



**SCHOOL OF BIOMEDICAL
ENGINEERING**
COLORADO STATE UNIVERSITY

Message from Director

Infusion of BME education at CSU and beyond



With an aging population and growing sophistication of medical equipment and technology, employment for biomedical engineers is projected to grow 23 percent from 2014 to 2024, according to the Bureau of Labor Statistics. With this growth, universities around the country are rethinking the fusion of engineering and medicine.

The University of Illinois at Urbana-Champaign is planning a brand new college aimed at infusing engineering education into medical student training. Associate Director for Research at the U. of Illinois Coordinated Science Laboratory, Normand Paquin, believes that this college will create a new type of physician—physician scientists, physician engineers, and physician entrepreneurs. Former Chancellor Phyllis Wise spoke at a CSU seminar in October 2016 and shared her vision of this new college.

Texas A&M is planning an innovative engineering medical school, EnMed, at Houston Methodist Hospital. This school will prepare a new type of doctor who not only practices medicine, but can also solve problems and invent technology with an engineering mindset. According to Texas A&M Engineering Vice Chancellor and Dean of Engineering M. Katherine Banks, this new type of doctor or “physicianeer” will have a traditional engineering background (e.g. mechanical, chemical, electrical) as well as bioengineering education.

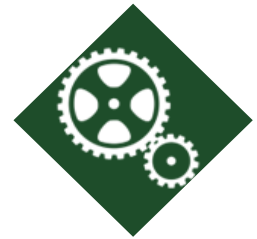
The School of Biomedical Engineering at Colorado State is proud to be the first ABET-accredited undergraduate biomedical engineering degree in the country that has an obligatory tie to a partner degree in chemical and biological engineering, electrical engineering, or mechanical engineering. Already on the cutting edge of this new mix of education, the SBME is proud to boast its strong collaborative ties with CSU’s veterinary school, which is ranked No. 3 in the country according to *U.S. News and World Report*.

In addition, the Wayne McIlwraith Translational Medicine Institute is expected to open at CSU in the fall of 2018 with an emphasis on stem cell biology and therapeutics. We are getting closer to the day when we can fuse biomedical engineering research and education for clinical students of all types.

We look forward to providing our students with resources to help them explore new occupations that combine medicine and engineering. If you would like to learn more about these programs, I can be reached at Stuart.Tobet@colostate.edu.

Sincerely,
Stuart Tobet, Director

Built on Strong Faculty & Research Programs



College of Engineering



College of Health and
Human Sciences



College of Natural
Sciences



College of Veterinary
Medicine & Biomedical
Sciences

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New SBME Advisory Board Member



Ray Goodrich is the executive director of the Infectious Disease Research Center at Colorado State University and has over 23 years of experience working in the fields of blood preservation and pathogen reduction technologies.

Prior to joining CSU in 2016, Goodrich served as president of Innovata BioConsulting and provided consultation related to medical products. From 2011 to 2016, he worked for Terumo BCT as the vice president of Scientific and Clinical Affairs as well as Chief Science Officer for Blood Bank Technologies.

Goodrich received his Ph.D. in chemistry from the California Institute of Technology and his Bachelor of Science in chemistry from Ohio State University. He is an active member of several professional organizations including the American Chemical Society, American Association of Blood Banks, and the International Society of Blood Transfusion.

Graduate Day Poster Session & Awards

On Monday, March 6, the School of Biomedical Engineering held its annual Graduate Interview Day Social for Ph.D. candidates seeking admission to the bioengineering program. During this event, our faculty had the opportunity to recognize three graduate students who have made a significant mark on the School of Biomedical Engineering for their diligence, consistency, and willingness to pursue distinction. Zach Fox received the Outstanding Graduate Student Overall Excellence Award, Nicole Ramo received the Graduate Teaching Award for Excellence, and Kristine Fischenich received the Academic Research Excellence Award. Congratulations Zach, Nicole, and Kristine! Each will receive \$100 from the SBME to celebrate their auspicious achievements.

Additionally, Ketul Popat, associate professor of mechanical engineering and biomedical engineering, received the Excellence in Teaching Award for going above and beyond to serve the SBME student body with his quality teaching efforts for both undergraduate and graduate students. Popat is recognized by his peers as a professor who embodies the high-quality teaching and mentorship that SBME strives to apportion to all students.

At the event, current students showcased their research. Sixteen visiting students were asked to list their top three posters of interest. Two laboratories were notable for the number of mentions in the top three. These were the laboratories of Melissa Reynolds, assistant professor of chemistry and biomedical engineering, and Tammy Donahue, professor of mechanical engineering and biomedical engineering. Each lab received a commemorative plaque and a cash award of \$150 for use in their labs.



BME Student Receives 1st Generation Scholar Award

Dominic Martinez, a fourth-year biomedical engineering and mechanical engineering student, was honored as a Jackson Distinguished First Generation



Scholar at the CSU First Generation Dinner held on March 1. The Jackson Scholars are

selected from the existing group of First Generation Award scholars and are selected for their contributions in the areas of outstanding leadership, involvement in the promotion of a positive climate for diversity on campus, and for whom the award has made a significant impact.

Giving Opportunities

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.

Donate to an SBME scholarship today and know that your gift will make an impact for years to come.

SBME Scholarship for Leadership and Innovation

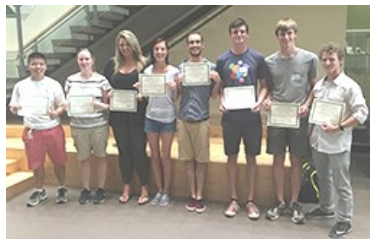
<https://advancing.colostate.edu/SBME>

Joan King Memorial Scholarship

<https://advancing.colostate.edu/KingScholarship>

Undergraduate Program Update

Spring 2017 graduation is approaching, and the undergraduate program is looking forward to graduating our third cohort of students. As we contemplate this milestone, we're reminded of the value of reaching beyond the academy and finding



opportunities for off-campus education—that is, the ever-important goal of getting our students engaged with the biomedical community at large. One way of doing so is encouraging student involvement with professional organizations. This year SBME awarded travel grants to 11 undergraduates to attend national conferences. Many students presented posters and all found great value in the experience. SBME also supports a student chapter of the Biomedical Engineering Society (BMES), which has recently organized events like a faculty meet and greet, and whose officers participated as judges in the 62nd annual Colorado Science & Engineering Fair.

Another avenue for engagement outside of the classroom is industry experience; SBME works collaboratively with the CSU Career Center to provide opportunities for students. The Career Center sponsors engagement at programs such as the Colorado BioScience Institute Industry Showcase and Biotech Connect, which provide a networking environment for students and industry. Exposure to trends in the biotechnology fields, as well as interactions with engineers, managers, and HR professionals help students gather information and make valuable connections, while industry partners discover and recruit incredible CSU talent.

Biotech Connect is an annual campus event and this year featured Darren Dasburg ('81 PE), VP & Site Director of AstraZeneca Biopharmaceuticals, who spoke on the changing face of biotechnology. In addition, spotlight talks gave 20-minute topic snapshots of topics such as “New Hope for Alzheimer’s Patients” and “Immuno-Oncology – New Facility Start-Up.” Over 60 BME undergraduates participated and networked with companies such as Sharklet Technologies, Hyde Engineering, Commissioning Agents, TOLMAR, AlloSource, and Agilent Technologies.

But perhaps the best way of engaging with the biomedical engineering community at large is joining it—in other words, graduating from SBME and starting the next stage of one’s career. Our first two graduating classes have set the bar high, finding positions in industry and prestigious graduate schools: 69% employed in a biomedical engineering field; 10% attending graduate school and pursuing a non-BME major; 9% employed in a traditional engineering field; 7% attending graduate school and pursuing a BME major; and 5% employed in a non-engineering field. These findings are based on an 84 percent response rate from 2015 and 2016 BME alumni.

Graduate Program Update

Spring is upon us! The burgeoning excitement of capping off a rigorous year provides much to celebrate. Additionally, with this season comes the joy of welcoming new students to the School of Biomedical Engineering PhD Program. The SBME hosted its annual Graduate Interview Days on March 6 and 7. A diverse group totaling 19 students spent two intense days interviewing and touring our beautiful campus and facilities. Final decisions are being made, and we would like to take a moment to welcome those who have already made commitments to join us for Fall 2017.

Justin Gangwish. Justin has spent the years since graduation working with Halliburton Energy Services as a Field Professional coordinating well site activities. Justin hopes to obtain his doctoral degree in biomedical engineering focusing on biomaterials and drug therapeutics research.

Peter Linde. Peter’s goals include assisting with advancing biomedical engineering through translation and discovery of innovative products and technologies to medicine while positively impacting animals, people, and the planet.

Alec Richardson. Alec has extensive research experience at Washington State University during his undergrad tenure. His first research project involved using COMSOL Multiphysics to develop a computational model of left ventricular contraction during ventricular systole. In Alec’s words: “Over time, my research interests have shifted from designing sophisticated medical technologies subject to high costs to advancing global health through Point-of-Care diagnostics and low-cost biosensors. Considering that the leading health issues in developing countries stem from infectious diseases, environmental factors, and poor water quality, there is an urgent need for these types of devices.”

Jake Wolynski. Jake has distinguished himself as an undergrad with his excellence in coursework and volunteer lab experience with OBRL (Orthopaedic Bioengineering Research Laboratory). Additionally, Jake earned a National Science Foundation Research Fellowship to travel to India and work closely with experts in the field of foot prosthetics.

We welcome all of our new graduate students to the SBME Family!

Microfluidics innovation earns student Biomedical Engineering Society honor

Lei Wang, biomedical engineering graduate student at Colorado State, received the Biomedical Engineering Society (BMES) Extended Abstract/Design and Research Award at the BMES Annual Meeting in Minnesota on October 8, 2016.

Wang, working with her advisor, Professor David Dandy, has found a way to study small-scale phenomena at the submicron level. The application for which Wang is leveraging microfluidic inertial focusing is harvesting cyanobacteria, a type of microalgae. She is the first to build a platform that can manipulate, concentrate, and separate a suspension of particles this small.



4TH Annual First Generation Dinner

The fourth annual BME First Generation Dinner was held on January 26, 2017 to recognize and connect first generation students with biomedical engineering faculty and staff. CSU defines 'first generation' as students whose parents did not receive a bachelor's (or higher) degree.

This year's event attracted over 30 students and 15 faculty and staff members. Faculty and staff sat with students and shared their first-generation experiences. Students were given an opportunity to share their challenges and struggles. Students walked away knowing that they have a large support group of professionals who are available to answer questions, provide encouragement in challenging times, or serve as a resource.

Tyler Heighes, a fifth-year student in the biomedical engineering program who helped organize the event, stated that the dinner "is a great way to make the professors more approachable" and the interaction with professors "removes the stigma of asking for help." In addition, Heighes mentioned that the event makes it easy to "identify fellow [first-generation] students."

Director Stu Tobet encouraged students to get to know one another and to reach out to first-generation faculty who have traveled their path.

Video of this year's event can be viewed on the SBME First Generation web page at <http://www.engr.colostate.edu/sbme/firstgeneration/>.



BME GRAD CONTINUES TO MAKE A DIFFERENCE

Brett Baeverstad (B.S. BME & B.S. CBE, '16) is a quality engineer at Terumo BCT and recently donated t-cells to a cancer patient via the same type of apheresis machine used for his Senior Design project last spring. This is the second time he's donated using a Terumo device. Read more about the first time he made a donation to the very same patient: <http://col.st/YRsfm>.

Graduate Advisor Sara Mattern Welcomes Baby Girl



Sara and Dane Mattern are proud parents of a daughter, Noah Kenton Mattern,

who was born at 8:04 a.m. on January 27, 2017. Noah weighed 7 pounds and measured 19.25 inches.

Graduate Seminar Summary: Dr. Phillis Wise of UIUC



By Liam Taylor

Dr. Wise gave a presentation on the developing future of The University of Illinois medical program. In recent years, the program consisted of medical students doing their initiate course work at the Urbana-Champaign campus and then transitioning to the more traditional school of medicine in Chicago. Their curriculum and training was very consistent with current medical schools across the nation. Dr. Wise and her team are collaborating with multiple businesses, government agencies, and schools to develop not only a new school of medicine, but a new way to train tomorrow's physicians.

The traditional route for a medical student is getting a bachelor's degree, then proceeding onto a medical school where they spend their first years focusing on basic sciences, anatomy, and physiology. As the medical student progressed into their final years in medical school, they start learning clinical sciences and research techniques. Dr. Wise's method is a distinct break from the normal progression. Her main goal is to develop a new age of physicians that are trained not only in the traditional methods, but with a solid foundation in engineering and medical research.

The first major change is that the normal classroom setting is being turned on its head. Much like many ivy league schools, they are transitioning away from direct lecture and testing methods to more of a comprehensive case study technique. Students will be broken into small teams where a facilitator guides discussion and learning to meet with intended goals. They focus on individual discussion and understanding, which fosters greater participation and retention.

The second major change is in the curriculum that is being covered. As I alluded to earlier, the traditional methods of medical school starts with physical sciences and then moves more to a clinical-focused curriculum once students have a baseline. With Dr. Wise, the school will start with basic sciences but clinical practice will be incorporated from day one. For example, students will learn about how the endocrine systems works, and then they will learn about normal cases that an endocrinologist experiences and pharmacology used to treat diseases. This method cements the knowledge by tying it directly to application, instead of relying on students not to brain dump the material and recall it many years later. Also, with the introduction of clinical sciences early, they also incorporate engineering and research into the mix. Most modern physicians need to be knowledgeable on current engineering methods, and technology because their use is revolutionizing the way we treat illnesses. Methods like 3D printing, tissue engineering, and ratification of limbs/organs are becoming very common at hospitals and physicians can take better care of their patients if they understand the newest technology and treatments.

The final major change to traditional medical schools is that the University teamed with the community to find what would serve their constituents best. They did studies on populations, industry, and businesses around the campus. They teamed with social engineers, architects, and government agencies to develop a school that fits into the community rather than a school located in a community. It allows for people to have jobs waiting for them when they graduate, keeps people around the school, and grows the town with an integrated campus. The integrated campus allows for students to keep their knowledge and skills in the community long after their graduation rather than moving away to another major city.

Dr. Wise and her team are truly looking into developing a new way of teaching medical school. They are focusing on new methods of learning, new curriculums, and maintaining the integration of the college with the local community. The future graduates from the U. of Illinois are going to be best set up for the future of medicine and the challenges of residency.

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 2016 speakers included:

Dr. Gaurav Misra
University of Florida
Neuroimaging of Pain and Movement Processing in the Human Brain

Anthony Di Franco
Counter Culture Labs
Biohacking, Open Source Biologics, and the Open Insulin Project

Dr. Abe Lee
University of California, Irvine
Microfluidic Circulation for Biomedicine: From in vivo liquid biopsy to in vitro vascularized micro organs

Dr. Phillis Wise
University of Illinois, Urbana-Champaign
Applying the Convergence Framework to Redesign Medicine

SBME Faculty Research & Awards

Blood-Repellent Materials: A new approach to medical implants



Medical implants like stents, catheters, and tubing introduce risk for blood clotting and infection—a perpetual problem for many patients. Colorado State University engineers offer a potential solution: a specially grown, “superhemophobic” titanium surface that’s extremely repellent to blood. The material could form the basis for surgical implants with lower risk of rejection by the body.

It’s an outside-the-box innovation achieved at the intersection of two disciplines: biomedical engineering and materials science. The work, recently published in [Advanced Healthcare Materials](#), is a collaboration between the labs of Arun Kota, assistant professor of mechanical engineering and biomedical engineering; and Ketul Papat, associate professor in the same departments.

Kota, an expert in novel, “superomniphobic” materials that repel virtually any liquid, joined forces with Papat, an innovator in tissue engineering and bio-compatible materials. Starting with sheets of titanium, commonly used for medical devices, their labs grew chemically altered surfaces that act as perfect barriers between the titanium and blood. Their teams conducted experiments showing very low levels of platelet adhesion, a biological process that leads to blood clotting and eventual rejection of a foreign material.

The researchers analyzed variations of titanium surfaces, including different textures and chemistries, and they compared the extent of platelet adhesion and activation. Fluorinated nanotubes offered the best protection against clotting, and they plan to conduct follow-up experiments.

Read the full story here: <http://source.colostate.edu/blood-repellent-materials-new-approach-medical-implants/>.

Ice is No Match for CSU-Developed Coating

Anyone who’s ever chipped ice off a windshield or nervously watched a plane get de-iced, take note: Colorado State University researchers have invented an ice-repellent coating that out-performs today’s best de-icing products.



Researchers led by Arun Kota, assistant professor of mechanical engineering and biomedical engineering, have created an environmentally friendly, inexpensive, long-lasting coating that could keep everything from cars and ships to planes and power lines ice-free.

Their innovation, described in the *Journal of Materials Chemistry*, is a gel-based, soft coating made out of PDMS (polydimethylsiloxane), a silicone polymer gel with already widespread industrial use. Their experiments were supported by careful analysis of ice adhesion mechanics.

The performance measure of de-icing coatings is called ice adhesion strength – the shear stress necessary to remove ice from a surface – and is measured in kilopascals (kPa). Kota’s group demonstrated ice adhesion strength for their coating of about 5 kPa. By contrast, soft coatings available on the market have ice adhesion strength of about 40 kPa (lower is better). Other types of de-icing coatings made of rigid materials typically perform at around 100 kPa.

Kota notes that de-icing coatings are not the same as anti-icing coatings. Anti-icers delay the formation of ice; de-icers facilitate easy removal of ice, once that ice has already formed and stuck to a surface. The CSU breakthrough is an environmentally friendly, high-performance solution that could rid us of toxic liquid de-icers and keep ice from sticking to our windshields. It would be applied as a more permanent protective coating. “We think there is significant commercial potential here,” Kota said.

Learn more at <http://source.colostate.edu/ice-no-match-csu-developed-coating/>.

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.

Transformational Gift to Propel College of Engineering to New Heights



Colorado State University has received a \$53.3 million gift, the largest in the University's history, from business icon Walter Scott, Jr. of Omaha, Neb. The commitment will provide wide-reaching support for student scholarships, faculty excellence, and research.

In recognition of this monumental gift, the College of Engineering will be renamed the Walter Scott, Jr. College of Engineering, becoming the only named college of engineering in Colorado. It is the second of CSU's eight colleges to be named for a prominent alumnus. In 2005, the Warner College of Natural Resources was named for Edward M. Warner.

"We are humbled and incredibly grateful for this remarkable gift from Walter Scott," said CSU President Tony Frank. "Walter has been a passionate and generous supporter of CSU since he graduated more than 60 years ago, and this gift is truly transformational. It will allow the Walter Scott, Jr. College of Engineering to attract and support the finest faculty and students for years to come. This truly is a great, great day in Colorado State University's history."

Scott graduated in 1953 from CSU, then known as Colorado A&M, with a bachelor's degree in civil engineering, embarking on a long career with contracting giant Peter Kiewit Sons', Inc. Scott's long history of support of the University and its College of Engineering has significantly impacted student experiences, programs, research, and infrastructure. With his late wife, Suzanne, he provided a leadership gift for the Suzanne and Walter Scott, Jr. Bioengineering Building, completed in 2015. It is home to more than 30 faculty and 120 graduate students conducting research on global challenges related to water, energy, health, and the environment.

Scott's passion for investing in young people shines through with this exceptionally generous gift. By significantly expanding a previous gift that established the Walter Scott, Jr. Scholarship Program, it will provide renewable merit scholarships for up to 80 undergraduates, and fellowships for up to 30 graduate students, with outstanding academic qualifications.

"As we get older, I think it's natural to think about the generations that will follow," said Scott. "And in a technological age, it's important that our top students have the opportunity to study at strong research universities."

Scott also noted the connection between the University and the company he once led. Kiewit, which has its Colorado offices in Englewood, employs more than 100 CSU alumni.

"CSU has long been near the top in the number of students the company hires each year," Scott said. "Helping young people with their education is one of the finest investments we can possibly make as a society, and I'm always pleased to see so many of the university's students choose to start their careers at Kiewit."

Read full story at <http://source.colostate.edu/transformational-gift-propel-college-engineering-new-heights/>.

Melissa Reynolds Named Professor Laureate



Dean Janice Neger of the College of Natural Science has named Melissa Reynolds, assistant professor of chemistry and biomedical engineering, Professor Laureate. The designation of Professor Laureate is the highest professorial title awarded by the College and is intended not only to honor the individual, but also to provide role models to the College.

Reynolds demonstrates the characteristics of a well-rounded productive academician. She is an inspiring, challenging, and effective teacher who has made important and extensive contributions to her discipline and devotes time and energy in service to the university, her profession, and the community at large.

Ph.D. Student Selected as VPR Fellow

Zachary Fox, a graduate student working with Advisor Brian Munsky, has been selected as a Vice President for Research Fellow for the 2017-18 academic year.

The VPR Graduate Fellows Program at Colorado State supports excellence in graduate research and promotes interdisciplinarity at the university by engaging the best and brightest students from graduate programs across the institution.

Fox will receive up to \$4,000 in scholarship and travel support to attend professional development workshops and seminars, OVPR events, networking events, and participate in mentoring and engagement activities with industry leaders.



**SCHOOL OF BIOMEDICAL
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Save the Date

APRIL 2017

SBME Seminar: Ben Wheatley, Ph.D. Student
Apr. 3 | 229 Scott Bioengineering Building | 12–12:50 p.m.

SBME Seminar: Dr. Peter Johnson, MedSurgPI, LLC.
Apr. 10 | 229 Scott Bioengineering Building | 12–12:50 p.m.

Engineering Days (E-Days)
Apr. 14 | CSU Lory Student Center | 9–3:00 p.m.

SBME Seminar: Hannah Pauly, SBME Ph.D. Student
Apr. 17 | 229 Scott Bioengineering Building | 12–12:50 p.m.

SBME Seminar: David Bark, Ph.D.
Apr. 24 | 229 Scott Bioengineering Building | 12–12:50 p.m.

MAY 2017

SBME Seminar: James Bamburg, Ph.D.
May 1 | 229 Scott Bioengineering Building | 12–12:50 p.m.

BME Spring Commencement
May 12 | Moby Arena | 11:30 a.m.

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