CornellEngineering
Nancy E. and Peter C. Meinig School of Biomedical Engineering

BME

Newsletter
Fall 2021

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Congratulations 2021 Graduates

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BME MESSAGE

MESSAGE FROM THE DIRECTOR: MARJOLEIN C.H. VAN DER MEULEN

Welcome to our 2021 newsletter! I write this message to you just after the long overdue 2020 commencement, held on September 19, 2021. The event provided some perspective on the past year. Having been uncertain whether we could pull off this celebration, we disproved the skeptics with a lovely gathering and perfect weather that felt just like May, but a little more joyous for the journey we traveled to get there. We hosted both undergraduate and Master of Engineering BME graduates at Weill Hall before the university event. Thank you to the 2020 alumni and families who were able to return. We missed those of you who were unable to attend and hope to see you at your five-year reunion, which is just around the corner.

We were fortunate to have an in-person graduation for our 2021 graduates last May. Often our Memorial Day event feels late compared to our peers, but the delayed timing worked in our favor this year. To de-densify, four separate outdoor events were held with masks, physical distancing, vaccinations and limited guests. The BME gathering after the fourth and final university ceremony felt similar to prior graduations: happy students, proud families, lots of photos and beautiful weather. Congratulations Class of 2021!

The 2021 commencement was the end to a unique academic year. A silver lining was that our campus-based COVID testing and modeling programs were a real success, enabling us to transition back to on-campus interactions in the spring and summer. We had no virus transmission in any classrooms, very encouraging news as we start the 2021-22 academic year. And, this summer "first year" Ph.D. students from both the 2020 and 2021 classes were able to complete the clinical immersion at Weill Cornell Medicine. Our largest cohort to-date spent seven weeks in Manhattan shadowing physicians and watching surgeries.

Planning for the Fall 2021 semester assumed a return-to-normal for classroom teaching and the student residential experience. Our course roster is always modeled on a prior version, and fall 2019 was the basis used: all teaching in person, no more six-foot separation, and back to using all classrooms on campus. In addition, vaccination is required for students, and our campus rate is well over 90% for our whole community. Then the Delta variant came along, and masks were required again inside, and then outside on campus. After an initial increase in asymptomatic cases in arriving students, and an over 1% positivity rate in testing, we seem to have returned to a better steady state. Having campus fully populated again is really wonderful.

We spent much of last year on strategic planning for the College of Engineering, led by our new Dean, Professor Lynden Archer. For BME, a particularly exciting aspect of planning has been a focus on interactions between the College and Weill Cornell Medicine. A joint task force was charged to examine educational and research opportunities. Joint offerings could include an M.D.-Master of Engineering (M.Eng.) degree, potentially an exciting fit with the M.Eng. design projects that are featured in the pages to follow Research discussions centered not only on current areas of synergy, but also on emerging opportunities and educating and empowering the physicians of the future. We hope to share more about these programs as we realize the task force vision.

This year's newsletter showcases our design education. Design is a unique and critical engineering skill, and "Senior Design" is a ritual for all engineering majors. Seeing the progress of the BME senior design projects with each graduating class has been truly inspiring; every year is more impressive than the last. This year's project quality was remarkable, and many could be used as initial prototypes for entrepreneurial ventures. On the M.Eng. side, our annual industry engagement day, held virtually this past May, becomes a bigger success each year. I look forward to hosting the event live in Ithaca next spring!

Sincerely,

Marjolein C.H. van der Meulen
James M. and Marsha McCormick Director of Biomedical Engineering
Swanson Professor of Biomedical Engineering

CORNELL BME MISSION

To educate students to understand the human body as an integrated system and the mechanisms of disease through quantitative engineering analysis, and to use that understanding to design better therapeutic strategies, devices, and diagnostics to improve human health.

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ABOUT THE COVER

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Cover image: M.Eng. design team Robotic Mobility Device for Toddlers, building prototype device electronics. Full team/device spotlight, page 12.

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FEATURE

DESIGN MIND

The Meinig School's creative, collaborative and applied approach to design

M.Eng. team Robotic Mobility Device meets at the Meinig School design studio for their sprint review, an exercise more effective and valuable when done in person. Students are required to follow a strict COVID-19 safety protocol—including masks, shields, lab coats, and distancing within their pods—that is closely monitored with a rf-id checking in and out system.

by Syl Kacapyr

A small group of students frantically struggles to fashion together pipe cleaners and manila folders with string and paper clips. A student attaches a sock to the creation and attempts to slide it over her foot.

"Okay, time is up," shouts James Antaki, the Susan K. McAdam Professor of Heart Assist Technology.

The students had been asked to quickly prototype a sock-assist device for people with mobility issues. It's one of several creative ways Antaki introduces biomedical engineering design concepts in his BME 4080/4090 course.

"I then show students some commercially-available devices so they can juxtapose those devices to what they produced in class," Antaki says. "Students learn the lessons of elegant simplicity and how to be resourceful. That gets their design juices going."

It's a simple exercise, but by the end of the two-semester course, students will have designed a wide assortment of inventive and original biomedical products such as an antibody-based diagnostic kit, devices to treat disease symptoms, and a cardiac monitoring system.

The Meinig School of Biomedical Engineering's creative, collaborative and applied approach to design is infused throughout its curriculum, from first-year courses all the way through its master's degree program. Students learn the essential elements of design thinking while learning about the human body and mechanisms of disease through biomedical engineering approaches.

"Think of it a little bit as working with training wheels," says Marjolein van der Meulen, the James M. and Marsha McCormick Director of Biomedical Engineering, "students are getting bits of design practice along the way before riding without the training wheels their senior year."

BIOLOGY MEETS DESIGN

Inside the walls of the Meinig School's Weill Hall, biomedical engineers are designing vaccines, synthetic organs, machines that 3D print living tissue, and new strategies for treating diseases such as cancer and Alzheimer's. Biomedical is an engineering discipline like none other, in which researchers must combine knowledge of technology and biology, and must design at the interface of living and non-living systems, among other challenges.

"The living system adapts to changes," van der Meulen says, "and so when you design a valve for the human heart, for instance, the living tissue around the device is going to respond even if that material is accepted and is inert, things are going to grow around it or into it."

Through a core set of course sequences, Meinig School students get acquainted with molecular, cellular, and physiological principles as multi-scale systems. And while students learn how molecular changes can affect tissue level-responses and how tissue can drive disease processes, that experience is embedded with hands-on design

application.

"The idea is that they can work between these interfaces and that being creative is a key component to creating solutions in this space," says Jonathan Butcher, professor of biomedical engineering and former director of undergraduate studies, who has played a key role in developing the school's undergraduate curriculum since the launch in 2015.

By the end of their first semester, Meinig School undergraduates are already working on open-ended design challenges through courses like BME 1310: Introduction to Biomedical Engineering, in which a multi-week design challenge is one of the first opportunities students have to apply the design process to a problem of their choosing.

"Because it's very early in the design program, we really are focusing their efforts on creativity and the process of generating and evaluating ideas," Butcher says.

While the designs usually tackle a variety of biomedical challenges, the spring 2021 semester provided a unique opportunity for students to design solutions for the COVID-19 pandemic, including designs for coronavirus tests, ventilators and social monitoring apps.

In BME 3030: Measurement and Instrumentation in Biomedical Engineering, students learn to produce high-quality measurements of physiological and biological variables by designing different approaches, sensors and systems with appropriate controls and calibrations.

Like BME 1310, BME 3030 emphasizes critical elements of the design process, such as how to develop a design history file – a detailed document recording research, modeling, design variations, testing and verification of a project, among other steps.

"It's useful not only as an assessment tool of their creativity," Butcher says, "but it helps students recognize the utility of that kind of portfolio element so they can consider that within the context of all the rest of their classes."

Once students get to Antaki's BME 4090 course, they are producing design history files that are hundreds of pages long, much like the documents they will be producing in their professional careers.

IMPROV ACTING AND PROOF-OF-CONCEPT PROTOTYPING

Lining the walls of Antaki's Weill Hall office are books about classic and modern design theory, which are stacked next to books on topics such as creativity, acting and improvisation. It's where he draws some of the inspiration for his capstone BME 4080 and 4090 courses, in which seniors receive instruction on the design process before embarking on an intensive design project to solve a real-world medical need.

"People think of design as using CAD software, 3D-printing something and then testing it, and students are very eager to do that on day one," Antaki says. "But I don't let them begin doing that until the spring semester. The entire first semester is learning principles of design, doing stakeholder discovery, pressure testing their ideas, and assembling a development plan."

Along with lessons about affinity diagrams, how to interview physicians, intellectual property, and regulatory agencies, are improvisational exercises to get students to bring out the "artist within them," Antaki says, "and to overcome their fears of being wrong." These lessons include not getting too invested in an initial idea – a common trap engineers fall into, according to Antaki – and how to function in multidisciplinary teams.

"PEOPLE THINK OF DESIGN AS USING CAD SOFTWARE, 3D-PRINTING SOMETHING AND THEN TESTING IT, AND STUDENTS ARE VERY EAGER TO DO THAT ON DAY ONE. BUT I DON'T LET THEM BEGIN DOING THAT UNTIL THE SPRING SEMESTER. THE ENTIRE FIRST SEMESTER IS LEARNING PRINCIPLES OF DESIGN, DOING STAKEHOLDER DISCOVERY, PRESSURE TESTING THEIR IDEAS AND ASSEMBLING A DEVELOPMENT PLAN."

—James Antaki, Susan K. McAdam Professor of Heart Assist Technology

Students participate in an improvisation workshop creativity exercise (2019) as part of the Meinig School design curriculum.

In one exercise, students have 30 seconds to shout out as many ridiculous flavors of ice cream as possible. In another, students play the classic drama game "Yes, And" by entering a conversation in which every sentence starts with the words "Yes, and…," with each statement becoming more exaggerated than the last.

"I want students to realize that they're full of ideas," Antaki says, "and they should throw out lots and lots of ideas, and not fall in love with just one, because it might be a mistake. I want them to be prepared to pivot."

To cap their undergraduate experience, students work in small groups to design and develop a proof-of-concept prototype for a medical product. For seniors, it's the application of four years of biomedical and design knowledge. Projects in the spring 2021 semester included:

- Bugbyte—A blood test to diagnose bedbug bites with a complimentary app using image recognition.
- Stimuglove—A glove that provides in-home treatment for chemotherapy-induced peripheral neuropathy (CIPN) using customized scrambler therapy.
- Digestim—A digestive muscle stimulation waistband that reduces irritable bowel syndrome symptoms through targeted electrical stimulation and heat therapy.
- Sub Concussive Project—A headband for athletes to record and analyze cumulative head trauma that could lead to concussions.

"Working with this group was the highlight of my senior year in BME, and I cannot stress how valuable the entire design experience is," says Rachel George '21, project manager for the Stimuglove team, "from the way collective ideas converge in the initial brainstorming process to the final product that results months later. It was also incredibly rewarding to interact with real CIPN patients and see how much of an impact our design could have on their lives."

[Read more about the Stimuglove design team on page 10]

Before graduating, students also have the option to design products through Cornell University DEBUT – a student project team and national biomedical design competition. In recent years, the team has developed a novel contraceptive, an allergy drug delivery device, a coronary bypass artery graft, and an ulcer prevention mattress system.

"I'm so impressed by these students, especially the way they stay so self-organized," Antaki says. "They follow a rigorous process and it's just really astounding."

Despite the global pandemic, Meinig School M.Eng. project teams kept going strong. Here, M.Eng. student John Montani (far right, speaking) in a design project planning meeting on campus this past spring.

BME M.ENG.—WORKING WITH PHYSICIANS AND INDUSTRY PROFESSIONALS

For John Montani, M.Eng. '21, his first time working with a physician and doing market research wasn't on the job. It was as a graduate student in the Meinig School, where he designed new techniques for quantifying physiological and behavioral responses to pain.

"The fact that we are collaborating with an external company illustrates the value of this project," says Montani, who collaborated with Hill-Rom, a medical technology company. "I value any opportunity I get to work on a project with such potential."

The Meinig School's one-year Master of Engineering degree requires graduate students to design biomedical devices within the bounds of health care economics, the needs of patients and physicians, and the medical device regulatory environment, among other considerations.

Students pursue many different pathways after obtaining their degree, but most are focused on landing an industry job. Montani hopes to pursue a career in the medtech industry.

The biomedical engineering M.Eng. program is led by Newton de Faria, professor of practice and M.Eng. program director, who spent two decades at NI Company—formerly National Instruments Corporation—before bringing his industry expertise to Cornell. He says enhancing design knowledge is just as important as the medical and industry connections students will make during their M.Eng. experience.

"We're trying to create this new generation of innovators that are not married to technology-driven innovation," de Faria says, "They need to be concerned about value-based innovation, so they define a problem and then look for technologies that meet that need."

To ensure their M.Eng. prototypes meet real-world needs, students choose to have their projects sponsored by a clinician, corporation, research lab or humanitarian organization. For example, students have worked with Guthrie Robert Packer Hospital on challenges in

minimally invasive surgery, with Weill Cornell Medicine on neurological surgery, and with the College of Veterinary Medicine on peripheral nerve regeneration. And they have collaborated with companies like West Pharmaceutical and Johnson & Johnson on drug delivery technologies and medical devices.

The M.Eng. is a valuable opportunity for students to work directly with professionals, obtain new marketable skills, and in some cases, try out for a job. According to van der Meulen, it's not uncommon for students to get hired by the companies sponsoring them.

"I WANT STUDENTS TO SEPARATE BRAINWORK AND IDEATION FROM THE MAKING PROCESS . . . IT'S MORE THE TYPE OF ENVIRONMENT THEY WILL EXPERIENCE WHEN THEY GO OFF INTO INDUSTRY."
—Newton de Faria, Professor of Practice, M.Eng. Program Director

"Newton has built some great partners for our students, and the industry experience that they're getting is a really important part of our program," van der Meulen says. "And at the same time, the industry and clinical partners really see the value in it."

M.Eng. students also get an opportunity to interact with professionals during the graduate program's annual Industry Engagement Day, in which over a dozen industry professionals attend a student poster session, career panel discussions, and a Shark Tank-style competition in which students pitch their projects to industry and faculty participants.

BME DESIGN COMPLEX

When James Bennett, M.Eng. '21, was ready to prototype his design for an independent mobility device for toddlers, at his disposal were 3D printers, laser cutters, machining tools, wet labs and conference rooms. M.Eng. students gain access to these tools through the Meinig School's BME Design Complex—a 2,600-square foot, state-of-the-art design facility inside Weill Hall, where students conceptualize and bring their ideas to life.

Inside the Design Complex, Bennett and a team of students built a small robotic wheelchair, with the goal of enabling environmental interaction and social behavior development in toddlers with mobility delays or impairments.

"I pursued a BME M.Eng. degree because I want to improve people's quality of life through medical devices. I believe gaining in-depth knowledge of the lifecycle of a biomedical device, from concept to commercialization, and enhancing my ability to identify and address unmet health care needs is critical in achieving my goal."

Meinig School BME Design Complex facilities consist of distinct spaces in which students and faculty can brainstorm, test, grow, build and realize their ideas, including a design studio (top); design laboratory (middle); wet laboratory (not pictured); and fabrication lab (bottom).

[Read more about Bennett's infant mobility device on page 12]

The BME Design Complex was built by de Faria to emulate three industry environments: The office, where student teams can meet and brainstorm ideas; the laboratory, where students can fabricate parts of their design; and the design space, where students can prototype and test their designs.

"I want students to separate brainwork and ideation with the making process," de Faria says. "It's more the type of environment they will experience when they go off into industry."

Inside the BME Design Complex, projects M.Eng. students worked on this year included a detection and response system for opioid overdose, a bioreactor for mature cardiomyocyte development, and augmented reality models for cancer mapping.

THE FUTURE OF BIOMEDICAL DESIGN

Only six years after its founding, the Meinig School's undergraduate program has quickly gained notoriety as one of the top biomedical engineering programs in the country. Van der Meulen says the program will continue to break the mold of 'textbooks first, design application last,' by finding more ways to strategically integrate design thinking into its entire curriculum.

This push for concurrent biomedical and design theory education is one embraced by Antaki. As many of his students will attest, their undergraduate experience felt the most purposeful while applying biomedical concepts to design projects.

"Science is discovering the world as it is, and design is creating the world that never was," says Antaki, paraphrasing the late engineer Theodore von Karman. "Students can learn about how cells migrate and how chemical pathways work, but design is where they truly become engineers."

Students present their design projects and interact with industry professionals during the annual Industry Engagement Day (2019 event pictured; 2020 and 2021 events were virtual).

Craniectomy Prosthesis design team (L to R: Karli Thornton, Shwetha Sairam, Stacey Kim, and Tyler Webb), sponsored by Dr. Susan Pannullo from Weill Cornell Medicine, became "for life" friends through their M.Eng.design project.

No matter the pandemic challenges, Meinig School faculty, students & staff were thrilled to celebrate at a modified in-person commencement on May 30, 2021. [Undergraduate design team Visation outside Weill Hall on commencement day (L to R: Jaimie Diamond, Kevin Cavallo, Jennifer Tieu, & Alexandria Calder).]

DESIGN IN THE COVID-19 ERA

As the COVID-19 pandemic was beginning to shut down laboratories across the country in the spring of 2020, Newton de Faria swung into action, helping many of the Meinig School's research spaces avoid the same fate.

With the goal of keeping the BME Design Complex open, De Faria, professor of practice and M.Eng. program director, analyzed the facility's airflow, added fans, and adjusted laboratory hood vents when necessary. He adapted spaces with separation barriers and created standard operating procedures that required students to follow safety and behavioral protocols. And an ID scanning and reservation system was developed to limit the facility's population. Entry into the complex was akin to a 'biosafety level 2' lab.

"I had no problems with students following the protocols and procedures," de Faria said. "We felt safe and it gave students the ability to remain productive."

The protocols were so effective, several research laboratories throughout the Meinig School adopted them. In turn, some of those labs began conducting COVID-19 research.

"The pandemic has made the value of biomedical engineering incredibly apparent," says Marjolein van der Meulen, the James M. and Marsha McCormick Director of Biomedical Engineering, pointing to biomedical engineers such as alumnus Robert Langer '70, cofounder of vaccine producer Moderna.

Van der Meulen says Cornell University's testing and health protocols also played a large role in keeping laboratories open, helping students retain one of the most valuable aspects of their educational experience.

"I participated in a virtual panel for a summer program, and students were asking me about applying to graduate schools without lab experience," van der Meulen said. "We're really lucky because we had our students in the lab, graduates and undergraduates. It's been essential for us to have that campus-based presence."

Meinig School leadership implemented many safety protocols early on that allowed students to keep design projects moving forward on campus and off. A few student teams working on projects on campus this past spring pictured here:

Posture Patch: a portable, wearable patch tracks and corrects posture with a customized app.

Craniectomy Prosthesis: an affordable skull prosthetic protects post-craniectomy surgical site.

Infusion Buddy: an ambulatory infusion pack for pediatric patients to carry life-saving IV drips.

Robotic Mobility Device for Toddlers: a powered independent mobility device for toddlers with mobility impairments.

STUDENT DESIGN PROJECTS

UNDERGRADUATE SENIORS
STIMUGLOVE BY TEAM CIPNIA

STUDENT TEAM
Rachel George
Sophia Windemuth
Michelle Chang
Acacia Tam
Trisha Ray

FACULTY ADVISORS
Dr. James Antaki, Meinig School Faculty Advisor
Monica Vakiner, Director of Finger Lakes Cancer Resource Center
Dr. Michael Cooney, Clinical Director, Calmare Therapy

Chemotherapy-induced peripheral neuropathy (CIPN) such as numbness and hypersensitivity in the hands occurs in up to 85% of cancer patients undergoing chemotherapy treatments and is the most common dose-limiting side effect of chemotherapy. Currently, the only way to address this issue is to lessen the dose of potentially life-saving chemotherapy. Effective non-pharmacological solutions for CIPN are even more scarce. Although physical therapy and neuromodulation methods offer some relief, few studies have demonstrated robust success in these methods.

A new, non-pharmacological treatment known as Scrambler Therapy uses electrical stimulation through electrode placement on a patient's skin to interfere with the pain pathway in a patient's nervous system. While this therapy has shown immense promise in clinical trials as an effective treatment, it can only be performed in a medical office, which is often inconvenient for patients who may be required to travel far distances for treatment.

Undergraduate team Cipnia's objective was to provide patients with an accessible and effective non-pharmacological solution for CIPN. Their answer was a wearable electronic glove designed to alleviate the symptoms of CIPN and provide a greater quality of life with its minimal and sleek design and portability. The Stimuglove device takes a novel approach to incorporating Scrambler Therapy into a portable and convenient glove equipped with an app to track therapy feedback and progress.

While working on Stimuglove over the 2020-21 academic year, during the pandemic, team Cipnia discovered how important effective communication was in helping them to achieve their ambitious project goals. They accomplished this by reaching out to specialists and patients for feedback, which helped guide product development and motivated the team every step of the way. The team used cloud-based project management tools to assign tasks and track progress, and provided weekly progress updates by Zoom. The team also learned the value of reaching out to expert stakeholders, to better understand underlying design concepts and to better address their goals. Perhaps equally as important, they learned the importance of empathy toward one another, of how to understand and adapt to difficulties associated with the pandemic.

The Stimuglove device prototype and app in use.

"We always checked in with and supported each other," said Michelle Chang. "Whether through a quick message on GroupMe, or joking around in the lab."

"Working with this group was the highlight of my senior year in BME," said Rachel George of the overall experience. "I cannot stress how valuable the entire design experience was, from the way collective ideas converge in the initial brainstorming process to the final product that results months later."

"I absolutely loved working with this group during my senior year," added team member Trisha Ray. "It was amazing to see how much passion and positive energy everyone brought to the project, and how well we were all able to work together to achieve our ultimate goal. It was also incredibly rewarding to interact with real CIPN patients and see how much of an impact our design could have on their lives."

Moving forward, the Cipnia team is considering a patent for this pioneering product for CIPN treatments.

"The Cipnia team made mind-boggling progress on their project, pushing past obstacles the pandemic threw at them," said Meinig School faculty advisor James Antaki.

Monica Vakiner, Director of Finger Lakes Cancer Resource Center, who works with a lot of cancer patients, agreed: "I think this glove could be a significant improvement for anybody who has neuropathy, to help with their quality of life."

TEAM VISATION

STUDENT TEAM

Kevin Cavallo
Alexandria Calder
Jaimie Diamond
Jennifer Tieu

FACULTY ADVISORS

Dr. James Antaki, Meinig School Faculty Advisor
Sonny Carlton, Teaching Assistant

Team Visation presents their project at the 2020 Industry Engagement Day in May 2021 (left). The Visation waistbaind device in use (right).

Globally, over 240 million people are either are fully blind or suffer from moderate to severe visual impairment yet have few options to help them safely navigate their surroundings. The primary solution for this population is a white cane that must be moved around the individual to detect local obstructions. But this widely accepted device has several disadvantages: its inability to efficiently detect objects far away, approaching objects, and objects that are not in the lower front span of the individual.

Modern technology necessitates a more robust and comprehensive solution to the disadvantages of cane technology. Enter undergraduate team Visation, who, through the Meinig School's senior design course, developed just such a solution. Incorporating principles of sensory-motor integration and physical impairment mediation in medicine, the team's wearable waistband can detect a user's local environment and, through a sensor-based haptic feedback system, alert them to surrounding obstructions. This advanced system can be used in conjunction with cane technology to offer a multi-layered approach to meeting this need.

While the design process for the waistband device was a lengthy one, requiring teamwork and advising every step of the way, team Visation agreed the reward of a functional prototype was worth the time and effort.

"It's a process that is difficult to anticipate until you are face-first in the actual prototyping," noted Kevin Cavallo. "There are so many intricacies you don't even consider until talking to stakeholders and tackling device development."

Jennifer Tieu agreed: "This project made me very cognizant and appreciative of the customer-driven and user-centric design process and its importance in developing a valuable product. We were able to gain useful insights that guided critical design decisions . . . [and learned that] producing a successful product isn't just building a device that is exactly as the team envisioned but is rather building a device that is truly functional to its intended users."

"It was interesting to see how sort-of overlooked things actually played some of the largest roles. Like online forums helping us connect the vibration motors to the Arduino uno, or how the ability to sew helped us tweak our waistband design," added Alexandra Calder. "It reminded me of the power of resourcefulness, which is something I will surely take with me going forward."

On working together through a pandemic, the team said there were few issues thanks to the many open workspaces in the Meinig School Design Complex. "Aside from the shields and masks worn in the lab," said Cavallo, "everything felt pretty normal because the administration did a fantastic job ensuring that all design endeavors could continue to function during the pandemic."

Alexandra Calder added that "Open communication and equal commitment [by all team members] allowed us to make it happen."

Of the overall experience, Cavallo said, "BME Senior Design showed me that it's possible to develop something out of nothing. What started as a simple idea from a quick, eight-minute brainstorming assignment, became a functional device that could change the lives of millions of people."

Very soon team Visation will be working on patenting the Visation Waistband technology!

STUDENT DESIGN PROJECTS

M.ENG.
A ROBOTIC MOBILITY DEVICE FOR TODDLERS

STUDENT TEAM
James Bennett
Angelys Cuello
Maddison Nadolny
Denielle Smith
Caroline Waksmuski

FACULTY ADVISORS
Dr. Newton de Faria
Dr. Omar Emon
Jack Thompson, PE

SPONSORS
Dr. Sharon Stansfield and Dr. Carole Dennis, Assistance in Motion, Inc.

Toddlers (children 1-3 years old) learn primarily by interacting with their environment through crawling and/or walking. This independent mobility is accompanied by emotional, perceptual, cognitive and social development. But young children with disabilities such as spina bifida, cerebral palsy, and Down syndrome often demonstrate apathetic behavior, depressed motivation, a lack of curiosity and confidence due to associated mobility limitations. Providing powered independent mobility devices to children with mobility impairments may prevent these negative effects from developing, but powered wheelchairs are typically not prescribed to children younger than three years old. Consequently, this population is deprived of the developmental benefits associated with independent mobility.

The M.Eng. Robotic Mobility Device for Toddlers team set out to improve upon a first-generation robotic prototype developed in Ithaca. The Weebot, designed by project sponsors and Assistance in Motion founders Dr. Sharon Stansfield and Dr. Carole Dennis of Ithaca College, allows children as young as six months to move about a room by shifting their weight atop the robot to interact with their environment.

While there were some challenges to device-building due to Covid-19 restrictions—the team could not access the original Weebot prototype, or demonstrate the new robot in person to sponsors—the team adapted tremendously well to work together over the 2020-21 academic year. They were able to work safely on campus in the BME Design Lab thanks to Cornell's testing and COVID guidelines. They met daily through Zoom calls and collaborated with teaching faculty in biweekly meetings. By the end of the spring 2021 semester, the team finalized construction on the device with plans to undergo testing, and won first place in the end-of-year BME M.Eng. Showcase Autodesk Fusion 360 competition.

"It was rewarding to build this device and see the impact it would make for children with this need," said team member Denielle Smith. "Though it came with many learning curves, building this device taught me many lessons and strengthened my technical/engineering skills . . . [that] will be very helpful in my career. I can't wait to see the children's happy smiles as they have fun with the device we helped to build."

"I learned so much from the hands-on experience of creating this device," said Caroline Waksmuski, an undergraduate who joined the team in spring 2021. "I'm grateful to have had the opportunity to work on the project and interact with our sponsors and advisers." Waksmuski will continue working on the device in the fall, expanding on customization and safety features.

Moving forward, Drs. Stansfield and Dennis are hoping to commercialize the device at low cost, so that most children who can benefit from the WeeBot will have access to it. "Dr. de Faria and his team definitely contributed toward bringing us closer to that reality with this project," said Stansfield. "It was also a pleasure to work with such a diverse team of engineers—as a woman who has worked in a STEM discipline for many, many years, I was happy to see this team of students represent the inclusion that I have always advocated."

At work in the design lab (top); building the mobility device electronics (middle); CAD model of the Infant Mobility Device prototype, c/o team member James Bennett (botom).

NEW FACULTY

WELCOME NATE CIRA

Nate Cira

Nate Cira joined the Meinig School as an assistant professor in January 2021. Cira comes to Cornell after three years as a Rowland Fellow at the Rowland Institute at Harvard.

At Cornell, the Cira laboratory is developing technologies to enable new scales of experimental throughput and using them to untangle complex biological systems. Many biological systems involve the interaction of large numbers of different components, and many of biology's most pressing questions involve understanding properties that emerge out of this complexity. These questions include, "How do combinations of different microbial species result in community stability?", "How do different genetic variants combine to give resistance or susceptibility to disease?", and "How do RNA expression levels give rise to different cell types?" Answering questions like these will require numbers of experiments commensurate with the complexity of the systems being studied.

Cira's work aims to develop new devices and techniques to gather the data necessary to reveal the basic forces at work in some of these intimidatingly complex systems.

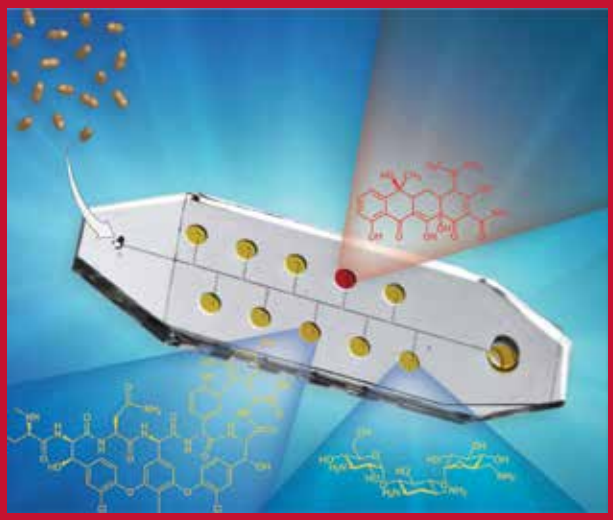
Cira is particularly excited about a class of devices that leverage the unique interactions between liquid droplets and surfaces. These devices can meter out very precise quantities of liquid, allowing a researcher to run many different reactions in parallel.

"This will be one of the big thrusts of our group at Cornell, both for various projects we want to do, but also in collaborations where these devices could be useful for people more broadly." This possibility of collaboration across many fields was one of the selling points that brought Cira to the Meinig School.

Cira grew up in Wisconsin and attended the University of Wisconsin-Madison for his undergraduate degrees in biomedical engineering, microbiology, biochemistry, molecular biology, and biology. Cira then earned his Master's and his Ph.D. in bioengineering from Stanford University. From Stanford, Cira was awarded a prestigious Rowland Fellowship, which is designed to allow recent Ph.D. graduates the space, funding, and personnel to establish high-risk, creative, independent research programs.

In addition to fluid physics and microfluidic devices, Cira also uses mathematical modeling to understand biological systems. His work in the quantitative biology realm has focused thus far on microbial ecology, synthetic microbial communities, and dynamic connected systems.

Surface tension gradients generate internal flow patterns that imbue droplets with unique attributes. Pictured are tracer particle streaks that show a toroidal flow pattern in an evaporating droplet of heptane.



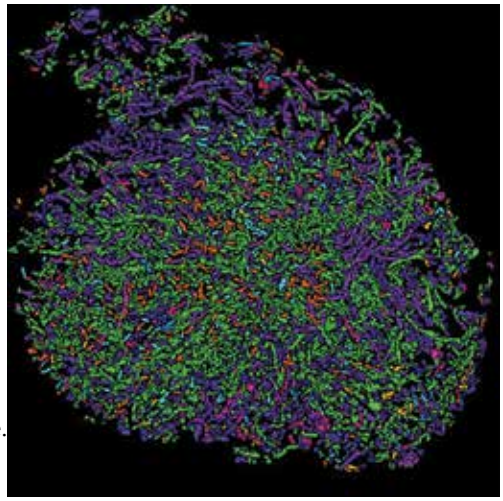
A device for measuring the antibiotic susceptibility of bacteria. The device automatically loads bacteria into chambers with different types and concentrations of antibiotics where they either grow (yellow) or are inhibited (red).

For more on Cira's research at Cornell, visit: https://www.engineering.cornell.edu/faculty-directory/nate-cira.

MAPPING THE GUT MICROBIOME

(Adapted from articles by David Nutt, originally published in the Cornell Chronicle)

SPATIAL MAPS GIVE NEW VIEW OF GUT MICROBIOME



A color-coded spatial map of microbial communities in human oral plaque.

Researchers in the Meinig School's De Vlaminck Lab have developed an imaging tool to create intricate spatial maps of the locations and identities of hundreds of different microbial species, such as those that make up the gut microbiome. The tool will help scientists understand how complex communities of microorganisms interact with each other and also their environment, which is to say, us.

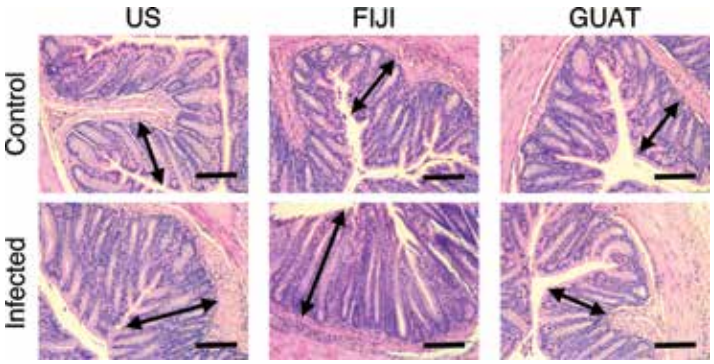
"There are communities of bacteria that live in our bodies and play an important role in human health and biology, and there's a rich diversity of these microbes," said associate professor Iwijn De Vlaminck. "However, there are very limited tools to understand the spatial interactions between these microbes, and those are important to understand the metabolism of these communities, and also how these microbes interact with their host."

To incorporate additional imaging and microbiome expertise, De Vlaminck collaborated with the Meinig School labs of Warren Zipfel and Ilana Brito. The team created HiPR-FISH and applied it to two different systems: the gut microbiome in mice and the human oral plaque microbiome. In the case of the gut microbiome, they were able to demonstrate how the spatial associations between different bacteria are disrupted by antibiotic treatment.

Spatial mapping could be an important tool for studying and possibly treating a range of diseases in which bacteria are a major culprit, such as inflammatory bowel disease, colorectal cancer and infection.

Read more:
"Highly multiplexed spatial mapping of microbial communities." Hao Shi, Qiaojuan Shi, Benjamin Grodner, Joan Sesing Lenz, Warren R. Zipfel, Ilana Lauren Brito & Iwijn De Vlaminck. *Nature*. 588, 676–681 (2020).

GEOGRAPHIC DIFFERENCES IN GUT MICROBIOTA BOOST IMMUNITY



Representative images of H&E-stained colon sections of control and infected mice 14 days after infection. The arrows depict average crypt length with hyperplasia observed in the US and FIJI mice. Scale bar represents 100 μm.

An international collaboration led by Ilana Brito, assistant professor and the Mong Family Sesquicentennial Faculty Fellow in Biomedical Engineering, reports that microbial differences alone can impact immune responses, and that shared microbiota helped mice with low resistance to infection become more resilient.

A range of factors can influence disparities in gut microbiome composition, from genetics and diet to antibiotic use, sanitation infrastructure and exposure to infectious diseases. It can be difficult to control for so many variables, so the researchers took microbiome samples from three global populations- Guatemala, U.S., and Fiji- and put them in 30 germ-free mice, then exposed them to infectious bacteria, to see how they responded. The result was "different immune responses of these microbiomes in these different mice that led them to be either more or less resilient to infection," said Brito. A follow-up experiment found that less resilient mice benefited from the sharing of microbiota.

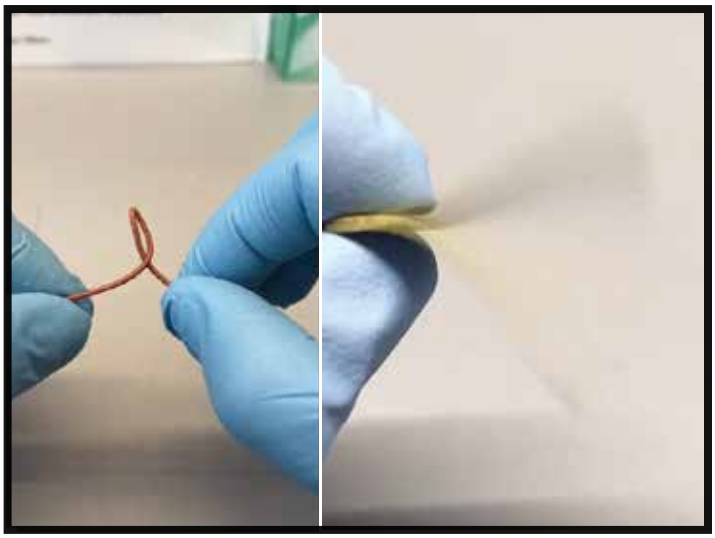
The ability to transfer resistance to infection demonstrates the potential of harnessing the microbiome for therapeutic treatments.

"I think the broader point is that we should be studying the health effects of microbes that we find outside of our backyard," Brito said. "How could we improve people's health with microbiome interventions throughout the world, for different types of health problems? It warrants a global view."

Read more:
"Geographic differences in gut microbiota composition impact susceptibility to enteric infection." Porras AM, Shi Q, Zhou H, Callahan R, Montenegro-Bethancourt G, Solomons N, Brito IL. *Cell Reports*. 2021 Jul 27;36(4):109457.

METAL-ION BREAKTHROUGH LEADS TO NEW BIOMATERIALS

(Adapted from article by Syl Kacapyr, originally published in the Cornell Chronicle)



The elasticity of a biodegradable, metal-chelation elastomer is demonstrated. The first-of-its-kind material, developed in the Yadong Wang Lab, can be used to repair skin, blood vessels and other soft tissue.

Metals such as iron and calcium play a crucial role inside the human body, so integrating them into the soft, elastic materials used to repair skin, blood vessels, lungs and other tissue is not only natural but also could confer bioactivity to the materials.

Designing elastomers—a type of polymer with rubber-like properties—is a laborious process. But Yadong Wang, the McAdam Family Foundation Professor of Heart Assist Technology, and postdoctoral associate Ying Chen, have developed a new framework that makes elastomer design a modular process, allowing for the mixing and matching of different metals with a single polymer. It is like playing with Legos.

The team's biodegradable metal-chelation elastomer can yield a wide range of mechanical properties—such as stiffness and toughness—as well as inherent biological properties. Mechanical testing reveals a wide range of properties attainable, and the materials show excellent biocompatibility, matching some of the traditional biomaterials already used in medicine.

New research on the elastomer will focus on its ability to repair blood vessels and heart tissues. Possible applications for the framework are wide open to other fields including wound healing, soft tissue reconstruction and regeneration or for eco-friendly tires that biodegrade.

Read more:
"Chelation Crosslinking of Biodegradable Elastomers." Ying Chen, Paula G. Miller, Xiaochu Ding, Chelsea E. T. Stowell, Katie M. Kelly, Yadong Wang. *Advanced Materials*, 32 (43).

STUDIES OFFER TIPS ON LESSENING SPACEFLIGHT-RELATED RISK

(Adapted from article by Bridget Kuehn, originally published in the Cornell Chronicle)

Space travel, illnesses like COVID-19 and climbing Mount Everest can trigger the body's stress response systems in similar ways, according to new studies by Weill Cornell Medicine, space agencies and other investigators.

Christopher Mason, an associate professor of physiology and biophysics at Weill Cornell Medicine, led multiple studies by teams of investigators spanning four of the largest space agencies in the world—NASA; the Japan Aerospace Exploration Agency (JAXA); the European Space Agency (ESA); and Russia's ROSCOSMOS—as well as academic institutions and industry groups.

Together, the Weill Cornell Medicine and global teams investigated genetic, biochemical and physiological changes in 56 astronauts, making it the largest study of astronauts to date. They published 20 studies that detail the effects of space travel on the human body and reveals potential prevention and treatment approaches that may allow longer term spaceflight, such as missions to Mars.

"It's a turning point in space biology and aerospace medicine," said Mason. "We can start thinking at the molecular and cellular level about longer term missions, and also what drugs, countermeasures and therapies could be tried to minimize the risks for astronauts.".

Mason's team included researchers at Weill Cornell Medicine and Meinig School associate professor Iwijn De Vlaminck, utilizing diagnostic technology his lab developed to monitor the health of organ transplants, to show that spaceflight was associated with dysfunction in mitochondria, which provide the cells with energy, suggesting that the immune cells may have disrupted functions.

The discoveries, including new maps of the abundance of mutations and immune changes found in blood cells during spaceflight, may lead to new ways to protect space travelers. They may also provide insights on caring for Earth-bound patients with illnesses that trigger similar physiological responses.

Read more:
https://bit.ly/3m1CEMb

MAKING CONNECTIONS

STEM CELL SYMPOSIUM
ENHANCING KNOWLEDGE THROUGH CROSS-CAMPUS EXCHANGE

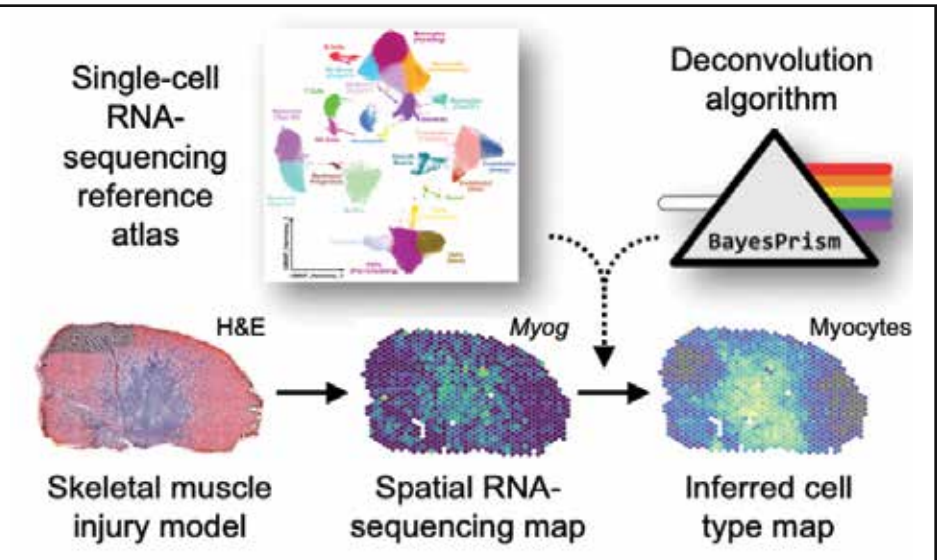
In June 2021, the Cornell Stem Cell Program held its 8th biannual Stem Cell Symposium, an event intended to stimulate exchange of experience with researchers outside of Cornell, enhance interactions within Cornell, and promote education in stem cell research.

The virtual event featured scientific presentations by distinguished invited speakers on the latest advances in stem cell biology, and included prominent talks reflecting on how bioengineering has improved our understanding and use of stem cells in regenerative medicine.

Co-organized by Meinig School assistant professor Ben Cosgrove, the symposium featured Dr. Timothy Downing from the University of California at Irvine, who spoke on synthetic biology approaches to investigate how the epigenome can be regulated for cell and tissue engineering.

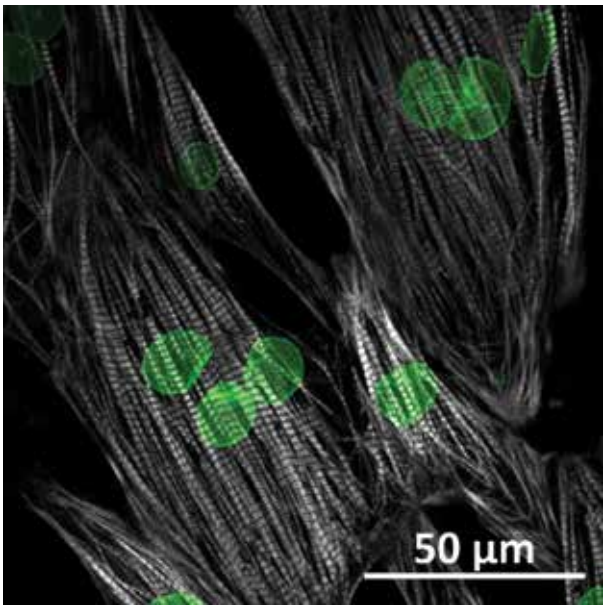
Several Meinig School trainees were also selected to present their research at the event, including Dr. Elizabeth Moore (a postdoctoral fellow in professor Claudia Fischbach-Teschl's lab) and Paula Petrella (a Ph.D. candidate in professor Cosgrove's lab). Each described their bioengineering approaches to reveal how breast cancer evades chemotherapy treatments. Xi Wang (a Ph.D. candidate in the lab of professor Minglin Ma, a BME field member) discussed her approach to encapsulate stem cell-derived pancreatic beta cells in a nanofibrous encapsulation system for the treatment of type 1 diabetes. David McKellar (a Ph.D. candidate in professor Cosgrove and professor Iwijn De Vlaminck labs) won the 1st place award for best trainee talk, for his presentation on single-cell genomic methods to elucidate the variation in stem cells found in skeletal muscle tissues through the construction of open-access database resources.

The Cornell Stem Cell Program is jointly supported by the Cornell College of Veterinary Medicine, the College of Engineering, and the Office of the Vice Provost for Research, as well as the New York State Stem Cell Science (NYSTEM) Board. In contrast with many stem cell biologists who use traditional genetic and molecular biology tools, stem cell bioengineers incorporate tissue engineering, systems biology, and computational modeling into their approaches to glean a more integrated understanding of how stem cells function in health and disease.



The Cosgrove and De Vlaminck laboratories use computational algorithms to deconvolve the complexity of whole-transcriptome spatial profiling by assembling large-scale (350,000+ cells) single-cell RNA-sequencing (RNA-seq) references atlases (McKellar et al., bioRxiv 2020).

Ph.D. student David McKellar won first place for best trainee talk at the Stem Cell Symposium.



Stem cell-derived cardiomyocytes for modeling the role of cell mechanics in rare heart diseases (Image: Lammerding Lab Ph.D. student Melanie Maurer).

HSS-CAMEO

NEW GRANT CREATES CENTER FOR ADVANCED MATERIALS AND ENGINEERING IN ORTHOPAEDICS (CAMEO)

In June 2021, the Hospital for Special Surgery (HSS) in partnership with Cornell University was awarded an NIH T32 Training Grant for the 'Combined Engineering and Orthopaedics Training Program'. Dr. Suzanne Maher, associate director of the HSS Department of Biomechanics is principal investigator on the grant, which initiates a 5-year program to educate, support and empower exceptional pre-doctoral and post-doctoral trainees to excel in careers that apply engineering principles to maintain and restore musculoskeletal function. Program trainees will receive unique mentoring and research opportunities at Cornell's Ithaca campus and at the HSS main campus in New York City. All graduate students trained in the program will have a team of mentors that includes a Cornell faculty member and a clinical faculty member at HSS. Each student will be supported by the program for 18-24 months, during which time they will work on a collaborative project between the two campuses, which will include a semester of research at the HSS main campus.

HSS-CAMEO program faculty and alums at a meeting in 2019.

The program is administered by the HSS-Cornell Center for Advanced Materials and Engineering in Orthopedics (CAMEO), a collaboration of more than 30 academic, research, and clinical faculty dedicated to applying engineering tools to solve problems in musculoskeletal health. The Center leverages the 40-year history of collaboration between Cornell and HSS that revolutionized the process of orthopaedic implant design and has expanded to include research into cartilage and osteoarthritis, bone and osteoporosis, and regenerative medicine.

The first two graduate fellows of the program, selected in summer 2021, are Meinig School Ph.D. students Ana Witkowski and Lainie Eisner, 3rd and 2nd year Ph.D. students, respectively. Ana's research is a collaboration between Prof. Marjolein van der Meulen at Cornell and Dr. Mathias Bostrom at HSS, studying the role of parathyroid hormone treatment in osteoarthritis. Lainie's research is a collaboration between Prof. Nelly Andarawis-Puri of Cornell and Dr. Michael Fu of HSS, and will focus on understanding the biological response to mechanical fatigue in tendon injury.

The program is supported by numerous Meinig School affiliates including James M. and Marsha McCormick Director of Biomedical Engineering and Swanson Professor of Biomedical Engineering Dr. Marjolein van der Meulen and HSS senior scientist Dr. Tim Wright serving as executive co-directors. Drs. Lawrence Bonassar, Daljit S. and Elaine Sarkaria Professor in Biomedical Engineering and Suzanne Maher serve as the site directors for the program at Cornell and HSS, respectively. The program has the strong support of the Dean of the College of Engineering, and the Chief Scientific Officer, the Surgeon-in-Chief, and the CEO at HSS.

THE HSS-CORNELL CONNECTION

HSS is an affiliate hospital of Weill Cornell Medicine, and has for the past 12 consecutive years been ranked #1 nationally among othopaedics hospitals by US News and World Report. A Newsweek survey of professionals across 22 countries ranks HSS #1 in the world for orthopaedics. Many HSS scientists and physicians hold Weill Cornell faculty appointments and/or Cornell Ithaca graduate faculty appointments. For more than 40 years, collaborations between HSS research scientists and clinicians and Cornell faculty and students have been the cornerstone of orthopaedic bioengineering effects with staff from HSS and Cornell travelling between New York City and Ithaca to teach students and medical residents. The Program also facilitates access to equipment and resources to researchers at both locations, including research cores at HSS and Weill Cornell, the College of Veterinary Medicine, the Cornell Nanobiotechnology Center and the Cornell Center for Materials Research. Faculty from the HSS Department of Biomechanics also serve as thesis committee members and advisors for students seeking MS and PhD degrees at the Ithaca campus.

In 1998, with support from a Whitaker Foundation Special Opportunity award, the Program developed an immersion experience to allow graduate students to spend extended periods in New York City for research and for medical students or residents to spend time in Ithaca. The immersion experience for Ithaca-based graduate students has become a part of the field of biomedical engineering's graduate curriculum and is now formalized further with HSS-CAMEO.

SPOTLIGHT ON STUDENTS

STUDENTS HONORED WITH DIVERSITY AWARDS

Each year Cornell's Diversity Programs in Engineering (DPE) office recognizes outstanding undergraduate and graduate students, student organizations, faculty and staff through its annual awards. Additionally, with support from industry partners, DPE presents corporate awards and scholarships to students. Cornell's Diversity Programs in Engineering (DPE) office is responsible for fostering a vision of diversity appreciation reflective of the College of Engineering's strategic plan, which enables members from all backgrounds and cultures to thrive and succeed at Cornell University. Award recipients were selected via a nomination process that provided qualitative examples of their deeds and efforts within the Engineering community and/or across Cornell.

The following Meinig School students were recognized with awards from Cornell's Diversity Programs in Engineering (DPE) in 2021:

COMMITMENT TO DIVERSITY AWARDS

- Tibra Wheeler, Zellman Warhaft Graduate Student Awardee
- Zeinab Mohamed, Zellman Warhaft Graduate Student Awardee
- Caroline Waksmunksi '21, Zellman Warhaft Undergraduate Student Awardee

LEADERSHIP AND SERVICE AWARDS

- Ana Elhom '21, Undergraduate Excellence in Leadership Award

CORPORATE AWARDS & SCHOLARSHIPS

- Samantha Pitts '21, Society of American Military Engineers (SAME) scholarship
- Edith Chen '23, Diversity Scholar Award

MENTORSHIP AWARDS

- Jon Albo, CU Empower Outstanding Peer Mentor Awardee
- Jason (Chang) Marvin, Ephrahim Garcia Graduate Excellence in Mentoring Awardee
- Emily Laurilliard, Ephrahim Garcia Graduate Excellence in Mentoring Awardee

Honorable Mention for Ephrahim Garcia Graduate Excellence in Mentoring:

- Jon Albo
- Garrett Beeghly
- Monideepa Chatterjee
- Taylor Oeschger












STUDENT GROUP SPOTLIGHT: BMES

By Ana Witkowski and Marguerite Pacheco

Graduate programs can be challenging without a great support system, and Cornell's graduate student chapter of the Biomedical Engineering Society (CUBMES) is one organization providing such support to Meinig School students. With a mission to promote biomedical engineering through research, educational outreach, and advocacy of engineering approaches to biology and human health, CUBMES facilitates opportunities for graduate students to develop professionally, socially, and personally at Cornell and beyond.

In normal times, CUBMES organizes in-person events within and external to Cornell. But over the 2020-21 year, the group had to step back and reevaluate how to best serve its peers and community during the pandemic. They worked hard to maintain a presence on campus through coffee hours, trivia nights, and information panels for incoming Ph.D. students. The group also successfully transitioned its largest outreach event, Girl Scout Engineering Day (GSED), online, and extended its reach across the country. With the support of funds raised through Cornell Giving Day, BMES was able to ship event supplies all the way to Texas!

To enhance community engagement and student well being, CUBMES is also taking the lead on pushing for diversity, equity, and inclusion (DEI) initiatives at the Meinig School and beyond, working actively to provide a welcoming space for minority students. CUBMES led school conversations on these topics and, together with the student body, developed several initiatives such as hosting movie nights and happy hours to foster conversations on cultural awareness.

Moving forward, CUBMES will continue to prioritize virtual events to maintain accessibility for all, as well as to develop a feedback loop between the student body, the CUBMES executive board, and school leadership, to work toward making mental health initiatives on campus more available to the student population.

The CUBMES team is excited to transition back to in-person general body meetings and continuing support students returning to campus. They can't wait to meet the incoming class of graduate students and last year's cohort in person for the first time.

Any support to CUBMES and its efforts are immensely beneficial, and help the group enhance its programming options and students' growth. To contribute, scan the following QR code to be directed to the CUBMES donations page, or look for the BMES Graduate Student Chapter page on Cornell Giving Day in March.

Cornell BMES graduate students hosted online workshops for Girl Scout Engineering Day in 2021.

AT-A-GLANCE
CORNELL BMES GRADUATE CHAPTER

WHO WE ARE:

- Meinig School graduate students and a faculty advisor

WHAT WE DO:

- promote biomedical engineering through research, educational outreach, and advocacy of engineering approaches to biology and human health
- provide avenues for members to develop professionally, socially, and personally, as well as contribute to the community inside and outside of Cornell, by way of:

Professional Development:

- research visits to potential employers
- video seminars and Q&A with local industry representatives
- networking events, professional skills workshops

Outreach:

- Girl Scout Engineering Day (GSED)
- Expanding Your Horizons (EYH) workshops for girls
- Family Science Nights at Ithaca Sciencenter
- STEAM Night at local elementary schools

Community Engagement

- student-faculty happy hours
- events to promote cultural diversity
- holiday party, movie and game nights, wine and paint night, karaoke, apple-picking, and a wine tour

HONORS & AWARDS

CORE FACULTY

Shivaun Archer
Appointed 2021 fellow of the James McCormick Family Teaching Excellence Institute (MTEI) by Cornell Engineering.

Lawrence Bonassar
Selected Orthopaedic Research Society (ORS) 2021 Fellow.

Jonathan Butcher
Elected American Society of Mechanical Engineers (ASME) Fellow.

Newton de Faria
Awarded 2021 John Swanson '61 ME in honor of his mother, Dorothy G. Swanson teaching award from Cornell Engineering.

Iwijn De Vlaminck
Awarded 2020 research excellence award from Cornell Engineering.

Jan Lammerding
Honored as an inspirational Cornell faculty member by Merrill Presidential Scholar Alexa Podolsky.

Esak Lee
Awarded 2021 Microcirculatory Society (MCS) Award for Excellence in Lymphatic Research; Adam Rachel Broder Fund for Cancer Research from Cornell University; Multi-Investigator Seed Grant from Cornell University.

David Putnam
Named 2020 Fellow, National Academy of Inventors (NAI); inaugural Associate Dean for Innovation and Entrepreneurship by Cornell Engineering.

Marjolein van der Meulen
Named 2021 Class of Fellows of the Biomedical Engineering Society (BMES).

STUDENTS & POSTDOCS

GRADUATE STUDENTS

Jon Albo (Cira Lab) awarded CU Empower Outstanding Peer Mentor Award from Cornell's Diversity Programs in Engineering.

Sonny Carlton (M.Eng.) awarded teaching assistant award for outstanding BME teaching 2020-21.

Alex Cheng (De Vlaminck Lab) co-lead author on the paper, "Cell-Free DNA Tissues-of-Origin by Methylation Profiling Reveals Significant Cell, Tissue and Organ-Specific Injury Related to COVID-19 Severity."

Lainie Eisner (Andarawis-Puri Lab) awarded a two-year Hospital for Special Surgery (HSS)-Cornell T32 Combined Engineering and Orthopaedics Training Grant.

Jongkil Kim (Bonassar Lab) Best Podium Presentation Award from the Meniscus Section of the 2021 Orthopaedic Research Society meeting; this research titled, "Combining TGF-β1 and Mechanical Anchoring to Enhance Collagen Fiber Formation and Alignment in Tissue-Engineered Menisci" was featured on the cover of *ACS Biomaterials Science & Engineering*.

Maho Kaga (M.Eng.) awarded teaching assistant award for outstanding BME teaching 2020-21.

Emily Laurilliard (Cosgrove Lab) received an Ephrahim Garcia Graduate Excellence in Mentoring Award from Cornell's Diversity Programs in Engineering.

Joseph Long (Lammerding Lab) selected, second National Science Policy Network SciPol Scholars cohort for Spring 2021.

Jason (Chang) Marvin (Andarawis-Puri Lab) received an Ephrahim Garcia Graduate Excellence in Mentoring Award from Cornell's Diversity Programs in Engineering; awarded a 2021 Kappa Delta travel award at Cornell; awarded a 2021 Orthopaedic Research Society (ORS) Tendon Section Podium Award; invited to present his highest-scoring ORS tendon section podium at the EORS 2021.

David McKellar (Cosgrove & De Vlaminck Labs) awarded 1st place in the trainee talks session at the 2021 Cornell Stem Cell Symposium.

Zeinab Mohamed (Daniel Lab) received a Zellman Warhaft Graduate Student Award from Cornell's Diversity Programs in Engineering.

Marguerite Pacheco (Andarawis-Puri Lab) awarded an Exemplary Service Award - Early Career at the annual Graduate Diversity & Inclusion Awards & Recognition Celebration, held virtually this year.

Nancy Ruiz-Uribe (Schaffer-Nishimura Lab) awarded a predoctoral fellowship from the American Heart Association (AHA) for her projected titled for her project titled, "Molecular mechanisms leading to capillary stalling and hypoperfusion in the APP/PS1 mouse model of Alzheimer's disease."

Leigh Slyker (Bonassar Lab) awarded an NIH F31 fellowship for his project "Extensible Collagen Hydrogels for Cartilage Tissue Engineering".

Tibra Wheeler (Singh & van der Meulen Labs) inducted into the Cornell chapter of the Edward A. Bouchet Graduate Honor Society; Excellence in Leadership Award at the annual Graduate Diversity & Inclusion Awards & Recognition Celebration, held virtually this year; received a Zellman Warhaft Graduate Student Award from Diversity Programs in Engineering; selected for a trainee registration award from the Orthopaedic Research Society for the 2021 Virtual Annual meeting.

Ana Witkowski (van der Meulen Lab) awarded a two-year Hospital for Special Surgery (HSS)-Cornell T32 Combined Engineering and Orthopaedics Training Grant.

Jonathan Albo, Alexus Cruz, Liz-Audrey Djomnang Kounatse, Alikhan Fidai, Brooke Filanoski, Caleb Jones, Marianne Lintz, Alicia Matavosian, and Shola Onissema-Karimu each pinned Dean's Scholars at the 2020 Cornell Graduate School event.

UNDERGRADUATE STUDENTS

Jackson Bauer named a 2021 Kessler Fellow by Cornell Engineering.

Edith Chen received a Diversity Scholar Award from Cornell's Diversity Programs in Engineering.

Ana Elhom (Butcher Lab) awarded Undergraduate Excellence in Leadership Award from Cornell's Diversity Programs in Engineering.

Raina Kikani (Cosgrove Lab) awarded 2nd place in the 2021 American Society of Engineering Education (ASEE) St. Lawrence Sectional Conference poster competition.

Samantha Pitts received a Society of American Military Engineers (SAME) scholarship from Cornell's Diversity Programs in Engineering.

Alexa Podolsky (Lammerding Lab) named a 2021 Merrill Scholar.

Caroline Waksmunksi received a Zellman Warhaft Undergraduate Student Award from Cornell's Diversity Programs in Engineering.

Sophia Windemuth awarded teaching assistant award for outstanding BME teaching 2020-21.

Anna Ashford, Brooke Cohen, Caleb A McCurdy, Edith Chen, Isha Arora, Lauren Kret, Nandika Nair, and **Samuel Schirmacher** each awarded Engineering Learning Initiatives (ELI) funding for biomedical engineering-focused projects this year from Cornell Engineering.

POSTDOCS

Mingkun Wang (Butcher Lab) awarded $136,236 from the American Heart Association (AHA) for congenital heart defect research.

ALUMNI

Bayan Alturkestani (M.Eng. '20) recognized as a Top 100 Healthcare Leader at the 2020-21 International Forum on Advancements in Healthcare in Las Vegas.

Olufunmilayo (Funmi) Ayobami (Ph.D. '17, van der Meulen Lab) joined the faculty at Worcester Polytechnic Institute (WPI) in January 2021 as assistant teaching professor in the Department of Biomedical Engineering.

Robby Bowles (Ph.D. '11, Bonassar Lab), promoted to associate professor with tenure in the department of bioengineering at University of Utah.

Paula Fraczek (B.S., '19, Cosgrove Lab) selected to receive a 2021 NSF fellowship.

Julius Korley (Ph.D. '10, Putnam Lab) selected co-director of NSF Innovation Corps (I-Corps™) Northeast Hub.

Andrea Ippolito (Bonassar Lab, B.S. '06, M.Eng. '07) selected to serve on the Biden-Harris Department of Veterans Affairs Agency Review Team.

Mike Mitchell (Ph.D. '14, King Lab) Journal of Nanobiotechnology Rising Star Award.

Erica Pratt (Ph.D. '15, Kirby Lab) will join Boston University as an assistant professor in the BME department in 2022.

Jenny Puetzer (Ph.D. '14, Bonassar Lab) NSF CAREER Award for her proposal "Driving cells to produce strong, mature collagen fibers for post-injury healing."

Young Hye Song (Ph.D. '16, Fischbach Lab), assistant professor in the Department of Biomedical Engineering at the University of Arkansas, has received a $429,000 grant from the National Institute of Health for research in tissue engineering.

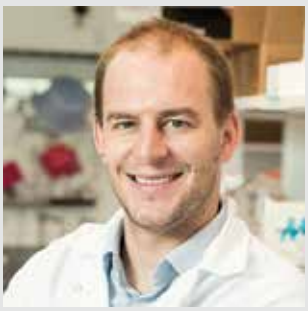
MEET THE 2021 NSF FELLOWS

2021 NSF Fellows L to R: Ph.D. students Erik Chow, Aria R. Henderson, Shola Onissema-Karimu, Erica Wagner, Rick Zirkel and undergraduate student Sophia Windemuth.

The Meinig School proudly congratulates Ph.D. students Erik Chow (Paszek Lab), Aria R. Henderson (Lee lab), Shola Onissema-Karimu (Fischbach Lab), Erica Wagner (Jiang Lab), and Rick Zirkel (Schaffer-Nishimura lab) who each recently won a 2021 National Science Foundation (NSF) Graduate Research Fellowship (GRFP). The NSF GRFP offers three years of stipend support during a 5-year fellowship tenure to applicants selected through a national competition.

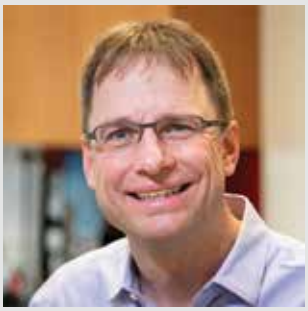
Undergraduate student Sophia Windemuth also received an NSF fellowship.

FACULTY PROMOTIONS



Iwijn De Vlaminck
promoted to associate professor with indefinite tenure.

Shaoyi Jiang
elected the inaugural Robert S. Langer '70 Family and Friends Professor, elected professor with indefinite tenure.



Jan Lammerding
promoted to professor.

ALUMNI PROFILES

CAROL HUNG
B.S. 2019

Carol Hung completed her B.S. in biomedical engineering from Cornell University in 2019 as a Merrill Presidential Scholar. During her undergraduate years, she was a research assistant in the Schaffer-Nishimura Lab, studying cancer metastasis in the brain. She was also involved in iGEM, Cornell's premier synthetic biology project team, as a member of the wet lab and product development subteams, eventually co-leading the wet lab subteam.

After graduating, Hung forewent her plan to pursue a career in medicine, turning down medical school offers, to pursue a career in medical technology development. She joined Noah Medical Corporation in Redwood City, California, as a clinical engineer, becoming one of their first employees. The medical device startup is building a next-generation robotic platform that targets early diagnosis and treatment of patients. As a clinical engineer, Hung works closely with physicians to understand the operating environment and clinical needs to become an internal expert within the company. Using this knowledge, she represents the clinical perspective in defining and assessing product requirements and performance targets. She works closely with cross-functional teams to develop components and features of the system and to validate performance goals.

Hung credits the Meinig School undergraduate program with her success in this fast-paced environment, providing her with an engineering background and wide breath that enhances her ability to support the diverse engineering teams. In addition, the medical focus Hung maintained throughout her time at Cornell, in combination with the product development focus of the BME capstone course, provided her with relevant experience to engage with clinicians and apply clinical knowledge to product design.

ERIC KADEN
B.S. 2018

Eric Kaden received a B.S. in biomedical engineering in 2018 from Cornell University as a member of the Meinig School's inaugural undergraduate class. After finishing his undergraduate degree, Eric moved to his home state of New Jersey and spent two years working in medical device manufacturing. His first role was as a process engineer at Zimmer Biomet. A year later, he transitioned to a role as a quality engineer at Stryker. In early 2020, Eric decided that he wanted to go to law school and become an attorney. He is excited to announce that in August 2021 he started his legal education at Emory University School of Law in Atlanta, Georgia. Eric is not sure in which area of the law he will specialize. However, given his background he is certainly considering patent law.

Eric is grateful to the faculty and staff of the Meinig School as well as his BME classmates for making his undergraduate experience a memorable one. He believes completing the BME program helped him develop a strong work ethic that will carry over to his time as a law student. Some of Eric's hobbies include pickleball, making Spotify playlists, meditation and yoga, and watching comedy bits on YouTube. For anyone interested in connecting further, he can be reached at eric.kaden120@gmail.com.

MARY CLARE MCCORRY
PH.D. 2017

Mary Clare McCorry received her Ph.D. in biomedical engineering in 2017. She worked in Dr. Larry Bonassar's lab designing tissue engineered meniscal constructs and studying biomechanical and chemical mechanisms of action of cells to build functional tissues. Her research was highly interdisciplinary and translational, working closely with Lara Estroff in Materials Science and Engineering, Lisa Fortier in the College of Veterinary Sciences, and Suzanne Maher at the Hospital for Special Surgery.

After finishing her Ph.D., McCorry was offered an opportunity to work at the Food and Drug Administration through the AIMBE Scholars program. As an AIMBE Scholar, she led science policy initiatives and coordinated collaborations between experts in academia, industry, government and non-profit organizations. Her AIMBE project was with the program for Pediatrics and Special Populations in Office of the Center Director (OCD) at Center for Devices and Radiological Heath (CDRH) where she worked to organize and lead the development of projects associated with the Pediatric Medical Device Development Public Meeting. To better understand industry needs and concerns in the context of regulatory guidelines, she worked with industry representatives, industry trade organizations, professional organizations, and clinicians. She also investigated trends in medical devices indicated for use in pediatrics, examining the three medical device evaluation pathways for innovative devices: Premarket Approvals (PMAs), Humanitarian Device Exemptions (HDEs), and De Novos. Through her experience as an AIMBE scholar, she learned how regulatory process and decision-making influences the market from early stage discovery and ideation to post-market monitoring.

Currently, McCorry is the Director for Technology and Process Development at the Advanced Regenerative Manufacturing Institute (ARMI). ARMI is a non-profit

Mary Clare McCorry and her boss, ARMI | BioFabUSA CTO Tom Bollenbach, at the Advanced Regenerative Manufacturing Institute (ARMI) in front of the tissue manufacturing line she helped to build.

organization which operates the BioFabUSA Manufacturing Institute funded by the Department of Defense. The goal of the program is to achieve scalable, consistent and cost-effective manufacturing of cells, tissue and organs through the development of manufacturing technologies. At ARMI, she is advising the development of several scalable, modular, automated and closed tissue manufacturing production lines as well as leading Institute-based Technology Working Groups focused on advancing tissue and organ manufacturing. Additionally, she is responsible for directing technical partnerships for collaboration on Institute funded projects. The field is growing rapidly, and McCorry is excited to be a part of an organization that is paving the way to bring tissue technologies to market.

YOUNG HYE SONG
PH.D. 2016

Young Hye Song received her Ph.D. in 2016. Her research under the mentorship of professor Claudia Fischbach-Teschl focused on understanding the pro-angiogenic behavior of adipose-derived stem cells (ASCs) in the context of breast tumor microenvironment. Using tissue engineering tools, she helped uncover new mechanisms in which cell-extracellular matrix interactions and paracrine signaling lead to ASC activation and subsequent increase in angiogenesis.

In August 2016, Young Hye started her postdoctoral training under professor Christine Schmidt in biomedical engineering at the University of Florida in Gainesville, FL. There she worked on novel, apoptosis-based tissue decellularization methods and developing in vitro test beds of traumatic neural injuries. Her postdoctoral work led to several U.S. patent applications and peer-reviewed publications. After three years of postdoctoral training, Young Hye moved to Fayetteville, AR in August 2019 to start her faculty career as a tenure-track assistant professor of biomedical engineering at the University of Arkansas. Based on experiences and knowledge gained from both Fischbach-Teschl and Schmidt labs, Young Hye currently directs a lab that uses tissue engineering strategies to study cancer-nerve crosstalk and traumatic neural injuries. She hopes that work from her lab will lead to identifying novel treatment targets and developing combinatorial therapeutics. Young Hye is grateful for the experiences and connections she made during her time at Cornell and hopes to leverage her faculty position to pay it forward to the future generation of biomedical engineers.

SCOTT TUCKER
M.ENG. 2011

Scott Tucker graduated Cornell with a B.S. in biological engineering in 2010 and an M.Eng. in biomedical engineering in 2011. After graduation he worked as a research engineer at Hospital for Special Surgery in NYC for two years. Following that, he matriculated to the MSTP program at Penn State, where he completed a Ph.D. in engineering science and mechanics in 2019 and an M.D. in 2021. The flagship publication from his thesis work was featured on the cover of the November 2017 issue of the *Journal of Orthopaedic Research*.

During his training, Tucker also developed a patent for a total wrist arthroplasty and received grant funding from the PA state department of health to compare the basic biomechanics of the novel device to current industry standards. In 2018 he was awarded Penn State's Student Award for Excellence in Innovation, the Orthopaedic Research Society International Section for Fracture Repair poster award, the Daniel A. Notterman Physician Scientist Award, and the Penn State Pediatric Research Day Young Investigator Award.

Tucker volunteers as a mentor to the American Physician Scientist Association and as a science fair judge for the Pennsylvania Junior Academy of Science and is now working as an orthopaedic surgery resident at Penn State. He is a proud husband and father of 2 young children, Molly (4) and Will (7 mos.).

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For more information, please contact Jack Thompson, major gifts officer for the College of Engineering at jat355@cornell.edu, 212-351-7678.

Alma Mater

Far above Cayuga's waters,
With its waves of blue,
Stands our noble alma mater,
Glorious to view.

Lift the chorus, speed it onward,
Loud her praises tell;
Hail to thee, our alma mater!
Hail, all hail, Cornell!

Far above the busy humming
Of the bustling town,
Reared against the arch of heaven,
Looks she proudly down.

Lift the chorus, speed it onward,
Loud her praises tell;
Hail to thee, our alma mater!
Hail, all hail, Cornell!

CornellEngineering

Meinig School of Biomedical Engineering

Class of 2021

CLASS OF 2021

DOCTOR OF PHILOSOPHY

Aaron Chiou
Terence Gee
Korie A. Grayson
Rebecca Irwin
Ramin Jafari
Lu Ling
Alexander Loiben
Juan Paredes
Shivem Shah
Sarah Snyder
Tiffany St. Bernard
Chelsea Stowell
Ruisheng Wang
Yen-Lin (Ian) Wu
Fei Xia
Matthew Zanotelli
Yuying (Sylvia) Zhang
Sophia Ziemian

MASTER OF ENGINEERING

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Aaron Berman
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Sonny Carlton
William Chan
Xiaohui Chen
Yucong Chen
Yanda Cheng
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Archana Varman
Tyler Webb
Jacob Weinman
Kelly Wu
Dianwen Xu
Chengqi Xu

For more about our 2021 commencment and associated media, including photos, videos, and student design project descriptions, scan the QR Code, right:

BACHELOR OF SCIENCE

Members of the Meinig School undergraduate class of 2021 and faculty celebrate in front of Weill Hall on Sunday May 30, 2021.

Ethan Blum
Lindsay Browning
Alexandria Calder
Kevin Cavallo
Matthew Caverly
Michelle Chang Wu
Samantha Cohen
Annabelle Cram
Jaimie Diamond
Ana Elhom
Allison Fleisher
Rachel George
Cassandra Gologorsky
Zheshen Gong
Audrey Guo
Shaminta Hamidian
Jessica Hernandez
Michael Hill
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Chiemezue Ijomanta
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Taylor Joines
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Samantha Pitts
Alexa Podolsky
Trisha Ray
Maegan Rudolph
Yashi Sanghvi
David Shamritsky
Nicole Soriano
Erica St. Jean
Acacia Tam
Nicolas Tan
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Shreya Venkatesh
Caroline Waksmunski
Julia Walsh
Sophia Windemuth
Ann Zhao
Yvette Zhu