



**SCHOOL OF BIOMEDICAL  
ENGINEERING**  
COLORADO STATE UNIVERSITY

## Message from Director

### The Power of Collaboration

As the School of Biomedical Engineering celebrates its 10th anniversary, we look back on its inception built on collaborative relationships and discussions among CSU faculty from around the University. A cornerstone question to all faculty interested in joining SBME is who they are collaborating with in the program and who they look forward to collaborating with in the future. That spirit has led to projects that sometimes include SBME faculty from three of the four colleges that comprise SBME.

As SBME matures we remain open to finding creative ways to share knowledge and resources in our backyard and around the world. We start simply by having an engineering program online that allows students the ability to earn a Master of Engineering degree. This brings us in contact with students from all walks of industry and from diverse locations around the globe. More recently, we have stepped up efforts at the undergraduate level by arranging a partnership with the Range of Motion Project (ROMP), an international nonprofit organization based in Denver, to take a group of students to Ecuador. We have extended that interest to the broader SBME community in discussions with Zubaida Bai (CEO, Ayzh, Inc), faculty in Rwanda interested in starting a new degree program in biomedical engineering, and people with interests in helping underserved communities in Colorado and surrounding states.

As discussions among collaborative faculty drove the creation of SBME, discussions with professionals in industry stressed the need for

recruiting engineers with biomedical engineering knowledge. To address this need, we created an innovative BME undergraduate degree program, focused on traditional engineering disciplines: electrical, mechanical, and chemical and biological. Our students earn two bachelor degrees, giving them a competitive advantage when seeking employment.

As our undergraduate student enrollment grows (currently, over 400 students), we continue to seek partnerships with industry to sponsor multidisciplinary team capstone projects. This year, we have partnerships with AlloSource, Applied Medical, Sharklet Technologies, and Terumo BCT. By utilizing young, vibrant minds, these companies are not only exploring new concepts, but are also gaining recruiting exposure to our graduating engineers.

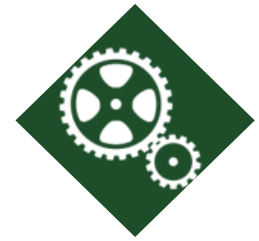
In this issue, you will find articles on our 10 years of industry-focused collaboration. The power of collaboration is key to expanding our students' real-world experience, creating new knowledge among scientists, and helping industry see new solutions through fresh, young eyes. Collaborative opportunities are endless in the SBME. To learn more visit [www.engr.colostate.edu/sbme/collaboration](http://www.engr.colostate.edu/sbme/collaboration).

Together, we are stronger. I invite you to contact me at [Stuart.Tobet@colostate.edu](mailto:Stuart.Tobet@colostate.edu) with your ideas on how we can build a mutually beneficial partnership.

Sincerely,

*Stuart Tobet*

### Built on Strong Faculty & Research Programs



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## Double your Donation!

Each donation made to the SBME Scholarship for Leadership and Innovation in April 2018 will be matched up to \$10,000. Our goal is to endow this scholarship to create a permanent fund that provides a \$1,000 annual scholarship in perpetuity.

### SBME Scholarship for Leadership and Innovation

[www.advancing.colostate.edu/SBME](http://www.advancing.colostate.edu/SBME)

Scholarship support at all levels provides critical aid to our students.

We strive to help as many students as possible with the financial obligations of their engineering education. To learn more about our past scholarship recipients, visit: <http://enr.colostate.edu/sbme/scholarship-recipients>.

## DID YOU KNOW?

The School of Biomedical Engineering is proud to boast a high percentage of faculty innovators. Over 25% of inventions disclosed to CSU Ventures, the technology transfer office for the University, between FY2013 and FY2017 were created by SBME faculty.

You can find a list of inventions by visiting <http://csuventures.org/for-investors/startups/existing-startups/>.

If you are interested in collaborating with these brilliant minds, please contact SBME Director Stuart Tobet at [Stuart.Tobet@colostate.edu](mailto:Stuart.Tobet@colostate.edu).

## Graduate Seminar Summary: Dr. Mark Borden

By Joshua Mannheimer

One of the key aspects that determines the success of a drug is the ability of the drug to get to the desired target. For the drug to make it to its intended target it must make it into the bloodstream, diffuse from the bloodstream into the desired tissue, and in some cases, make it into the actual cells. Several physical properties such as size, hydrophilicity/hydrophobicity, non-specific interactions with other proteins, and charge affect the ability of a drug to reach the intended target. Nowhere is this more apparent than when trying to get drugs across the blood-brain barrier, a highly selective barrier that often only allows passive transport of small molecules. Larger molecules often cannot get through the blood-brain barrier efficiently to deliver the drug in effective concentrations.

Dr. Mark Borden is a professor of mechanical engineering at the University of Colorado in Boulder. His research takes a novel approach to facilitate the transport of drugs across the blood-brain barrier. Micro bubbles are 1-10 micrometer gas-filled bubbles stabilized by an additional layer of lipids. When subjected to high intensity focused ultrasound (HIFU) the bubbles respond by subsequent contraction and expansion scattering the incoming HIFU. The idea is that these scattered pressure waves might mechanically disturb the blood brain-barrier allowing for transport of drugs that typically would not pass the blood-brain barrier. Dr. Borden has researched many critical aspects of this technique, such as the relationship between bubble size and efficiency of drug transport, as well as tissue necrosis that might be induced by mechanical perturbation of tissue component. This is a promising new technology for getting drugs across the blood-brain barrier and clinical trials are currently underway for Alzheimer's and cancer patients in Canada.

## The Company We Keep

Each semester, the School of Biomedical Engineering invites distinguished guests from around the world to speak on biomedical engineering research and related disciplines for its weekly seminar series. The Fall 2017 speakers included:

**Dr. Kevin Baker**, William Beaumont Hospital, Oakland University William Beaumont School of Medicine  
*The Role of Systemic Stem Cell Trafficking in ACL Rupture-Induced Post-Traumatic Osteoarthritis*

**Dr. Narayan Bhattarai**, North Carolina A&T State University  
*Electrospun Scaffolds for Tissue Engineering Application*

**Dr. Mark Borden**, University of Colorado, Boulder  
*Engineering Microbubbles for Ultrasound Drug Delivery*

**Dr. Yap Choon Hwai**, National University of Singapore  
*Fluid Mechanics of the Human Fetal Heart in Health and Congenital Malformations*

**Dr. Bruce Tromberg**, University of California, Irvine  
*Wearable and Bedside Biophotonics: technologies at the intersection between personalized medicine and personal health*

## Undergraduate Program Update

As we all remember from Sesame Street, E is for engineering, as in E-Days, the zenith of the academic year—at least as far as graduating BME seniors are concerned. Beyond E-Days lies only final capitulation to senioritis, the completion of a last few odds and ends, and commencement parties.

By far, the favorite day of E-Days is Showcase. There the accomplishments of 8 months of toil, trial-and-error, and testing of ambition against immutable reality are distilled into a poster surrounded by better-dressed-than-usual scholars. The teams eagerly present to visitors using enthusiasm, a bit of surprised self-awe at their accomplishments, and perhaps extra doses of caffeine to overcome their underlying exhaustion accumulated in the final push. Advisors, friends, family, faculty, and even local K-12 students come to admire and celebrate their work and glimpse the impact of the past four or five years. The students are rightfully proud of persisting to this milestone. Walking the aisles of the Showcase, engaging the presenters, taking in the broad spectrum of all the knowledge and skills represented, and considering each individual contributor's story and plans for the future is an immensely satisfying experience.

It takes a technical community to raise an engineer. At the Showcase, we are extremely grateful for the wide range of contributions that our industry advisors and friends have made to bring the students to this point. About half of our students work on teams sponsored by industry or medical professionals that address real problems the sponsors face. The other half are on teams engineering solutions in support of faculty research or other faculty-led endeavors. The generosity of commercial, clinical, and faculty advisors, through both their time and their institution's resources, delivers rich opportunities to the students. Our industry advisory board and other professionals also volunteer their time at the Showcase to judge the performance of the students. Senior design teams fiercely compete to be recognized at a banquet on the evening of the Showcase with award ribbons based on the judges' evaluations. These same evaluations of all of the teams provide feedback on BME program quality.

Beyond the winning senior design teams, several other BME students are recognized at the Showcase banquet for distinction in academics, research, and service. Many times, the stories of these outstanding students intersect with the generosity of the technical community outside the campus boundaries. Many have benefitted both financially and professionally from summer internships or co-op positions. Some of them have received scholarships, such as the SBME Leadership and Innovation Scholarship, which has been funded through the donations of advisory board members and other supporters of BME at CSU. All who wish can receive advice on resumes and career plans from the advisory board.

The students, staff, faculty, and directors thank you, our technical community, for your many-faceted contributions to the BME program. If you saw any well-dressed student at the Showcase, smiling through tired eyes, and telling someone about their future jobs as a biomedical engineer, know that they are there because many of you have kept them on that path.

## Graduate Program Update

It certainly has been an interesting year for the graduate program in the School of Biomedical Engineering! Graduate Academic Advisor Sara Mattern is back from taking time off to care for her new baby and she hit the ground running. The BME graduate program received two mini-grants from the Graduate School this academic year: one to recruit prospective students in the fall semester and a second to host a career event for our current students in the spring semester. Another mini-grant was co-awarded in the spring for creating joint career discussion groups that include SBME trainees and faculty and College of Veterinary Medicine and Biomedical Sciences trainees and faculty.

Sara visited Adams State University and Fort Lewis College in southern Colorado in early December in an effort to promote our graduate programs and educate prospective students on the prerequisites required and experience recommended to be eligible for admission into all of our programs. She engaged with students and faculty at both institutions, was met with enthusiasm, and received positive feedback. We hope we can expand our outreach to more visits to additional institutions in Colorado, and will kick-start lasting relationships with various undergraduate programs around the state.

The SBME Graduate Program will also be hosting a career panel in the spring semester to include alumni from companies along the Front Range here in Colorado. It's an opportunity for current graduate students to interface with SBME alumni to better understand what they can expect during the job search and how to be better prepared. The event is slated for Thursday, May 3.

Lastly, we have several students showcasing their research around the world. Justin Gangwish had an abstract accepted for the World Congress of Biomechanics in Ireland, and Wenqiang Liu and Michael Nguyen-Truong are going to the Experimental Biology Conference in San Diego in April.

## BME Students Prepare for 8-Day Trip to Ecuador

*80% of the world's amputees live in developing countries, and only 2% have access to prosthetic care.*

– World Health Organization



“I can’t study abroad. It won’t fit in my curriculum.” “I want to help people.” “I want hands-on experience.” These are comments often made by undergraduate biomedical engineering students at CSU. The undergraduate program in the School of Biomedical Engineering listened to these students and created a new, hands-on, short-term, study abroad opportunity that focuses on user-centered design and gives students the opportunity to design and test prosthetic technology in a low-resource environment.

The program is partnering with the Range of Motion Project (ROMP), an international, non-profit, mobility organization based in Denver that works to bridge

the gap between access and resources available in America to people with amputation in the developing world.

On November 14, 2017, 20 students attended an information session to learn more about the education abroad experience. “Our students want to make the world a better place and ROMP is currently doing that, so it was a perfect fit,” said co-leader, program creator, and BME academic advisor Deb Misuraca. “Our hope is that students will come away from this experience with a stronger base of knowledge and hands-on experiences in prosthetic and orthotic care, a greater sense of purpose, and a stronger connection to the global community.

In May, Misuraca and BME senior design instructor and research scientist Ellen Brennan-Pierce will co-lead an 8-day, study abroad experience with 24 CSU students in Quito, Ecuador to provide prosthetic and orthotic care to people in need. “Our students are incredible and I cannot wait to see what they are capable of,” said Misuraca.

To learn more about ROMP, visit <http://rompglobal.org>.

## First Woman to Lead the SBME Industry Advisory Board



It is fitting that in our 10th anniversary year of celebration we also usher in another transition for the SBME Advisory Board. **Julie Dunn** will serve as the next chair of the board. Julie is the medical director of trauma research and education for the University of Colorado Health in Loveland, Colorado. She brings a wealth of knowledge and resources to the biomedical engineering program.

Julie succeeds Steve Simske, who chaired the board since 2015. Julie will be the first woman and physician to chair the board. For years, Julie has been actively engaged with the SBME faculty from a variety of departments across campus, collaborating on joint research to address unmet medical needs. This research has spawned development of several medical improvements, including a hernia mesh patch that discourages bacterial growth and a non-invasive method of monitoring lung function without the need for radiation and dye. Currently, she is collaborating with a large group of CSU professors working toward unraveling the cellular and molecular interactions that occur in the human intestine and other boundary issues. The SBME core faculty involved with this project include Randy Bartels, Tom Chen, David Dandy, Chuck Henry, Kevin Lear, Stuart Tobet, and Jesse Wilson, in addition to non-SBME faculty including Zaid Abdo, Gregg Dean, Candace Mathiason, and Elizabeth Ryan.

## SAVE THE DATE

The Biomedical Engineering Society (BMES) celebrates its 50th anniversary this year.

Join us in Atlanta, Georgia for the BMES Annual Meeting on October 17-20.

The SBME looks forward to another strong showing at the 2018 meeting.

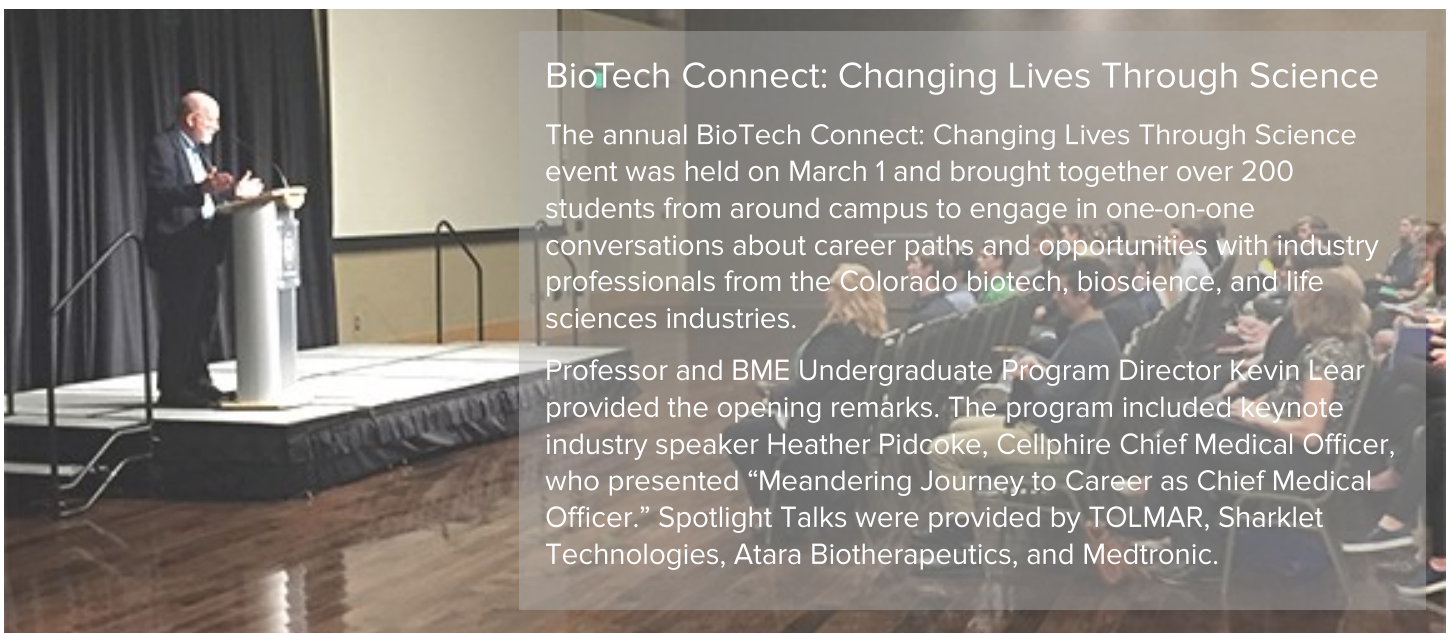
## SBME Student Events

### 2018 Graduate Day Poster Session & Awards

On Monday, February 26, the School of Biomedical Engineering hosted its annual poster session and awards ceremony, part of the activities on Graduate Interview Day. On this day, 15 Ph.D. candidates seeking admission to the bioengineering program had an opportunity to interview with faculty, tour labs and campus, and interact with current graduate students at various events. Current students showcased their research, giving prospective students an opportunity to learn more about the research taking place in our laboratories.

During this event, we recognize students and faculty for their achievements and impact on those around them. Yanyi Zang received the Outstanding Graduate Student Overall Excellence Award and Dr. Jennifer Mueller, professor of math and biomedical engineering, received the Excellence in Teaching Award for going above and beyond to serve her students.

At the event, the prospective students also had the opportunity to list their top three posters of interest. They voted Hannah Pauly's poster, Polymer Scaffold for Ligament Replacement, as the most intriguing poster.



#### BioTech Connect: Changing Lives Through Science

The annual BioTech Connect: Changing Lives Through Science event was held on March 1 and brought together over 200 students from around campus to engage in one-on-one conversations about career paths and opportunities with industry professionals from the Colorado biotech, bioscience, and life sciences industries.

Professor and BME Undergraduate Program Director Kevin Lear provided the opening remarks. The program included keynote industry speaker Heather Pidooke, Cellphire Chief Medical Officer, who presented "Meandering Journey to Career as Chief Medical Officer." Spotlight Talks were provided by TOLMAR, Sharklet Technologies, Atara Biotherapeutics, and Medtronic.

### 5th Annual SBME First-Generation Dinner

CSU was one of the first universities in the country to provide resources to first generation students, and BME proudly carries on that tradition with a dinner designed to recognize the unique challenges and joys that come with being the first in the family to receive a bachelor's degree. Approximately 40 BME students, faculty, and staff gathered at the 5<sup>th</sup> Annual First Generation Student Dinner on January 30, 2018. "This opportunity," said Dr. Stu Tobet, SBME Director and first generation student himself, "allows students to get to know more people, to learn to ask for advice, to connect with faculty and other students, and to tap into their experiences."

Students found that conversations with faculty helped them feel more at home, provided insight into potential lab research opportunities, and connected them with students and faculty with similar backgrounds and were very valuable outcomes from the event. Teryn Degenhart, a 3<sup>rd</sup> year biomedical and mechanical engineering student and one of the event coordinators, shared that "we have an unspoken bond as first generation students and this event promotes unity within our shared experiences. There have been times I've felt isolated and alone and this was an outlet I needed, and I wanted this sense of community to be true for others as well." Teryn was also part of the new First Generation Mentor program that pairs 1<sup>st</sup> and 2<sup>nd</sup> year students with 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> year students to engender a sense of connection within BME.

For more information on supporting first generation BME students, please contact [Brett.Beal@Colostate.edu](mailto:Brett.Beal@Colostate.edu). We are always looking for alumni and industry partners to share their stories and help mentor our students!

## SBME Faculty Awards & Student Activities

### College of Engineering Faculty Awards

**Thomas Chen** received the George T. Abell Award for Outstanding Economic Development

*“Over his 25 years of tenure at CSU, Tom has had a very strong relationship with local tech industry and is a champion in developing interdisciplinary research and education programs, especially in the area of biomedical engineering.”*

–Dean David McLean

**Christie Peebles** received the George T. Abell Award for Outstanding Teaching and Service

Students have nothing but positive remarks: *“Dr. Peebles is one of the best instructors I have ever had.” “She is genuinely interested in what is best for her students.” “Such a cool professor! Really down-to-earth.”* Christie has also mentored scores of undergraduate and high school students and has worked tirelessly as the principal mentor to the University’s iGEM team.

### For high school girls, a day in the life of CSU

High school girls got to live a day in an engineering student’s shoes this month for Stick with SWE, a Society of Women Engineers (SWE) event. Each of the 27 girls in attendance was paired with a female student in the Walter Scott, Jr. College of Engineering (and CSU SWE member) and served as a “shadow,” attending classes, visiting campus landmarks, and exploring major-specific labs.

Inspired by a similar event spearheaded by the SWE chapter at California Polytechnic State University, Caley Dallman, a junior in civil engineering, was determined to bring Stick with SWE to CSU.

“Caley was the spirit of the event,” said Theresa O’Donnell-Sloan, a sophomore in civil engineering and fellow SWE member. “She put everything aside and focused on planning.”

SWE leadership, including Dallman and O’Donnell-Sloan, matched up prospective students with CSU students based on major and interest, built a schedule for each attendee, and alerted professors of the high school students’ class visits. SWE members showcased the CSU engineering experience for the duration of the day.

#### Sharing the CSU experience

Annie Elefante, a junior biomedical and mechanical engineering student and president of CSU SWE, took her shadow, a prospective mechanical engineering student, on a personalized tour. “I took her to a 100-level class, to Morgan Library, and the machine shop to show her the machines so she could see what she’d be doing if she came to CSU,” she said.

Also part of the event was a welcome reception and student panel, during which the high school students and their parents listened to engineering students of different majors and class levels discuss their CSU experience. “I said on the panel that SWE probably changed my life,” said O’Donnell-Sloan. “I don’t think I would’ve stuck with engineering if it wasn’t for the community I found here.”

#### A community among like-minded women

SWE members exemplified their overall objective for the event, which was to encourage the high school students that they are capable of earning a degree in engineering and forming a supportive community through SWE. The success of the event was reflected by the glowing responses from the high school girls in attendance.

“I decided that I will be pursuing a major in engineering at CSU,” said one student. “This event helped me realize that I do have what it takes to be an engineer.” Another student confirmed, “CSU has jumped to the top of my list because of this event.”

CSU SWE leadership confirms they’ll be holding the event again next year, and are considering running it twice a year instead of annually. Families traveled from all over the state and region to attend.

“College is hard and expensive in terms of money and time,” said Elefante. “But it’s the people beside you that are assets worth the price of admission.”



# Biomedical Engineering Celebrates 10 Years of Industry-Focused Collaboration

By Jessica Cox

## Biomedical engineering celebrates 10 years of industry-focused collaboration

A foundation of excellence in four colleges – engineering, health and human sciences, natural sciences, and veterinary medicine and biomedical sciences – represents the interdisciplinary nature of the School of Biomedical Engineering. The school, which has grown from 29 core faculty in 2007 to almost 50 core faculty today, celebrates its tenth anniversary this academic year.

“Faculty join from other colleges because of their collaborative interest, and we expand on the basis of collaboration,” said Stu Tobet, director of the School of Biomedical Engineering.

### A cauldron of collaboration

Through research and teaching, the school’s vision is to address critical issues in healthcare by bringing together a diverse population of scientists and engineers. Strength is found within these collaborations, as researchers sit down and brainstorm about solving unmet medical needs.

When the Scott Bioengineering building was completed in 2012, it provided a focus for the administrative part of the program, and a space for bioengineering research. The building has four different interdisciplinary research areas—biomedical engineering, environmental engineering, bioanalytical devices, and systems and synthetic biology—allowing faculty and students to collaborate on research in these areas.

### Responding to industry need

The school’s strength in collaboration lends the program especially well to partnering with industry, which was a driving force behind the creation of the undergraduate program in 2011. The undergraduate program is the first in the state to earn accreditation and it’s grown to over 400 students. Undergraduate students are required to select two majors, which makes them far more competitive when applying for jobs.

“Industry doesn’t want to hire for biomedical engineering alone,” said Tobet. “The depth of another major makes candidates more desirable.”

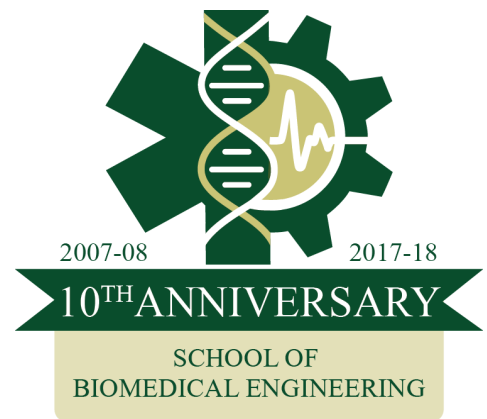
Students at both the undergraduate and graduate levels are well equipped to enter industry because biomedical engineering is a strongly translational field; researchers are working to engineer solutions to biomedical problems. Some of these solutions are processed as inventions via partnership with CSU Ventures — over a quarter of inventions disclosed to CSU Ventures between fiscal year 2013 and 2017 were created by biomedical engineering faculty.

“As a student in the program, you know that you have faculty who are not only teaching you, but they also understand how industry works because they’re entrepreneurs, too,” said Allison Robin, business development and marketing manager for the School of Biomedical Engineering.

### Focus on faculty

With 10 years of experience, the School of Biomedical Engineering is adept at responding to the needs of industry, and seeks to continue to grow organically to solve major health care problems prevalent in society. At the heart of past and future successes are CSU faculty across campus, who recognize this industry need and are open to collaboration.

“The school’s potential is vast because of the way we grow interdisciplinary research,” said Tobet. “Our faculty are highly productive people driving the success of the school.”





**SCHOOL OF BIOMEDICAL  
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**FIND US ON:**



**Save the Date**

**APRIL 2018**

**SBME Seminar: Dr. K. Jane Grande-Allen, Rice University**  
Apr. 2 | 229 Scott Bioengineering Building | 12–12:50 p.m.

**Engineering Days (E-Days)**  
Apr. 12 | CSU Lory Student Center | 9–3:00 p.m.

**SBME Seminar: Raoul Reiser, Ph.D.**  
Apr. 16 | 229 Scott Bioengineering Building | 12–12:50 p.m.

**Celebrate Undergraduate Research & Creativity Showcase**  
Apr. 16 | CSU Lory Student Center | 5–7:00 p.m.

**SBME Seminar: Dr. Barbara S. Smith, ASU**  
Apr. 30 | 229 Scott Bioengineering Building | 12–12:50 p.m.

**MAY 2018**

**BME Spring Commencement**  
May 11 | Moby Arena | 11:30 a.m.

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