical engineering graduate students and research associates who are working alongside faculty while they earn their Ph.D.s – and prepare to enter the world of scientific education and research armed with invaluable first-hand experience.

Sean Kelly *is a graduate student scheduled to receive his Ph.D. in December, 2019.* ***Kathleen Ross*** *obtained her Ph.D. from CBE in 2013 and now works for the institute as an assistant scientist.* ***Sujata Senapati*** *is a graduate student who plans to obtain her Ph.D.*

What led you to Iowa State for your graduate work?

Sean: "When I was an undergrad at Colorado State University, I studied under Matt Kipper, a faculty member at CSU, who was Dr. Narasimhan's first Ph.D. student at Iowa State. Through Dr. Kipper I learned about Iowa State and Dr. Narasimhan. I applied and started in the fall of 2014."

Kathleen: "I was at Michigan Tech as an undergrad in biomedical engineering and came to Iowa State for a summer with ISU's BioMaP REU undergrad research program. When it came time to choose a graduate program, I contacted Dr. Narasimhan, and ended up coming back. I got my Ph.D. here in 2013."

Sujata: "I was fascinated by nanomaterials and their biological applications, and ISU intrigued me!"

What type of research are you doing with the Nanovaccine Institute?

Sean: "My focus is on respiratory pathogens and how nanovaccines can address them. I'm helping to create vaccines that deal with this by being 'shelf-stable.' Vaccines that remain viable in storage for the long term and can be used in the future if needed for large disease outbreaks."

Sujata: "I am working on a nanomaterials-based vaccine against influenza, specifically designed for older adults. People above 65 are more susceptible to flu because conventional technology doesn't address changes in their immune system. We do."

An addition to your experience in the lab has been a spray dryer-based process you've designed to help create the nanovaccine materials you use. Tell us about that.

Sean: "The process uses a piece of lab equipment called a spray dryer and Kathleen, Dr. Narasimhan and I developed it to help produce the nanoparticles used in creating the vaccines more efficiently. It basically mass-produces them, which makes turning them out in larger quantities viable. You can't produce thousands of nanoparticles by doing them in small batches, as is normally done. The spray dryer combines a solution with a vaccine of interest and basically sprays fine droplets out at the top of a large tube. As the droplets fall through the tube a solvent on the outside of each particle dissolves away and dries and you are left with many nanoparticles that encapsulate the vaccine."

Kathleen: "The spray dryer benefits our work in different ways. It is more cost-effective since it allows you to create nanoparticles en masse. It's also environmentally friendly because the process uses a lot less chemicals.

What do you like best about your work with the Institute?

Sean: "It is very humbling to work with a group like this where you are constantly reminded of how working together can accomplish many goals."

Kathleen: "We get to work with people from so many different disciplines, and we also work with different animal models with the research. We work with biologists, virologists, immunologists and other engineers."

Sujata: "We understand that pathogens are smart, and to tackle them, we need expertise from people in different fields."

What are your future plans?

Sean: "I'm just finishing up my Ph.D. program, but I hope to to stay on for another year to continue development of the spray dryer-based process. I really like working with biomaterials in vaccines, and I look forward to working with that."

Kathleen: "I want to continue working as an assistant scientist with the group. I've looked at industry and education, but neither seemed like a 100 percent fit for me. Work we are doing with the flu nanovaccine on mice will be entering its next phase, which will be testing it on monkeys. That would be the final step to applying for FDA clinical trials."

Sujata: "I want to do postdoctoral training after my Ph.D. to find improved global healthcare."

The Nanovaccine Institute will soon move into a new dedicated space in ISU's Advanced Teaching and Research Building. This will put all nanovaccine researchers together under one roof, creating an even more united and efficient collaboration.

Semiconductor materials power Panthani to NSF CAREER award

Department of Chemical and Biological Engineering assistant professor and Herbert L. Stiles Faculty Fellow **Matthew Panthani** was awarded the prestigious National Science Foundation CAREER Award in April 2019.

The Faculty Early Career Development Program (CAREER) honor is one of the most sought-after awards for university-level teacher-scholars who are in the early stages of their careers. It supports those who most effectively integrate research and education into their work. A particular research topic for the individual is selected for the honor.

Panthani was funded for "Synthesis and Properties of Group IV Colloidal Quantum Wells." The research is aimed at continuing the arc of creating better, more efficient ways of transmitting data for computer processors that will benefit areas such as education, health care, scientific research and national defense.

"The current method of using fiber optic cables to transmit data over long distances has become very energy efficient in recent years," Panthani explains. "But – when we transmit this data over a short distance, there is a lot less efficiency." He uses the example of the computer you may have on your desk right now: "When you use that computer it generates a lot of heat. The computer circuit chips in that computer contain miles and miles of wiring that heats up a lot and this heat limits the computer's performance."

Panthani and his research group are tackling this issue by developing a way for this data to be transmitted using optoelectronic properties (a laser is an example) instead of through wiring. This is done by thinking small. Very small. One-thousandth the width of a human hair small. That's the thickness of ultrathin sheets of semiconductor material using silicon or silicon mixed with the chemical element germanium. But the sheets need material on top of them to perform the needed functions. Panthani's group is experimenting with controlling and coordinating the composition, structure and chemistry of molecules attached (ligands). The plan is to have each molecule coordinated with a ligand to help protect it from things that can inhibit performance. The goal is to make processing of electronic devices better for computing and telecommunications.

A key team member in the research has been graduate student **Bradley Ryan**, who began his involvement with Panthani's research in 2014 as an undergraduate and has now continued on with the team as a graduate student. Ryan says he is "enthralled by investigating and understanding the reality that lies beyond what we know." In this case, what is known is that "this research has the potential to benefit society by enabling technologies that can lead to integrated photonics, which would enable faster, lighter and more efficient personal devices." He says these areas "need engineers

to mature technologies for implementation in commercially available products."

"Dr. Panthani enables me to think for myself, push the boundaries of science, and develop the skills that I need to be a successful scientist," says Ryan. "He is a main reason why I came back to Iowa State University to pursue a graduate degree."

The NSF CAREER award provides funding for the project to 2024. "But we have already established different directions to move in, and we have collaborators who are now interested," says Panthani, "including physicists at Argonne National Laboratory to look at silicon-based laser technology."

And perhaps one of the biggest contributions the research project will make is to help spread scientific knowledge and interest to K-12 students. "One of the goals of the grant is to have my group work with high school teachers to increase their exposure to scientific endeavors. It's all part of the Next Generation Science Standards, a national program for students," Panthani explains. "This program stresses the importance of moving away from just learning facts to actually experiencing the process of science. Teachers typically don't have hands-on experience in these processes. This program will have me working with science teachers in the summer to give them the kind of real world exposure they need to better teach their students, and we will collaborate with them to help them achieve this." The program will also help encourage underrepresented groups to pursue careers in STEM fields.

Panthani joined the Iowa State CBE faculty in 2014. His research focuses on addressing global challenges in the areas of energy production, utilization and efficiency.

Professor Eric Cochran named director of Center for Bioplastics and Biocomposites

Department of Chemical and Biological Engineering professor Eric Cochran has been named director of the Center for Bioplastics and Biocomposites (CB^2), which is based at Iowa State University. He had previously served as the center's deputy director.

CB^2 serves as a National Science Foundation (NSF) Industry & University Cooperative Research Center (IUCRC), which helps build partnerships between industry, universities and policymakers to promote the development of bioplastics and biocomposites, which are materials derived from natural, renewable sources such as biomass. "The IUCRC reduces the element of risk for companies involved in university research," Cochran explains.

As part of his duties as director Cochran will be responsible for growing membership in CB^2 with those very companies. Current industry members of the center include 3M, ADM, Boehringer Ingelheim, Ford, Hyundai Motor Group, John Deere, Kimberly-Clark, Sherwin Williams and others. Members receive priority access to technical data developed by the center, access to world-class facilities and researchers and reduced overhead costs for research.

The NSF supports centers such as CB^2 by providing a graduated funding plan. CB^2 was launched in 2014. It has hosted a research experience for undergraduates program since 2017.

CB^2 includes a number of Iowa State University faculty members and researchers, including **Balaji Narasimhan**, **Jean-Philippe Tessonnier** and **Nacu Hernandez** from CBE.

From Sweeney Hall classrooms to **Alumna Lori Ryerkerk is new CEO**

"A great experience before getting out into the workplace!" Those words about Iowa State's Department of Chemical and Biological Engineering curriculum are from alumna **Lori J. Ryerkerk** (B.S., 1983). Her new workplace is the CEO's office of Celanese Corporation in Dallas, Texas.

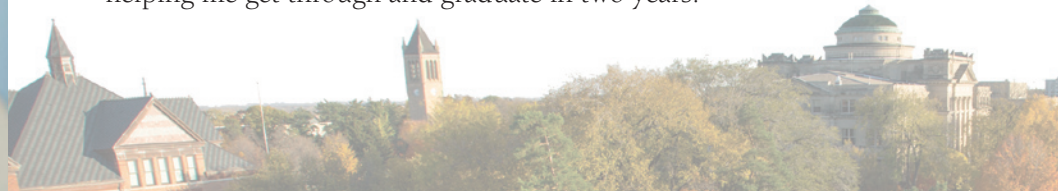
Celanese is a Fortune 500 global leader in specialty materials and chemical products used in most major industries and consumer applications. Ryerkerk was named chief executive officer, and a member of its board of directors, in May of 2019. Her three-plus decade journey in the energy industry began at Iowa State as a chemical engineering undergraduate in the early 1980s.

"I had a pretty short, but intense, stint at Iowa State," she says. "I transferred from a community college and I finished my chemical engineering degree in two years. I took engineering courses, organic and physical chemistry. Most of my professors had industry work experience of some sort and were able to relate what we were learning into practical examples and applications. We had a chemical engineering lab that was very hands-on, and I also did the summer session at University College London, which was very intense lab work and had visits to U.K. industries and facilities."

Ryerkerk also took advantage of a study group, which she says, "Taught me valuable skills in working as part of a group and learning from my peers."

Chemical reactions comes in first as her favorite ISU CBE class, "And," she says, "I used that pretty extensively in my first few years of work."

But not unlike many students who have been through the ISU chemical engineering program, there were a couple of faculty members who really stood out as ones who had a great influence on her experience: "I was fortunate enough to have **Maurice Larson**, then head of the department, as my academic advisor. He was great in helping me get through and graduate in two years.



the corner office: of Celanese

"I'm also thankful to **Terry King**. I graded papers for Dr. King and it was probably his influence, more than anything, that convinced me to go to work in the oil and chemical industry, which is how I got where I am today!"

Having spent her days as a chemical engineering student in the early 1980s when female students were in a significant minority, Ryerkerk was, and still is, keenly aware of the importance of diversity in university engineering programs and in the field itself. "I think it's very important that we continue to get more women into engineering," she remarks. "Research has proven that companies with more diversity have better financial results, and my own experience reinforces this. The most successful teams I have had were diverse – women, men, different nationalities, different personalities, different ways of working; lots of different opinions and backgrounds which often led to long discussions and debate. But as a result we ended up with better, more creative solutions. And since engineering requires creative problem solving, it only makes sense that we need to encourage a wider, more diverse population in our universities and in our businesses.

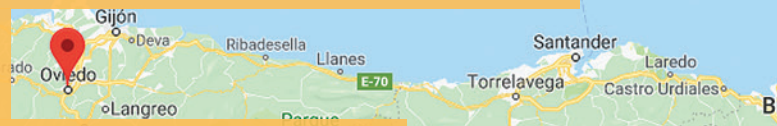
"I also think it's an incredibly rewarding career for women – intellectually stimulating, results focused and financially rewarding. It provides an excellent platform to develop collaboration and leadership skills and can open many other doors into other businesses and roles."

Prior to joining Celanese she was executive vice president of Global Manufacturing at Shell Downstream, Inc. (a division of energy and petrochemical giant Shell Global), where she led a team of 30,000 employees and contractors at refineries and chemical sites worldwide. She also worked for Hess Corporation and for ExxonMobil for 24 years.

"The most successful teams I have had were diverse – women, men, different nationalities, different personalities, different ways of working; lots of different opinions and backgrounds which often led to long discussions and debate. But as a result we ended up with better, more creative solutions."

- Lori Ryerkerk
CEO, Celanese Corporation

Expanded education and horizons – *with new financial aid* – for Oviedo, Spain lab students



It's a demanding program. But one many participants describe as the high point of their chemical and biological engineering experience at Iowa State – the Oviedo, Spain Summer Lab Program.

Eight students who recently returned from the 2019 Iberian adventure can now add themselves to the long list of students who have benefited from the trip: **Danniel Arriaga**, **Tyler Franke**, **Yi Hua Heng**, **Kyle Jackson**, **Logan Mayberry**, **Tim Schwanbeck**, **Kristian Shipley** and **Kevin Shoucair**.

Each student was able to take part in this year's program with scholarships available through the Hershel B. Whitney Global Initiatives Program. Established in 2018 and named in honor of the late Whitney, a 1949 graduate of the department, the assistance can play a large role in student participation.

"The Whitney scholarship solidified my decision to do this," says Mayberry. "I want to extend my appreciation to the kind donors because they have truly left a positive impact on my life through their generosity."

"Without this scholarship," says Jackson. "I would not have had the chance to do any of this international engineering learning and exploring."

The program utilizes the facilities and faculty of the University of Oviedo in northern Spain. It also includes students from the University of Wisconsin-Madison. The intensive five-week course serves up the equivalent of two different chemical engineering lab courses with hands-on experiments performed in teams, along with regular written reports and an oral presentation.

"There is lots of work and lots of sleep deprivation," says associate professor **Kaitlin Bratlie**, who served as the faculty mentor on the trip for the first time.

She pointed to the industry tours that are also part of the program as an excellent learning opportunity for the students. A bioethanol plant, a dairy (which makes milk lactose-free, performs spray-drying for dried milk and creates infant formula), and a Bayer facility that produces 90% of the world's aspirin supply were on this year's agenda.

There's also time for sightseeing, which includes visits to landmarks such as the cathedral of Santiago de Compostela, and the many natural attractions. "The beauty of the Asturias region (where Oviedo is located) just blew me away," says Mayberry. "From jagged mountains in the Picos de Europa to small coastal fishing villages."

Though the pace of the lab program is daunting, most students find the experience highly valuable for helping them prepare for life after graduation – both in work and in personal life.

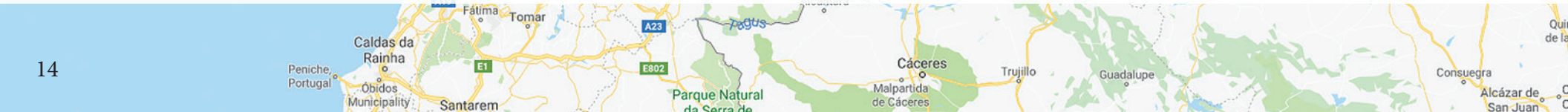
"We got the chance to do hands-on learning and apply what we were learning," says Jackson, who added, "The trip really showed me how much diversity exists in other parts of the world."

"I learned how to create figures that are simple and easy to understand. That's a valuable skill set for chemical engineering students whether going into industry or academia," says Mayberry.

"The program was a truly amazing experience," says Jackson. "I had the chance to make new friends and experience a new culture. I could not have been happier with my choice to take part."

"I think many of them wished it could have lasted longer," says Bratlie.

Thanks to the Hershel B. Whitney Global Initiatives Program, scholarship support will continue to be provided for all students who participate in this summer lab.



ISU again bound for nationals in AIChE Chem-E-Car student competition

For the fourth consecutive year, an Iowa State University team will be taking part in the national Chem-E-Car competition with the American Institute of Chemical Engineers.

CBE entered two teams in the regional Chem-E-Car competition at the AIChE Mid-America Student Regional Conference at Missouri University of Science and Technology, which features student-designed miniature vehicles that are both powered and stopped by chemical reactions. Cars compete for the longest distance traveled from the start line to when the car stops.

Team "Caterpie Clan" claimed a third place finish in the competition and advanced to the nationals at the Annual AIChE Student Conference in November in Orlando, Florida.

"The car runs on a hydrogen fuel cell with a reaction of sodium hydroxide and aluminum as the hydrogen source," explains **Stephanie Loveland**, associate teaching professor and Chem-E-Car faculty advisor. "The stopping mechanism is the decomposition of hydrogen peroxide using potassium iodide as the catalyst. It produces oxygen as a product, and the oxygen was used to displace an electrolyte solution that completed a circuit between two copper electrodes. When the electrolyte is displaced, the resistance between the electrodes suddenly increases, and this sends a signal that cuts power to the motor."

Team Caterpie Clan also placed first in the Chem-E-Car poster competition. ISU's team "Golden Galvantulas" also showed well, netting a fifth-place finish in the distance competition.

Martin Asama (B.S., 2019) also kept ISU in the spotlight when he finished first in the conference research poster competition for his project "Coextrusion of Coated Frozen Desserts."

Ken Jolls is a:

1. Musician
2. Chemical engineer
3. Advocate of cognitive art

(hint: it's all of the above)

It's fair to say Department of Chemical and Biological Engineering emeritus professor **Ken Jolls** has led a double life. It might be more graceful to call him a "renaissance man." But in a world where science and the arts are strange bedfellows, Jolls has proven that you can successfully embrace both.

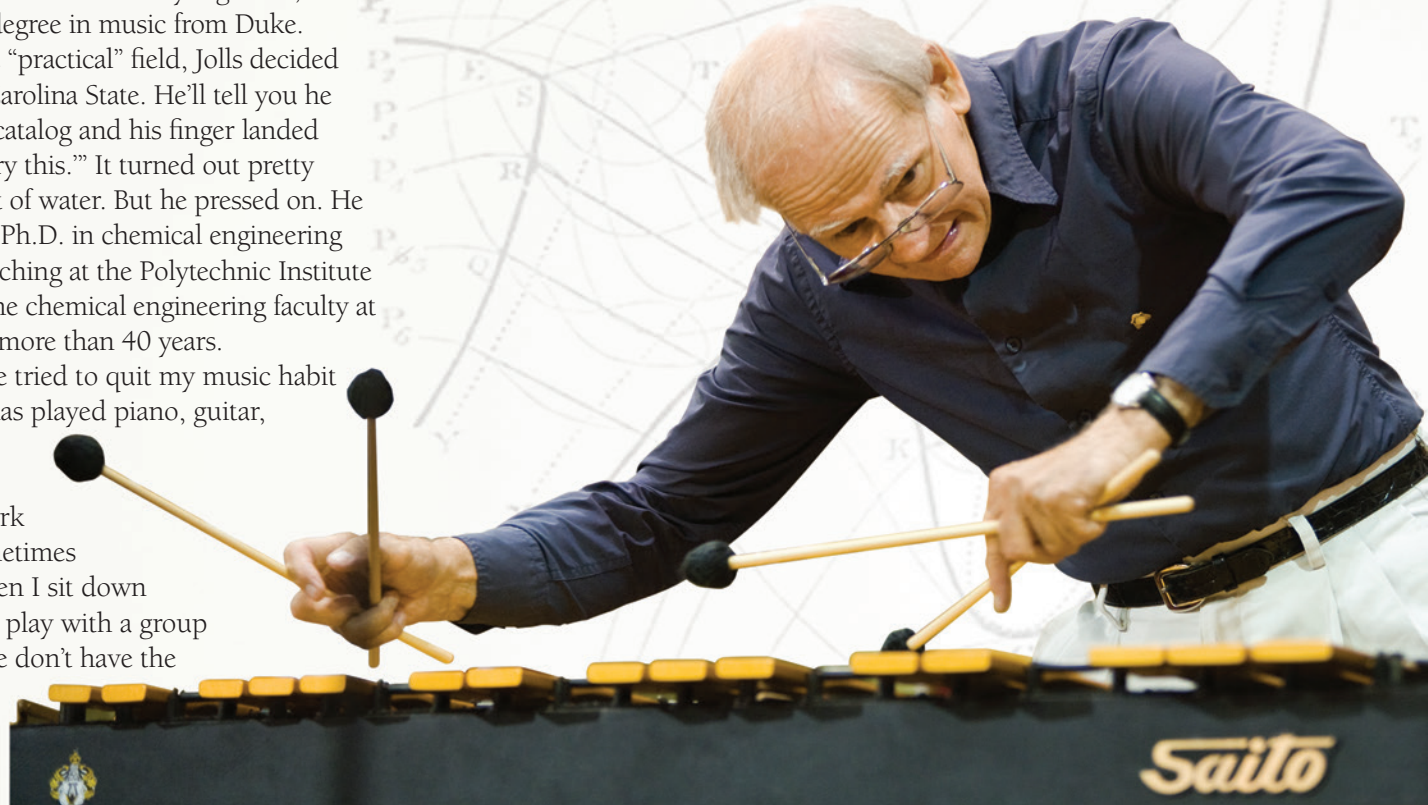
After falling in love with music at a young age Jolls had his sights set on a career in music performance until fate intervened prior to his senior year at the Indiana University School of Music. In 1954 he contracted polio and spent three months in an iron lung in his native North Carolina, followed by a long period of physical challenges, some of which became lifelong.

But even polio could not keep Jolls from reuniting with music during his recovery. He became involved with the popular Duke University big band, The Ambassadors. That helped lead to a bachelor's degree in music from Duke. But with a desire to also have training in a more "practical" field, Jolls decided to pursue a second bachelor's degree at North Carolina State. He'll tell you he closed his eyes, pointed to a spot in the course catalog and his finger landed on "chemical engineering." "I said, 'Well, we'll try this.'" It turned out pretty well. Jolls the musician at first felt like a fish out of water. But he pressed on. He received a B.S. from North Carolina State and a Ph.D. in chemical engineering from the University of Illinois in 1965. After teaching at the Polytechnic Institute of Brooklyn, in New York City, Jolls moved to the chemical engineering faculty at Iowa State, where he taught and researched for more than 40 years.

But the music has always been there too. "I've tried to quit my music habit many times, but it doesn't work," he says. He has played piano, guitar, the vibraphone and the marimba, all in many different venues, and those mallet percussion instruments became a bedrock in his life. "I work in science with chemistry and physics, but sometimes I just feel that I need more," Jolls says. "But when I sit down and play music, it brings me back. And when I play with a group of other musicians, it's euphoria. A lot of people don't have the opportunity to feel that in their lives."

Jolls' music interest gets most of the press, but there's another passion he's developed: following the philosophy that science and art can coexist. It's called "cognitive art." And in particular, it applies to the chemical engineering field of thermodynamics, something that Jolls taught from the outset in his academic world. There's a school of thought that entropy (and other thermodynamic functions) have geometrical analogies and these complex quantities can be turned into unique, visualized objects: thermodynamics represented as art. Jolls has traveled this road since the early 1970s – at ISU, at University of California, Berkeley, and Cornell. Just in the last year he has created a research poster on the subject called "Engineering, Entropy and Art, The Visual Side of Thermodynamics."

"Expressing such ideas through mathematics alone yields complex equations that befuddle nearly everyone. Yet visualizing them conveys the practical meaning without demanding theoretical depth," Jolls said in a 2001 editorial to the New York Times. But he went on to say, "Our educational system does not approve. Right-brain methods take a back seat to traditional science teaching, which emphasizes rules and mathematics. The two cultures are still far apart in most science classrooms." And in what could be called a commentary on his own life: "Let us teach our youth to think with their eyes open."



Board room to brush strokes: alum Barney Baxter discovers a new love in retirement

Department of Chemical and Biological Engineering alumnus **Reginald R. "Barney" Baxter** made a career running businesses of his own and helping to manage others. Now, in retirement, he's embracing the endeavor of creating portrait paintings. It's a hobby he picked up in retirement. And it's proof that it's never too late to start a new pursuit.

Baxter, who received an M.S. in chemical engineering from Iowa State in 1949, with his wife Jameson (Jamie), is a longtime supporter of the department. Their giving has made possible the CBE Reginald R. Baxter Endowed Department Chair, held by Andrew Hillier, the Reginald R. and Jameson A. Baxter Computing and Collaboration Lab, the Reginald R. and Jameson A. Baxter Graduate Fellowship, and others.

Barney is the retired chairman and CEO of business management consulting firm Baxter Associates in Palatine, Illinois, and has been involved with numerous other business ventures as both an employee and an advisor. But painting is something that previously only meant buying works created by others.

Acknowledging that he "had already failed at retirement," Barney says, "When I stopped working, I wanted to retire *to* something and not *from* something. I was recovering from open heart surgery and had time to think about what to do with the rest of my life. Painting seemed like a natural thing with my background in engineering and the drawing and drafting that is required in that field. I have been a collector of art all my adult life, and asked myself, 'Why can't I do that?'" Barney and Jamie moved to Florida and he quickly found a supportive environment for his painting in the community where they reside, in the form of a very active art group. "You don't know until you try," Barney says. "I was satisfied with my early efforts and soon I became a student of art, taking many classes."

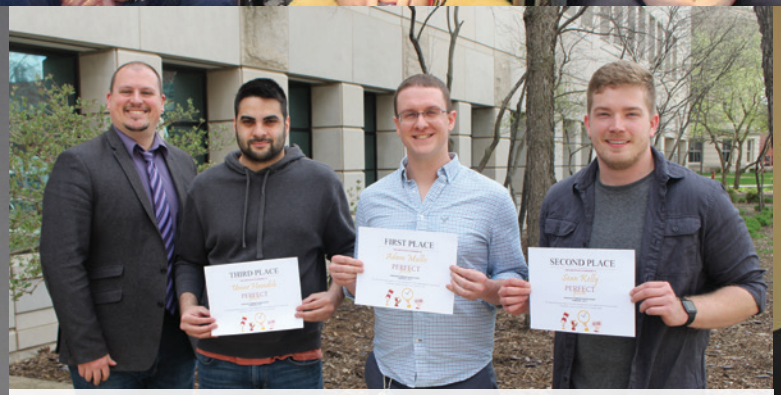
His works are displayed online (under the name "Barney the Artist" at barneytheartist.shutterfly.com), in his home and in the homes of family and friends, but they are not for sale. For him, the reward is in the creation of the works and in sharing them.

Baxter prefers painting subjects found in nature. But Iowa State University's iconic campanile became the subject in one painting (displayed in photo at left) that was created for a special recipient: **Sarah Rajala**, who recently retired as James L. and Katherine S. Melsa Dean of Engineering at Iowa State.

Baxter, who co-authored a book called "Manage the Personality, Not the Person," is now writing his personal memoirs. His canvas is still being filled. With many colors.

Spring 2019 pre-commencement reception.

Alum **Timothy J. Anderson**, College of Engineering Dean at The University of Massachusetts Amherst, was inducted into the CBE Hall of Fame.



Top finishers in the 2019 Perfect Pitch research competition for graduate students are honored. Pictured are (left to right): assistant professor **Thomas Mansell**, coordinator; **Umar Hamdeh**, **Adam Mullis** and **Sean Kelly**.

Tyler Gathman (right), named spring 2019 Lawrence E. Burkhart Outstanding Senior.

Davis Arbogast (left), named fall 2018 Lawrence E. Burkhart Outstanding Senior.

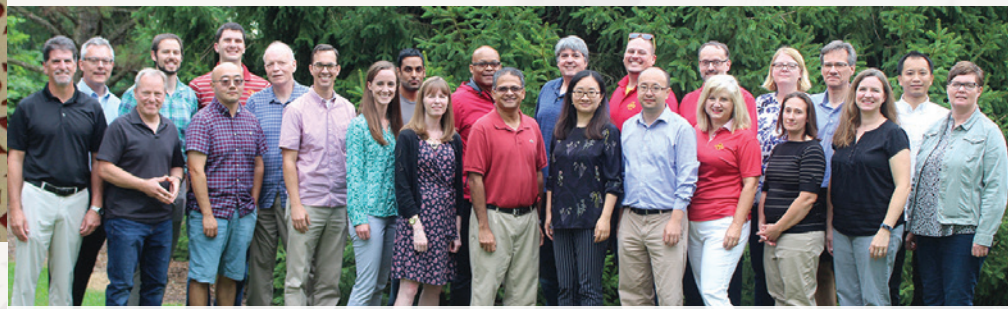
Senior **Martin Asama** took top honors in the research poster presentation competition in the American Institute of Chemical Engineers Regional Conference in April 2019.

Faculty members **Zengyi Shao** and **Matthew Panthani** were congratulated in a department reception. Shao was named associate professor and Panthani was recognized for receiving the National Science Foundation CAREER Award.

Alum **Gary Griswold** (left) and his wife **Mickie** are shown at a department reception honoring him as a recipient of the Iowa State University Distinguished Alumni Award.

CBE student **Victoria Kriuchkovskaia** was selected as the spring 2019 commencement student marshal for the College of Engineering. She's shown receiving a plaque from then-James L. and Katherine S. Melsa Dean of Engineering **Sarah Rajala**.

Faculty member **John Kaiser** strikes a familiar pose on CBE Donut Day. The photo on the wall of Sweeney Hall shows Kaiser when the alumnus was working as a chocolate developer for Mars.



CBE faculty members at the annual retreat prior to the beginning of the 2019 academic year.

Advisory Council 2019-2020

The Department of Chemical and Biological Engineering relies on the expertise, experience and advice of its advisory council, a group of chemical engineering professionals who are alumni of the department. The council plays a key role in helping to shape department policies and procedures in many areas, including curriculum development, accreditation, undergraduate and graduate student affairs, industry engagement, budget and more. The advisory council holds its annual meeting in the department each April, where interaction with faculty and students, review of data and other topics are used to help set plans and goals for the coming year. Degrees are in chemical engineering unless otherwise noted.

Members typically serve two consecutive three-year terms.

Jane Newman-Ford
B.S., 1991
Associate Project Engineer
Burns & McDonnell

W. Mark Saltzman
B.S., 1981
Goizueta Foundation Professor of Chemical and Biomedical Engineering, Yale University

Jack Starr
B.S., 1987
Director of Engineering R&D
Cargill

Amy Determan
B.S, 2001; Ph.D., 2006
Advanced Product Development Specialist
3M

Jeff Underwood
B.S., 1994
Vice President, Enterprise Innovation
Kent Corporation

Tess Duckett
B.S., 2002
Principal Systems Engineer
General Mills

Meghan Watt
B.S., 2002
Responsible Care Leader
FilmTec Corporation

Christian Edmiston
B.S., CBE/Econ., 1998
Senior Director, Sourcing and Risk Management
Land O'Lakes

Derek Winkel
B.S., CBE, 1998; MBA, 2015
Executive Director, Manufacturing Operations
Renewable Energy Group

Eric Fasnacht
B.S., 1989
Plant Manager
Archer Daniels Midland

Andrew Hillier, Ex-Officio
Reginald R. Baxter Endowed
Department Chair, Department of Chemical and Biological Engineering

Recent Faculty Publications

Kaitlin Bratlie
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Derrick Rollins
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Ian Schneider
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Zengyi Shao
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Yue Wu
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UNDERGRADUATE SCHOLARSHIPS

3M Endowed Scholarship in Engineering
Jedidiah Chukwusom

A. Douglas and Helen F. Steffenson Memorial Endowed Scholarship
Kaleb Still
Joanne Vo

Ag Processing Inc. Scholarship in Engineering
Michael Momchev

Alpha Chi Sigma Chemical Engineering Scholarship
Justin Watkins

Barbara L. Feroe Scholarship
Antonio Amadio

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Andrew Gilbertson
Bryce Stubbings
Hannah Nguyen

Bestmann Family Scholarship in Engineering
Ashley Harris

Bob Kaiser Memorial Scholarship
James Trettin

Building a World of Difference Renewable Energy and Sustainable Water Scholarship in Engineering
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Bradley Boyd
Brett DeConinck
Liam Herbst
Margaret Lashier

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Austin Angel
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Maija Beckwith
Kia Birnbaum
Alexandrea Bragdon
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Roger Cruz
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Charles Fields

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Trang Hoang

Kenneth L. Garrett Scholarship in Chemical and Biological Engineering
Divyesh Kumar
James Trettin

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Logan Mayberry
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Tyler Roling

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Laura Snyder
Charles Truka
Anne Wallace
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Noel and Ruth Smith Family Engineering Scholarships
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Laura Brown
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Professor Eugene H. Wissler Scholarship
Anders Glad
Clay Hugen

Project Lead the Way Scholarship
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Ralph Luebbers Scholarship in Chemical Engineering
Jaclyn Simons

Ralph S. Millhone Endowed Presidential Scholarship
Ethan Brown
Haley Greiman
Divyesh Kumar
Jaret Olderbak
Nathan Rider

Robert A. and Jacklyn R. Lane Engineering Scholarship
Margaret Lashier

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Micah Hollenbeck
Lina Somsaath

Roderick Seward, Flossie Ratcliffe and Helen M. Galloway Foundation Expendable Merit Scholarship
Emma Schwarck

Ross White Engineering Scholarship
Ethan Brown

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Andee Beierle
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Urvi Pai

Stuart M. Totty Scholarship
Tommy Krohn

Sullivan Scholarship in Chemical and Biological Engineering
Roger Cruz
Daniel Miron Ocampo
Josephine Trager

Tau Beta Pi Endowed Scholars Program
Hannah Gebur
Mark Schomers
Emma Schwarck
Kaitlin Steward
Caden Washburn

Thomas D. and Edra S. Wheelock Endowed Scholarship
Tyler Naughtrip
Matthew Schaschwary

Thor and Karen Hanson Scholarship
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Wayne and Gladys Mittman Scholarship
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Nithish Subramanian Kaushik

George W. Parrott Centennial Graduate Fellowship
Elizabeth Grego

James Katzer Energy Fellowship
Yee Jher Chan
Md Sakib Ferdous

Loren and Donna Luppes Graduate Fellowship in Chemical Engineering and Sweeney Memorial Family Scholarship
Efrain Rodriguez-Ocasio

M.A. Larson Fellowship in Chemical Engineering
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Brianna White

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Department of Chemical and Biological Engineering
618 Bissell Road
2114 Sweeney Hall
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