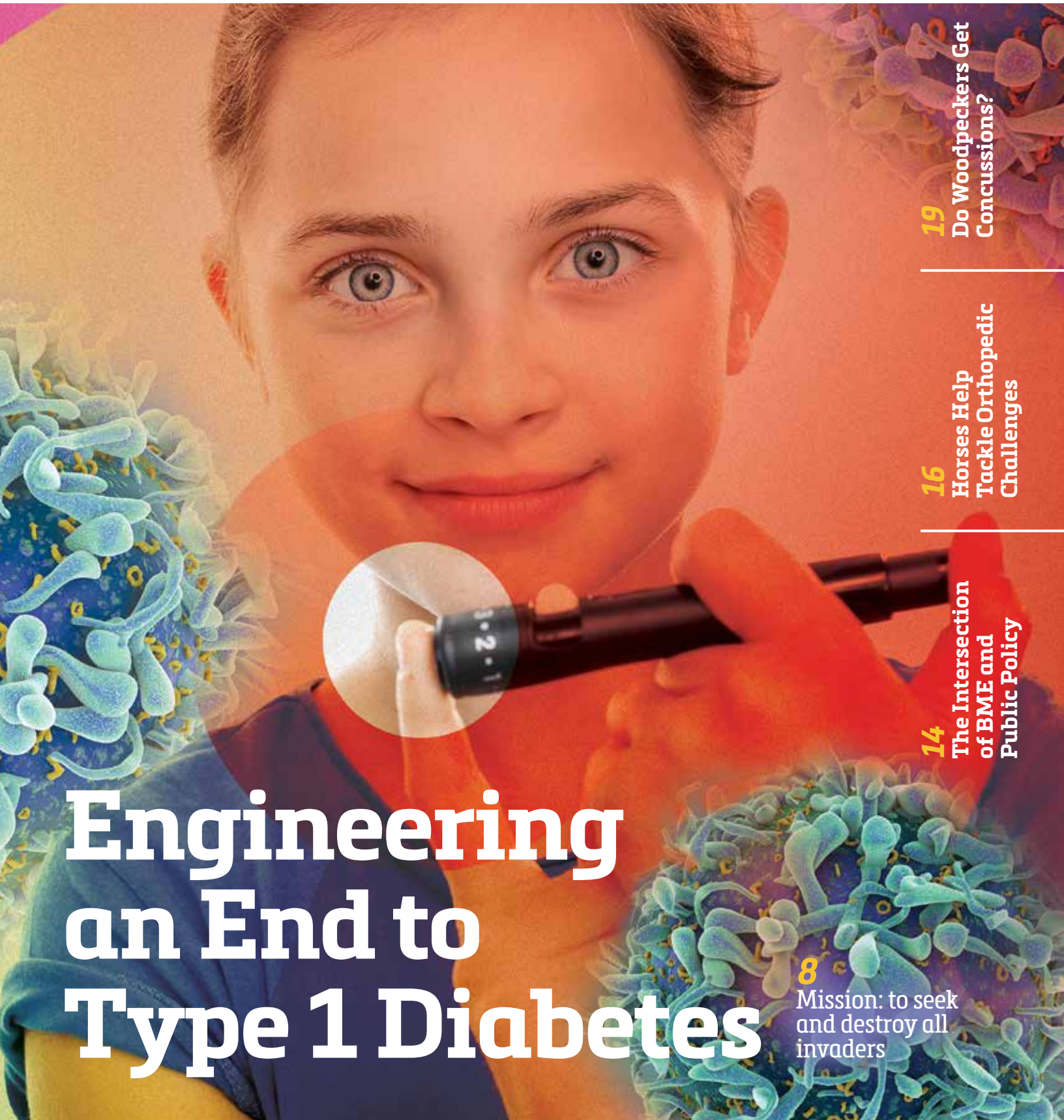
CrossLink

BIOMEDICAL ENGINEERING *at the* UNIVERSITY *of* FLORIDA // **FALL 2018**



Engineering an End to Type 1 Diabetes

UNIVERSITY OF FLORIDA
GO GREATER
HERBERT WERTHEIM COLLEGE OF ENGINEERING

A CASE FOR GREATNESS

GO GREATER is a bold statement of who we are and who we want to be. Together — inspired by shared vision, driven by our collective energy and bound by common purpose — there is little we can't achieve.

Through the GO GREATER campaign, the Herbert Wertheim College of Engineering answers a call to lead. Building on the spark that occurs at the intersection of vision and opportunity, we will blaze trails of success that will enrich the lives of citizens across our state, nation and world. With your help, we will:

- **Create more faculty endowments and new scholarships** — to attract and retain academia's best and brightest scholars
- **Invest in priority infrastructure and facilities** — to provide environments that inspire ideas and solutions
- **Fund multidisciplinary bright ideas** — to address grand challenges and improve how people experience life
- **Strengthen UF's national and global stature** — to better serve society
- **Increase the college's endowment** — to forever sustain excellence in scholarship, discovery and service

UF ENGINEERING STUDENT RUBEN JEAN AT THE FORBIDDEN CITY, BEIJING, CHINA

Dear UF BME Friends & Family,

Welcome to the 5th issue of CrossLink, the annual magazine of the J. Crayton Pruitt Family Department of Biomedical Engineering at the University of Florida.

A primary focus for the department over the past five years has been, and remains, the growth of our faculty to expand educational opportunities for our growing student body. With the bar set at the highest level, we seek to bring in the best people to join our stellar faculty through rigorous searches and joint efforts across the university. We also truly value the collegial environment we have built and focus on recruiting faculty who will further build a positive community.

This fall we are thrilled to welcome **Dr. Lakiesha Williams** to the department as an associate professor. Dr. Williams works to understand mechanistic changes associated with traumatic brain injuries. Please read more about her exciting research on page 19.

In addition to recruiting top faculty, central to our success has been building strong partnerships across campus and nationally. In line with this goal, we have implemented two new annual events, Industry Connect and Alumni Connect.

In terms of building partnerships, **we are happy to announce our new industry partner, Edwards Lifesciences** (see page 23). Industry partnerships are critical as they provide strategic connections between industry and our students and faculty. We look forward to meaningful interactions with Edwards Lifesciences and to further expand our industry partners program.

With the recent instability of federal research funding threatening the scientific progress of universities across the nation, **students at UF BME founded an organization focused on advocating for positive science policy and public awareness**. This team of passionate students aims to motivate others and take action to enact meaningful changes to the scientific community. Please read more about their efforts on page 14.

While we celebrate successes from the 2017-2018 academic year, we anticipate that the upcoming year will be even better. We have set our goals high and are **committed to moving the department forward to be among the top biomedical engineering departments in the country.** To continue to rise, we are focusing on raising funds to support new educational initiatives, undergraduate labs and new programs, graduate fellowships and new endowed chairs and professorships.

I hope you will spend some time reading about the great research and other activities our faculty and students are involved in. If you're in the Gainesville area, please stop by and visit!

Sincerely,

CSchmidt

Christine E. Schmidt
Professor, J. Crayton Pruitt Family Chair and Department Chair

CrossLink

A publication of the J. Crayton Pruitt Family Department of Biomedical Engineering at the University of Florida

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UF UNIVERSITY of FLORIDA

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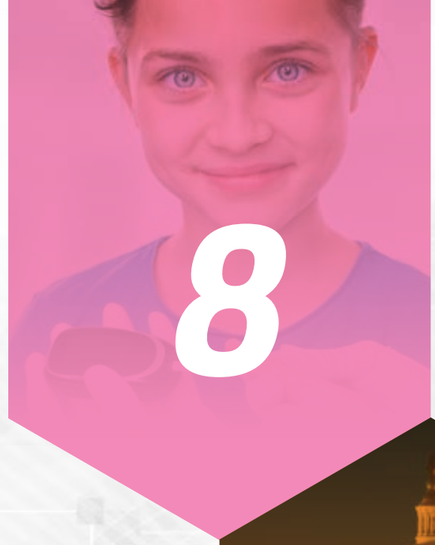

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AIMBE

The American Institute for Medical and Biological Engineering (AIMBE) is a non-profit organization headquartered in Washington, D.C., representing the most accomplished individuals in the fields of medical and biological engineering. AIMBE's mission is to provide leadership and advocacy in medical and biological engineering for the benefit of society.

Dr. Christine E. Schmidt named AIMBE President

Dr. Christine E. Schmidt, professor, J. Crayton Pruitt Family Chair and Department Chair, has been named President of AIMBE.

Drs. Benjamin G. Keselowsky and Cherie Stabler elected AIMBE Fellows

Drs. Benjamin G. Keselowsky, professor, and Cherie Stabler, professor, were elected as AIMBE Fellows representing a select group of the top two percent of medical and biological engineering professionals. The College of Fellows is composed of distinguished bioengineers in academia, industry and government.

Keselowsky was elected for his outstanding contributions to the field of immune engineering, at the interface of biomaterials and immunology.

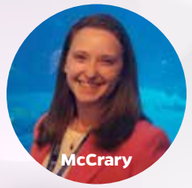
Stabler was elected for her outstanding contributions in the design of translational bioactive materials for cellular transplantation, focusing on treatment of type 1 diabetes.

Dr. Parisa Rashidi received prestigious NSF CAREER Award

For her research advancing the exploration of machine learning algorithms and critical care medicine.

NSF

Maggie Fettis elected President and Michaela McCrary elected Bylaws Chair for Society for Biomaterials National Student Chapter



Society For Biomaterials
Turning Life To a World of Materials

Major Faculty Awards + Recognitions

- Dr. Kyle D. Allen invited to serve as associate editor for the American Society of Mechanical Engineers (ASME) Journal of Biomechanical Engineering
- Dr. Kyle D. Allen invited to serve on NIH Skeletal Biology Structure and Regeneration (SBSR) study section
- Drs. Jon Dobson and Carlos Rinaldi published book, "Nanomagnetic Actuation in Biomedicine: Basic Principles and Applications"
- Dr. Ruogu Fang selected as a member of the Association for Computing Machinery's Future of Computer Academy
- Dr. Daniel Ferris awarded 2018 American Society of Biomechanics (ASB) Founders' Award
- Dr. Jennifer A. Nichols awarded the 2018 ASB Young Scientist Post-doctoral Award
- Dr. Edward Phelps received Young Investigator Award from the Network of Pancreatic Donors with Diabetes (nPOD)
- Dr. Carlos Rinaldi named chair of UF Department of Chemical Engineering

Key Research Advances + Innovation

- Dr. Kyle D. Allen awarded $1.8M collaborative NIH R01 grant, "A Pathogenesis Beyond Cartilage: A Preclinical Study of the Sources of Osteoarthritis Pain"
- Dr. Mingzhou Ding awarded $2.7M collaborative NIH R01 grant, "Mechanisms of Attentional Control: Structure and Dynamics from Simultaneous EEG-fMRI and Machine Learning"
- Dr. Daniel Ferris awarded $2M NIH R01 grant, "Supraspinal Control of Human Locomotor Adaptation"
- Dr. Gregory A. Hudalla awarded National Institute of Biomedical Imaging and Bioengineering (NIBIB) Trailblazer R21 Award
- Drs. Benjamin Keselowsky (PI) and Cherie Stabler awarded collaborative NIH T32 training grant, "Interdisciplinary Graduate Program in Type 1 Diabetes and Biomedical Engineering"
- Dr. Benjamin Keselowsky awarded $2.6M collaborative NIH R01 grant, "Tolerogenic Dual Microparticle System for Treatment of Multiple Sclerosis"
- Drs. Benjamin Keselowsky (PI) and Gregory Hudalla awarded $2.1M collaborative NIH R01 grant, "Tissue-Targeted Enzyme for Localized Tryptophan Catabolism to Direct Subcutaneous"
- Dr. Parisa Rashidi awarded NIH R01 grant, "PRECEDE: PREsurgical Cognitive Evaluation via Digital clockfacE Drawing"
- Dr. Blanka Sharma awarded $1.5M NIH R01 grant, "Nanoparticle Targeting within the Joint for Site-specific delivery of Osteoarthritis Therapeutics"

Student Awards

- Alexis Brake selected for National Institute of Standards and Technology (NIST) Summer Undergraduate Research Fellowship
- Jackson Cagle honored with Society for Neuroscience Trainee Professional Development Award
- Anis Davoudi selected as a grant recipient for Workshop for Women in Computer Vision (WiCV)
- Cassandra Frisch, part of Team Tech, placed second at the Society for Women Engineers Conference
- Anne Gormaley and Danny Xie accepted into NIH Biomedical Engineering Summer Internship Program (BESIP)
- Shruti Siva Kumar awarded scholarship to attend 2018 Grace Hopper Celebration
- Olivia Lanier and Rachna Sannegowda received fellowships to attend NSF Summer School
- Peng Liu won first place in the International Computational Competition on Diabetic Retinopathy Diagnosis
- Chandni Rana selected for RIKEN Brain Science Program
- Immanuel B.H. Samuel and Fuyong Xing honored as UF Outstanding International Students
- Joshua Stewart received SFB Student Travel and Professional Development Award

Distinguished Leadership Seminar Series

2017–2018 SPEAKERS

Nancy L. Allbritton, M.D., Ph.D.
Kenan Distinguished Professor, Chair of UNC/NC State Joint Department of Biomedical Engineering, Jointly Appointed with School of Medicine and School of Pharmacy
Mini-Guts on Microchips

Rebecca M. Bergman
President, Gustavus Adolphus College
From Technology Development to College Leadership: A Journey of Problem Solving, Critical Thinking, Innovation and Vision

Martha L. Gray, Ph.D.
J. W. Kieckhefer Professor of Health Sciences & Technology, Professor of Electrical Engineering and Computer Science, Massachusetts Institute of Technology
Are you a Biomedical Engineer who Dreams of Having an Impact on Healthcare?

Warren M. Grill, Ph.D.
Edmund T. Pratt, Jr. School Professor of Biomedical Engineering, Duke University
Temporal Pattern of Neural Stimulation as a New Dimension of Therapeutic Innovation

Buddy D. Ratner, Ph.D.
Director, University of Washington Engineered Biomaterials (UWEB21), Michael L. and Myrna Darland Endowed Chair in Technology Commercialization, Professor of Bioengineering and Chemical Engineering, University of Washington
Hemodialysis Re-envisioned: The Contributions of New Biomaterials

Lonnie Shea, Ph.D.
Professor and William and Valerie Hall Chair, Department of Biomedical Engineering, Professor, Department of Chemical Engineering, University of Michigan
Tissue Engineering of the Pre-metastatic Niche

2018–2019 SPEAKERS

Joseph M. DeSimone, Ph.D.
Chancellor's Eminent Professor of Chemistry, University of North Carolina Chapel Hill, William R. Kenan, Jr. Professor, Department of Chemical and Biomolecular Engineering, North Carolina State University

Susan S. Margulies, Ph.D.
Wallace H. Coulter Chair, Georgia Research Alliance Eminent Scholar in Injury Biomechanics, Wallace H. Coulter Department of Biomedical Engineering, Georgia Tech College of Engineering, Emory University School of Medicine

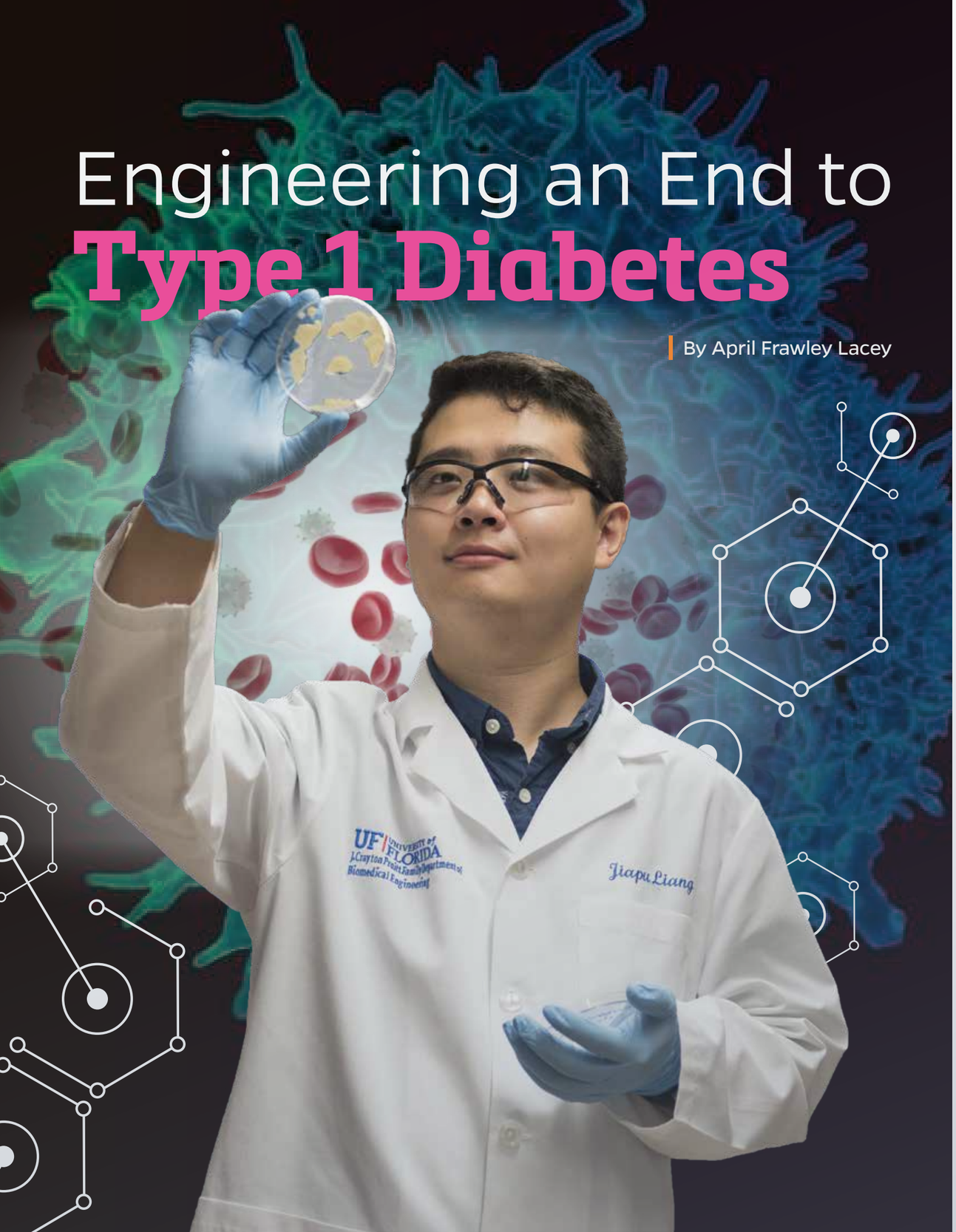
Leonard Pinchuk, Ph.D.
Distinguished Research Professor, Department of Biomedical Engineering, University of Miami, President/CEO at Innovia LLC

Thomas C. Skalak, Ph.D.
Vice President for Research Emeritus, University of Virginia

Marjolein C.H. van der Meulen, Ph.D.
James M. and Marsha McCormick Director and Swanson Professor of Biomedical Engineering, Nancy E. and Peter C. Meinig School of Biomedical Engineering, Cornell University

Engineering an End to Type 1 Diabetes

By April Frawley Lacey



Dr. Cherie Stabler (L) working with Ph.D. student, Sydney Wiggins (R)

Imagine you have a cold. Your immune system senses the threat and deploys its army of immune cells to the scene. Their mission: to seek and destroy all invaders. All threats must be eliminated.

But what if your immune system senses a threat a little closer to home – namely, the insulin-producing cells inside your pancreas? This is how type 1 diabetes starts, not because you eat too much chocolate cake, forget to exercise or drink orange soda instead of water.

There are no simple lifestyle changes that can stop someone's body from an autoimmune attack on itself, which is what happens in type 1 diabetes. But UF researchers in the J. Crayton Pruitt Family Department of Biomedical Engineering are working with experts in the UF Diabetes Institute on innovative ways to stop the disease in its tracks, and in some cases, prevent it from even occurring.

"Type 1 is out of the patient's control. It is a lethal condition, and they require insulin to survive," said Cherie Stabler, Ph.D., a UF professor of biomedical engineering and associate chair of graduate studies. "Patients face a lot of challenges managing their blood sugar. If their blood sugar gets too high, it can develop secondary complications. If it gets too low, it can kill them."

With an internationally recognized Diabetes Institute housed in the same building, a team of biomedical engineers in the department are focused on developing new ways to solve the challenges that face patients with type 1 diabetes, which affects more than 1.25 million children and adults in the United States.

"Biomedical engineers have had a huge impact on type 1 diabetes already," said Ed Phelps, Ph.D., an assistant professor of biomedical engineering who joined the department in 2017. "Recombinant human insulin was one of the first biotech drugs produced. Also, we have devices for continuous blood glucose monitoring and pumps for insulin delivery linked to smartphones."

"Biomedical engineers bring a different perspective and a way of problem solving so we can make new and innovative contributions."

The contributions UF biomedical engineers are making to improve the lives of people with diabetes run the gamut from better understanding the disease and developing better treatments for preventing the disease outright or curing it after it begins.

In the lab of Benjamin G. Keselowsky, Ph.D., a UF professor of biomedical engineering, he and his team are working on a project to retrain the immune system not to recognize islets in the pancreas as a threat. Islets are clusters of insulin-producing beta cells in the pancreas. When the islets that make insulin are destroyed in type 1 diabetes, patients rely on insulin they inject or get through pumps to survive. The body needs insulin because it directs other cells to absorb sugar from food to make energy.

"In diabetes, there is an autoimmune reaction that drives the formation and selection of T cells that distinguish an antigen from beta cells and islets in the pancreas. What we are trying to do is reeducate the immune system to ignore this antigen or selectively to kill these disease causing T cells," Keselowsky said.

The contributions UF biomedical engineers are making to improve the lives of people with diabetes run the gamut from better understanding the disease and developing better treatments to preventing the disease outright or curing it after it begins.

Keselowsky teamed with immunologists Mark Atkinson, Ph.D., Todd Brusko, Ph.D., and Clive Wasserfall, M.S., of the UF Diabetes Institute, to form a company focused on developing a vaccine that would prevent and reverse type 1 diabetes by retraining immune cells not to attack the insulin-producing beta cells.

With funding from the National Institutes of Health, the researchers have been studying what happens when they inject a microparticle formulation in the body that attracts immune cells and retrains them not to attack. A patent was awarded for the formulation, Keselowsky said.

In Phelps' lab, he and his team are working to understand how islets communicate. Similar to cells in the brain, islets use neurotransmitters to control functions and coordinate insulin secretion. But little is known about how these neurotransmitters function together, he said.

"We are trying to understand central biological questions," he said. "Only a few people have conducted research in this area. There are a lot of open questions, and they need an organized and systematic approach. We are

With funding from the National Institutes of Health, the researchers have been studying what happens when they inject a microparticle formulation in the body that attracts immune cells and retrains them not to attack.

interested in how they function normally and in diabetes, and how that contributes to the disease."

Phelps and his team work closely with Stabler, whose research focuses on improving islet transplantation. Islet transplants provide patients with working islets again, so their bodies can make their own insulin. However, the transplant is targeted to the liver, which isn't the ideal location for it and patients require immunosuppressive drugs for the islets to work. About half the islets that are transplanted usually die and although the transplant provides a cure, it is a temporary one. UF researchers are working on ways to improve how the transplant is delivered, engineering a better location so it can be delivered with fewer islets and last longer.

Stabler's team has developed an implant to house islets that can be delivered to the omentum, a fold of tissue that connects the stomach and other abdominal organs. It's an ideal location because the omentum will naturally remodel the implant once it is in place, linking it to blood vessels. This is important because islets need oxygen from the blood to survive. But it takes about two weeks for the omentum to remodel the implant, so the team is also working on ways to improve the microenvironment for the islets.

The implant includes a silicone-based scaffold that houses the microenvironment for the islets. Some of the improvements her team are working on include adding oxygen-generating material to protect the islets and delivering agents to suppress the immune system.

"We can deliver a drug that deactivates the immune cells in (the implant's) microenvironment," Stabler said. "We can also shrink wrap the islets in polymer to protect them."

The researchers already have a medical grade product to translate and are in conversations with the FDA, Stabler said.

Dr. Ed Phelps (R) working with Ph.D. student, Matthew Becker (L)

Dr. Benjamin G. Keselowsky (L) and Dr. Matthew R. Carstens (R)

Because it can be challenging to foresee how projects translate from animals to humans, Stabler's team is also focused on developing better predictive models. Her "Islet on a Chip" project creates a 3-D system that predicts what islets will do in the body under certain circumstances.

"Translation is difficult," she said. "There is nothing like a human."

To ensure researchers continue to develop innovative techniques to treat and cure type 1 diabetes, the UF Diabetes Institute (UFDI) and the Department of Biomedical Engineering received a training grant from the National Institutes of Health earlier this year to establish a graduate program in type 1 diabetes and biomedical engineering. This program allows five predoctoral students to be mentored and trained by experts in biomedical engineering and immunology.

"The training grant demonstrates that at UF we are training students at the cutting edge of type 1 diabetes and biomedical engineering research," Keselowsky said.

The researchers are all quick to point out that none of this would be possible without the expertise and resources of the UF Diabetes Institute at their disposal and the leadership by UFDI Director, Dr. Mark Atkinson. For example, the institute is home to the JDRF (a global organization funding type 1 diabetes research) Network for Pancreatic Organ Donors with Diabetes (or nPOD). UF's nPOD is the world's largest open research consortium dedicated to the study of the human pancreas and provides scientific investigators around the world with human pancreas samples for research.

"The environment at UF is top notch for doing this work," Phelps said. "The UFDI, with all they are doing, makes our research possible."

Stabler added, "The goal is to treat this disease and come up with a better option for patients. We want to move the needle forward."

A Comprehensive Approach to Tackling Diabetes

Ruogu Fang, Ph.D.
Assistant Professor
Machine learning to assess patient risk for retinopathy

Gregory A. Hudalla, Ph.D.
Assistant Professor &
J. Crayton Pruitt Family Term Fellow
Immunomodulatory enzyme assemblies and biomaterials to protect pancreatic tissues

Benjamin G. Keselowsky, Ph.D.
Professor
Biomaterials and controlled release systems for diabetes vaccine

Kevin J. Otto, Ph.D.
Professor
Neuromodulation of the pancreas to promote insulin secretion

Edward A. Phelps, Ph.D.
Assistant Professor
Pancreatic islet biology to understand diabetes and autoimmunity

Cherie Stabler, Ph.D.
Professor &
Associate Chair for Graduate Studies
Biomaterials for pancreatic islet transplantation and regeneration

Lin Yang, Ph.D.
Associate Professor
Imaging informatics of pancreatic tissue for personalized diabetes treatment

UF BME: RESEARCH IMPACT

- VACCINES FOR AUTOIMMUNE DISEASE
- SAFE DRUG DELIVERY SYSTEMS
- PREVENTION & TREATMENT THROUGH IMMUNE CELL INTERACTIONS
- AUTOMATION OF LARGESCALE SCREENING USING MACHINE LEARNING & DOMAIN KNOWLEDGE
- BIOMATERIAL PLATFORMS FOR CELL-BASED THERAPIES
- NEW BIOMARKERS THROUGH BIG DATA & ARTIFICIAL INTELLIGENCE
- THERAPIES THAT INTERVENE AT EARLY STAGE OF DISEASE

The Intersection of BME and Public Policy

Above, from L to R: Mary Kasper, Rep. Ted Yoho, Meggie Pires-Fernandez and Kaitlynn Olczak
Left: NIH Director, Dr. Francis Collins (L) and Eric Fuller (R)

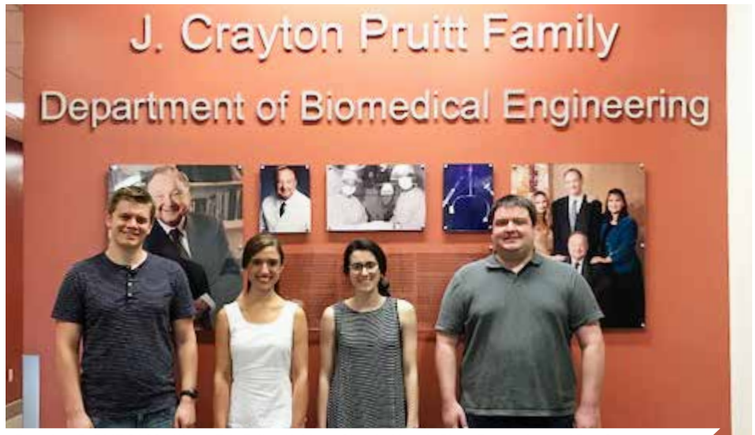
Concerned about budget cuts to scientific research institutions like the National Institutes of Health and the National Science Foundation, a new student group was founded by a few passionate students in the J. Crayton Pruitt Family Department of Biomedical Engineering. The Student Association for the Support of Science (SASS) was formed to advocate for positive science policy and public awareness.

The team has a three-fold mission, including:

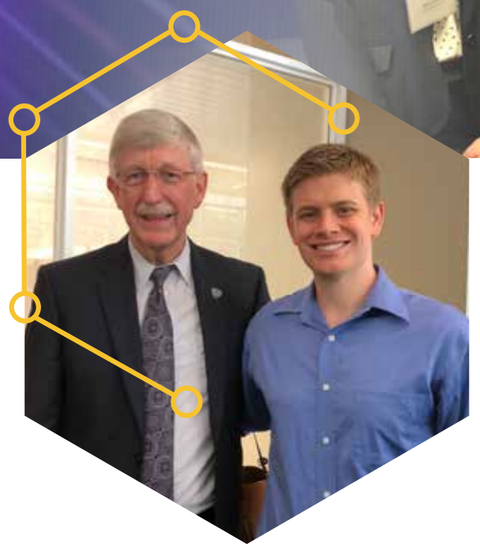
> **Motivate** – Communicate with both researchers and the public on the importance of science and science funding in the United States
> **Spread Awareness** – Update the scientific community on relevant major policies and decisions that affect science funding and research
> **Take Action** – Facilitate communication between people and their representatives to enact meaningful change on science policy

The team of science advocates has fulfilled this mission through several activities. These included writing a newsletter educating members of the department on how science policy impacts them, hosting a letter writing event to representatives in the House and Senate, and promoting attendance at a talk given on campus by National Institutes of Health Director, Dr. Francis Collins.

Pivotal in the formation of SASS was Milan Yager's visit to campus. Yager, who is the executive director of the American Institute for Medical and Biological Engineering (AIMBE), gave a talk titled, "The Losing Case for Innovation: Understanding Why Congress Doesn't Fund Research" where he discussed what is happening on Capitol Hill as it relates to science and research funding. His talk discussed the critical role of federally funded science and how this role can be protected and promoted.



From L to R: BME SASS officers Eric Fuller, Kaitlynn Olczak, Meggie Pires-Fernandez and Ben Spearman



Inspired by Yager's visit, BME SASS members Eric Fuller and Ben Spearman attended the AIMBE Public Policy Institute in Washington, D.C. where they were educated on how public policy impacts biomedical engineers. Members Kaitlynn Olczak, Meggie Pires-Fernandes, and Mary Kasper attended the Catalyzing Advocacy for Science and Engineering (CASE) Workshop also in D.C., where they were taught science policy and advocacy and had the opportunity to meet with Rep. Ted Yoho (FL-3rd). This culminated in inviting Rep. Yoho to meet with students and tour research labs within the department. During the tour, students demonstrated innovative lab work focused on next-generation treatments and cures for cancer, osteoarthritis, nerve injuries and more. Rep. Yoho learned through visual presentations and hands-on demos about the impact that federally funded science is having at UF.

"It's fantastic to see this group of students being pro-active in educating both the public and elected officials to the value of science and engineering," said Dr. Jon Dobson, Ph.D., UF BME professor and faculty advisor of SASS. "Their energy and dedication are impressive, and hopefully SASS inspires other students to become more engaged in activities that help to counter anti-science sentiment held by many."

The team hopes to encourage policymakers on all sides of the political spectrum to look to science when designing new laws, systems, and regulations and has big plans for the upcoming school year. This will include encouraging attendance at town hall meetings, spreading information about the upcoming 2018 elections to the BME and Gainesville communities, and bringing in speakers with relevant experience and insight to promoting public policy beneficial to the BME community.

Madison Temples (L) and Rep. Ted Yoho (R)

Horses Help Tackle Orthopedic Challenges

Merging Engineering and Veterinary Expertise

By Jonathan Griffin

Although they stand on four legs and often weigh over a thousand pounds, we can learn much about ourselves from horses.

In particular, certain similarities make horses invaluable for orthopedic research. Horse joints have cartilage thickness comparable to ours and damaging these joints, like for us, can eventually lead to osteoarthritis, or OA, a painful and incurable joint disease.

By studying these animals, researchers in the J. Crayton Pruitt Family Department of Biomedical Engineering and the UF College of Veterinary Medicine have made important progress towards better treatments for joint injury and disease in both horses and humans.

As a strategy to repair damaged cartilage, Blanka Sharma, Ph.D., UF BME assistant professor, has developed hydrogels to stimulate chondrogenesis, a process by which cells produce new cartilage. To better understand how the hydrogel behaves in the joint, an animal model that mimics human joints closely is necessary, Sharma says.

"I think the horse could be a good bridge for understanding repair in cartilage defects," Sharma said.

As a veterinary surgeon who regularly treats horse patients, Adam Biedrzycki, Ph.D., assistant professor of large animal surgery, collaborated with Sharma in a pilot study to implant hydrogels into horse stifles, which are analogous to human knees.

During surgeries, two different strategies for repair were employed. In the first, hydrogels were used to deliver stem cells provided by Glyn Palmer, Ph.D., assistant professor of orthopedics and rehabilitation, into large cartilage defects. In the second, hydrogels were placed into cartilage microfractures which were made to draw out marrow and blood cells from the underlying bone, which stimulates tissue repair.

Going into surgeries, it was suspected that differences in the mechanics of horses and humans may disrupt hydrogels and limit cell survival.

"We can't just tell the horses to chill in bed for two weeks," Biedrzycki said. "They have to stand up right after surgery."

One month later, small biopsies were collected, and the researchers were excited to find that both hydrogels and labeled cells remained in the joint tissue.

The close proximity of the BME department and the College of Veterinary Medicine has made it easy for biomedical engineers to openly communicate with veterinarians like Biedrzycki, and in doing so, they have gained new perspectives on the potential of their own research.

The successful surgeries and promising findings demonstrated feasibility of the treatment, however, the injuries did not necessarily replicate real injury or disease. In the future, Sharma and Biedrzycki plan on expanding the potential of this treatment by studying horses with OA.

"What we want to try to do is understand if the hydrogel or combination of hydrogel and cells can actually repair these OA lesions and if they can't, what other requirements are needed to promote regeneration," Sharma said.

Biedrzycki's collaboration with biomedical engineering extends to another project with Kyle Allen, Ph.D., UF BME associate professor, aimed at developing a new diagnostic method for joint disease by measuring synovial fluid viscosity.

Synovial fluid, which provides lubrication in joints, decreases in viscosity, becoming more water-like, as diseases such as OA progress and can therefore be used as a marker for joint disease.

The current standard for veterinarians to measure viscosity is by placing fluid between the thumb and pointer finger and checking if a string forms as the fingers are pulled apart, Biedrzycki says.

For a more quantitative and reliable measurement, Allen's lab in collaboration with Carlos Rinaldi, Ph.D., Chair of the Department of Chemical Engineering and BME professor, has developed an inexpensive method that only requires very small volumes and could potentially be used as a point-of-care tool.

A measurement such as this could be particularly useful for veterinary medicine where diagnostic tools can sometimes be more important than in human medicine.

"You're really limited to what the biology and the owner are telling you. The horse can't tell you what's going on with their knee," Allen said. With this new method, fluid viscosity can be determined by adding magnetic nanoparticles embedded in polymer microparticles to the fluid. A magnet is then placed within the fluid which attracts particles and the number of collected particles correlates to the viscosity.

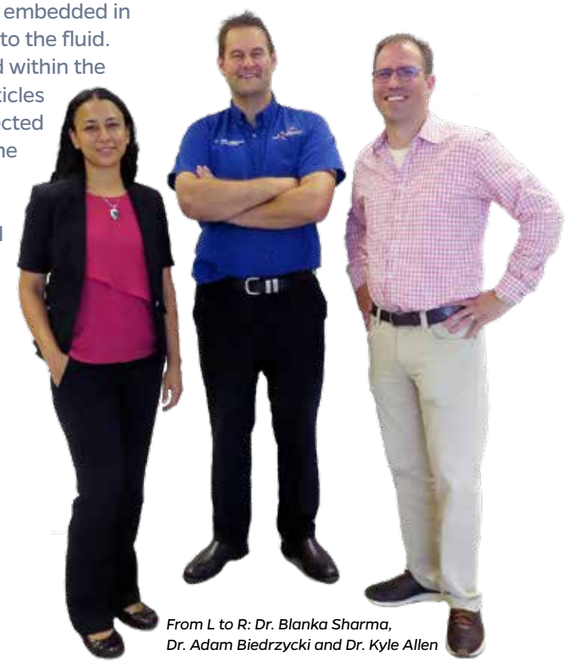
"It's really simplistic and it's dirt cheap…it's not that much, yet it's still correlating to the fluid properties," Allen said.

In a study published in the *Journal of Biomechanics* last year, this method was tested in clinical samples of synovial fluid gathered by Biedrzycki from healthy and OA horse joints. OA samples showed higher magnetic particle counts, which correctly correlated to lower viscosity, supporting the use of this method as a potential diagnostic tool.

The close proximity of the BME department and the College of Veterinary Medicine has made it easy for biomedical engineers to openly communicate with veterinarians like Biedrzycki, and in doing so, they have gained new perspectives on the potential of their own research.

"Being able to have access to these animal models and the veterinarians and the surgeons is just a huge advantage in terms of understanding the translatability of some of our technology sooner rather than later," Sharma said.

Moving forward, Sharma and Allen will continue expanding their collaborations with the vet school to better understand and develop strategies for joint diseases that affect both human and horsekind.



From L to R: Dr. Blanka Sharma, Dr. Adam Biedrzycki and Dr. Kyle Allen

Student Spotlight

Engineering Nanoparticles for Cancer Vaccines

In recent times, the lines between traditional disciplines have begun to blur. As new questions and challenges arise in science, engineering and medicine, new collaborations form to address them.

Adam Grippin, UF BME student, entered the University of Florida MD-PhD program to address theses challenges. Under the combined mentorship of Jon Dobson, Ph.D., the J. Crayton Pruitt Family Professor in the UF Biomedical Engineering Department, and Duane Mitchell, M.D., Ph.D., the Phyllis Kottler Friedman Professor in the UF Department of Neurosurgery, Grippin is developing a new nanoparticle based cancer vaccine to train patients' immune systems to eliminate cancer cells and predict which patients will benefit from this therapy just days after administration.

The base of Grippin's therapy is a dendritic cell vaccine that Mitchell developed to treat patients with glioblastoma. Adam is applying Dobson's experience with iron oxide nanoparticles to enable tracking of these cells with MRI.

The combination of these technologies could provide early information on whether a patient will benefit from dendritic cell vaccines. This would be a powerful tool for physicians because it would be one of the first to inform whether they should continue a patient on this therapy or switch the patient to an alternative option.

Grippin's research has produced promising results. He first engineered a nanoparticle to deliver tumor-derived RNA and iron oxide to dendritic cells. He then demonstrated that MRI could be used to noninvasively predict whether this treatment would inhibit tumor growth in animal models just two days after vaccination. Upon completion of preclinical studies, Mitchell plans to implement this novel therapy in his ongoing clinical trials.

Grippin's work has led to three UF fellowships, three private foundation grants, and an NIH F30, which is the most prestigious national award for MD-PhD scholars. Grippin has also been honored with numerous awards for presenting his project including Best Oral Presentation at the 2017 BME Pruitt Family Research Day and a Best Poster Award at the 16th Annual Meeting of the Association for Cancer Immunotherapy in Mainz, Germany.

Grippin hopes to establish a career engineering new therapies for patients. He is aided in this mission by participation in the clinical practicum, in which MD-PhD students like Grippin conceive, design, implement, and analyze a clinical trial of their own making.

"The clinical practicum was an incredibly insightful experience that has given me first-hand practice in every step of clinical trial design and implementation. The biggest benefit is that I can now use my own experience to judge how much work a clinical trial requires and rely on that training to initiate future studies," said Grippin.

Outside of his research and didactic training, Grippin serves as the Executive Director of the student-run Equal Access Clinic Network, which provides free, comprehensive healthcare to the uninsured. The organization also seeks to inspire and equip health professional students to make service to the financially disadvantaged an enduring component of their life's work.

"The Equal Access clinic is a tremendous resource for patients in our area. I am fortunate to serve here alongside inspiring students and health professionals who continually challenge me to make service to those in need a higher priority in my life," said Grippin.

Do Woodpeckers Get Concussions?

Learning from Nature to Protect the Brain

Lakiesha Williams, Ph.D.
Associate Professor
UF BME Welcomes New Faculty

Learning how nature solves problems and designs systems is a primary focus of new UF BME associate professor, Lakiesha Williams' research. Williams' interest in impact, injury, and injury protection led her and her team to ask the question "Do Woodpeckers Get Concussions?" This question led to years of ongoing research and discovery.

Williams uses experimental tools to study hierarchical structural changes of biological tissues that result from mechanical damage. More specifically, Williams studies mechanistic changes associated with traumatic brain injury resulting from high impacts and intense vibrations.

A wood pecker will spend many hours pecking for food or constructing cavities. When a woodpecker makes a blow into a tree trunk, its beak repeatedly strikes at a speed of approximately 100-300 times per minute with an impact deceleration that is 10 times that of a typical survivable car crash.

Williams' research is centered on the hierarchical multiscale-property relationship of biological materials, in this case the beaks of red-bellied woodpeckers. The structure of a woodpecker's beak consists of three layers, an outer keratin shell, a middle foam layer and an inner bony layer. The percentage of keratin, bone and foam changes from the root of the beak (near the face) to the beak's tip. Along with the amount of material changing, so does the percentage of special features within each material.

When compared to other birds (chicken, finch and toucan), the woodpecker's beak has more elongated keratin scales that can slide over each other. These keratin scales admit local shearing at the nanoscale. The shearing motion of the scales allow for emission of heat as a form of energy, which build up during pecking.

Correlating the structure and function in biological materials can provide insight on design guidelines for developing energy mitigating materials, especially those made to accept high impacts and intense vibrations.

One of Williams' goals in studying tissue mechanics is to identify and correlate structural change thresholds and feature changes that may lead to irreversible functional/physiological changes in tissues. There is great opportunity in adapting processes and ideas from nature to develop novel protective systems that may potentially protect people against extensive damage to tissues.

Williams earned her B.S. in biological engineering from Louisiana State University and received her Ph.D. in biomedical engineering from Mississippi State University (MSU). Before joining UF, Williams was an associate professor in the Department of Agricultural and Biological Engineering at MSU and director of the Human Body Simulation research team. In 2017, Williams was recognized by Mississippi's Business Journal as one of Mississippi's "Top in Technology" among a list of 28 others in the state. Additionally, she was awarded the IBM Women of Color Rising Star award, and MSU's Champion of Diversity award.

UF BME
Faculty Snapshot

ENGINEERS *for* LIFE.

Kyle D. Allen
Associate Professor, Associate Chair for Undergraduate Studies &
J. Crayton Pruitt Family Term Fellow
Ph.D., Rice University
Novel strategies to diagnose and treat degenerative joint diseases

Stephen H. Arce
Lecturer
Ph.D., University of Florida
Bioinstrumentation and biodesign

Wesley E. Bolch
Professor
Ph.D., University of Florida
Dosimetry, computational medical physics and dose assessment

Mingzhou Ding
Distinguished Professor &
J. Crayton Pruitt Family Professor
Ph.D., University of Maryland
Cognitive neuroscience, multivariate signal processing and multimodal neural imaging

Jon P. Dobson
J. Crayton Pruitt Family Professor
Ph.D., Swiss Federal Institute of Technology, ETH-Zurich
Magnetic micro- and nanoparticle-based biomedical applications

Ruogu Fang
Assistant Professor
Ph.D., Cornell University
Big data analytics, brain informatics and medical image analysis

Daniel Ferris
Robert W. Adenbaum Professor &
Senior Associate Chair
Ph.D., University of California, Berkeley
Biomechanics, neuromechanical control, locomotion and prosthetics

Aysegul Gunduz
Associate Professor &
J. Crayton Pruitt Family Term Fellow
Ph.D., University of Florida
Human brain mapping, neuromodulation and neural interfacing

Gregory A. Hudalla
Assistant Professor &
J. Crayton Pruitt Family Term Fellow
Ph.D., University of Wisconsin
Molecular engineering for immunotherapies and immune modulation

Benjamin G. Keselowsky
Professor
Ph.D., Georgia Institute of Technology
Biomaterials and controlled release systems for vaccines, immunotherapies and implants

Peter McFetridge
Associate Professor, Integra LifeSciences
Term Professor & Graduate Coordinator
Ph.D., University of Bath
Naturally inspired biomaterials for biologically functional implants and organ regeneration

Walter Lee Murfee
Associate Professor
Ph.D., University of Virginia
Cell dynamics, microcirculation, angiogenesis, lymphangiogenesis and neurogenesis

Jennifer A. Nichols
Assistant Professor
Ph.D., Northwestern University
Biomechanics, musculoskeletal modeling, predictive simulation and medical imaging

Kevin J. Otto
Professor
Ph.D., Arizona State University
Neural engineering, device-tissue interfaces and neurostimulation

Edward Phelps
Assistant Professor
Ph.D., Georgia Institute of Technology
Cell and tissue regeneration, islet biology, diabetes and immunoengineering

Parisa Rashidi
Assistant Professor
Ph.D., Washington State University
Biomedical data science, machine learning, pervasive health and clinical informatics

Carlos Rinaldi
Dean's Leadership Professor &
Chemical Engineering Department Chair
Ph.D., Massachusetts Institute of Technology
Nanomedicine, cancer nanotechnology, magnetic nanoparticles and transport phenomena

Sarah Rowlinson
Lecturer & Undergraduate Coordinator
Ph.D., Clemson University
BME cellular engineering laboratory and engineering education research

Christine E. Schmidt
Professor, J. Crayton Pruitt Family Chair &
Department Chair
Ph.D., University of Illinois
Biomaterials for neural tissue regeneration and neural interfacing

Blanka Sharma
Assistant Professor
Ph.D., Johns Hopkins University
Nanomedicine, stem cells, biomaterials, tissue engineering and targeted drug/gene delivery

Cherie Stabler
Professor & Associate Chair for Graduate Studies
Ph.D., Georgia Institute of Technology
Biomaterials, cell encapsulation, regenerative medicine, controlled release systems and diabetes

Hans van Oostrom
Associate Professor & Director, Institute for Excellence in Engineering Education
Ph.D., Eindhoven University of Technology
Human physiologic simulation to enhance noninvasive patient monitoring and education

Lakiesha N. Williams
Associate Professor
Ph.D., Mississippi State University
Traumatic brain injury, soft tissue mechanics, bio-inspired design & materials characterization

Lin Yang
Associate Professor
Ph.D., Rutgers University
Imaging informatics, biomedical image analysis, machine learning, computer vision and computer-aided diagnosis

UF BME ALUMNI: GIVING BACK TIME AND TALENT

By building meaningful relationships between alumni and current students, UF BME cultivates a tradition of giving back.

UF BME's diverse alumni play a vital role in the continued success of the department, serving as an important link between our academic community and the world we are preparing our students to lead.

April 2018

1st Annual Alumni Connect:

UF BME alumni shared their experiences in industry and non-industry backgrounds, provided recommendations to students about finding opportunities and discussed the attitudes and skills that successful job candidates possess.

UF BME alumni in attendance *(from left to right):*

- Troy Templin, *Quality Engineer, LivaNova (BS, 2015)*
- Shashank Kabra, *Manufacturing Engineer, AxoGen (MS, 2010)*
- Albina Mikhaylova, Ph.D., *Assistant Director, Materials Science and Engineering Research Facility, University of North Florida (PhD, 2004)*
- Bryan Schwarz, Ph.D., *Diagnostic Medical Physics Resident, University of Florida (MS, 2014 & PhD, 2016)*
- Stephen Myers, Ph.D., *Associate, Foley & Lardner, LLP (PhD, 2011)*
- Wil Companioni, *Medical Device Sales Executive, Nuvecta (ME, 2002)*

February 2018

UF Biomaterials Day:

Breaking Barriers in Biomaterials Research

The UF student chapter of the Society for Biomaterials (SFB) hosted its seventh annual Biomaterials Day, inviting UF BME alumnus Dr. Jamal Lewis, assistant professor of biomedical engineering at the University of California Davis, to deliver one of the four research presentations. Lewis' talk focused on different particulate systems currently under development in the Immunomodulatory Biomaterials Lab, which attempts to control critical cellular and humoral mediators that engender conditions such as type 1 diabetes, rheumatoid arthritis and autoimmune autism.

Before his professorship, Lewis was a senior scientist at OneVax, LLC and a post-doctoral associate in the J. Crayton Pruitt Family Department of Biomedical Engineering, where he also received a Ph.D. in biomedical engineering under the mentorship of Dr. Benjamin Keselowsky in 2012.

May 2018

Undergraduate Pinning Ceremony:

Alumnus Encourages New Graduates to Learn from Each Other

Nabors graduated in 2014 with her bachelor's degree and is currently an associate product manager at Becton, Dickinson and Company.

This spring, UF BME recognized the hard work of our bachelor students with a graduation reception and pinning ceremony to celebrate the new class of graduates. We invited UF BME alumnus, Abigail Nabors, to give a commencement speech. Nabors delivered a message inspiring students to build valuable lifelong relationships and support each other.

"Alumni stands for support. Support in your career, support in your education, and support in knowing you graduated from one of the toughest engineering programs. I encourage you to connect with your peers; collectively we have a diverse range of experiences that cover old and also uncharted ground. Peers can help you decide on a medical program or PhD pathway; peers can advise on internships and job opportunities; peers can give advice on problems specific to our industry. I encourage each of us to lean on each other."

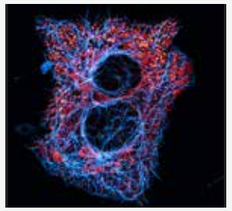
UF BME Alumni: *Keep us updated!*

Send us your news, updates, achievements or memories from your time at Florida.
Email us at **alumni@bme.ufl.edu** and stay connected on social media! Visit our website at **bme.ufl.edu**

SCIENCE BECOMES ART in the winning and notable photographs from the J. Crayton Pruitt Family Department of Biomedical Engineering 2017 Art of Research Photo Contest.

This annual event celebrates the art of research through the eyes of BME faculty, staff and students.

Judging was based on scientific significance, originality, and artistic and/or visual impact of the images. The winning photo, called "Human Beta Cells Manufacturing Insulin," by Dr. Ed Phelps, BME assistant professor, was chosen for its striking colors and overall aesthetic appeal.

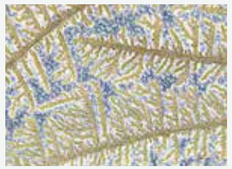


1st

Human Beta Cells Manufacturing Insulin
by Dr. Ed Phelps, BME assistant professor

2nd

Circle of the Universe in a Cup
by Jiapu Liang, BME Ph.D. student



3rd

Collagen - Hyaluronic Acid Hydrogel
by Syed Mustafa Jamal BME M.S. student

UF BME Welcomes New Industry Partner Edwards Lifesciences

Edwards Lifesciences is the global leader in the science of heart valves and hemodynamic monitoring. Driven by a passion to help patients, the company partners with clinicians to develop innovative technologies in the areas of structural heart disease and critical care monitoring, enabling them to save and enhance lives.

Edwards Lifesciences has built a partnership with the J. Crayton Pruitt Family Department of Biomedical Engineering over the past three years. This partnership is vital to the growth of our department because it directly impacts students and provides them with numerous opportunities; student design projects, travel to conferences and supports student-related activities and organizations.

Edwards

Thank you to all of the UF BME Industry Partners!

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If your company or organization would like more information on how to give to BME or become an industry partner, please contact **Paul Print** at **352-294-7947** or **pprint@eng.ufl.edu**.

UF UNIVERSITY of FLORIDA

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