UNIVERSITY OF WISCONSIN–MADISON
COLLEGE OF ENGINEERING

2023

PERSPECTIVE

BUILDING MOMENTUM

With a host of talented new faculty and a burgeoning student body, we're accelerating efforts to solve critical U.S. and global challenges.

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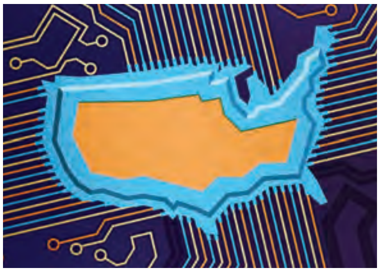

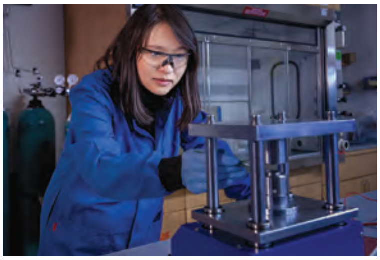

On the cover: The college is ramping up its semiconductor research and education to meet an ever-growing global need. Photo/illustration: Todd Brown/Joel Hallberg.

PERSPECTIVE
MAGAZINE

COMMUNICATIONS AND MARKETING

Editor: Renee Meiller
rlmeiller@wisc.edu

Writers: Jason Daley, Alex Holloway, Adam Malecek, Tom Ziemer

Designer: Joel Hallberg

COLLEGE LEADERSHIP

Dean: Ian M. Robertson

Executive Associate Dean: David Noyce

Associate Deans:
Edward Borbely, Interdisciplinary Professional Programs
Christian Castro, Inclusion, Equity and Diversity in Engineering
Kathy Prem, Academic Affairs
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College of Engineering
UNIVERSITY OF WISCONSIN–MADISON

Greetings from Wisconsin!

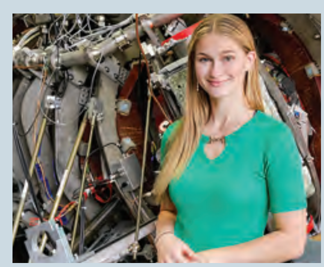
If you look at the evolution of the college's research, one constant for decades has been a strong and broad focus on energy. When the college recently rearticulated its research priorities, it was no accident that we paired energy with sustainability and the environment. In many ways, the three are intertwined, particularly as our nation moves toward a zero-carbon clean-energy future. To support this transition, the U.S. Inflation Reduction Act, signed into law in August 2022, designated billions of dollars in funding for breakthrough energy research.

While faculty in almost all of our departments conduct energy-related research, we're also not working in a vacuum. For example, we're leading an initiative to advance the economics of clean energy within our region and to facilitate a community-led, solution-focused transition to clean energy in the upper Midwest. Bringing together stakeholders from business, industry, government, research, education and communities around the region, this clean-energy partnership aims to empower communities, strengthen collaboration across partners, identify and close technology and policy gaps, and transform our region into a growing, evolving innovation ecosystem. Here at UW-Madison, our partners include members from across our campus.

The U.S. CHIPS and Science Act aims to revitalize the country's leadership in scientific research and technology and to strengthen its economic and national security. It includes a historic level of investment in ramping up production of U.S. semiconductors. As you'll read in our cover story, semiconductors also are a college strength area—one we're growing by enhancing existing or adding new educational offerings, hiring new faculty, and pursuing partnerships with other technology leaders. As an example of the latter, we've joined the American Semiconductor Innovation Coalition. With more than 160 members from industry, academia, government and nonprofit organizations, it's aiming to catalyze the U.S. semiconductor industry and drive technical leadership. In our college, we've launched the Semiconductor Science Initiative, which aims to establish a center for semiconductor science and technology. That center will bring together a community of partners, expand our semiconductor technology research portfolio, and compete for a national center of excellence in semiconductor science in the future.

Here on campus, we're also making progress in our quest to commercialize our innovations more quickly. For example, the Technology Entrepreneurship Office–founded in partnership with the College of Letters and Science and the School of Computing, Data and Information Sciences—is gaining momentum. We've hired Bonnie Bachman, an economics professor from Missouri University of Science and Technology, to lead the office, which guides faculty, staff and students through the ideation to commercialization process. Bonnie is an expert in innovation, entrepreneurship and corporate research and development. Drawing on experience from her previous role, she directs UW-Madison's involvement in the National Science Foundation's Great Lakes Innovation Corps Hub—an entrepreneurial training program designed to move more discoveries from research labs into the real world.

In everything I've just mentioned, and much more we already do, our goal is to work together to transfer knowledge and technologies rapidly into the hands of the people and companies who can use and benefit from them. Our 50,000+ graduates and students alike exemplify this innovative, entrepreneurial approach and are respected, passionate ambassadors of the College of Engineering in every corner of the globe. While there are countless examples (some of which you'll read in this issue), I'll recognize student Grace Stanke, who recently was crowned Miss America 2023 and regularly discusses the benefits of nuclear as a power source and for diagnosing and treating disease. I invite you to read more about this ambitious, talented nuclear engineering senior at engineering.wisc.edu/miss-america.



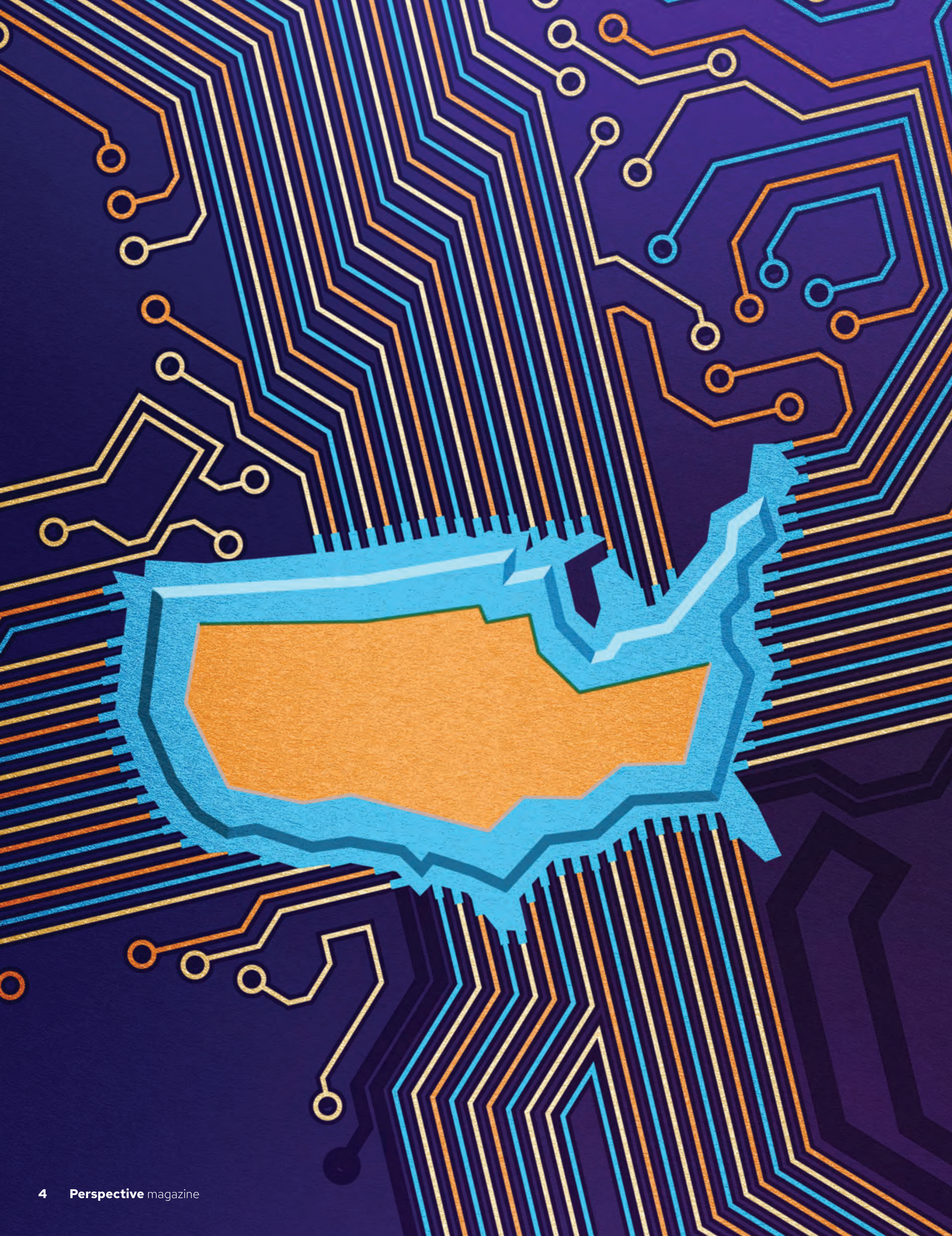
Joel Hallberg

Grace Stanke, nuclear engineering major and Miss America 2023.

On, Wisconsin!

Ian Robertson
Grainger Dean of the College of Engineering

Dedicated to fostering the highest standards of integrity, ethics, inclusiveness, and service to society.



ELECTRONIC ESSENTIAL

We are contributing talent and tech to a much-needed domestic semiconductor industry revitalization.

by Jason Daley

During the height of the coronavirus pandemic, anyone in the market for a new car, refrigerator or even a video game console was more or less out of luck; not only did COVID-19 impact supply chains, but it also delayed production of the chips and semiconductor devices that control just about every electronic gadget on the market.

Those shortages, as well as a long-simmering desire to rebuild technology manufacturing in the United States after decades of offshoring, led to the CHIPS (Creating Helpful Incentives to Produce Semiconductors) and Science Act. Signed into law in August 2022, CHIPS is a $280 billion package designed to support semiconductor chip manufacturing in the United States. By many accounts, it is the most significant investment in science and technology in generations.

While a large portion of the funding will go to private companies to help them build and expand microchip fabrication facilities in the United States, the act also provides a historic amount of funding to government agencies—including the National Science Foundation, Department of Energy, the National Institute of Standards and Technology, and NASA—that support university research.

In the next five years, billions of dollars in new funding will go to those agencies, and much of it will support basic and applied university-led research that will benefit the industry through technology advances and training for the future workforce. Universities with advanced facilities, talented faculty, industry ties and a strong student body—like UW-Madison—are poised to lead the way in this effort.

The college is already gearing up to take advantage of the new investments. It's leading a push to establish a semiconductor science center that will bring UW-Madison semiconductor efforts together. Many departments are already revising their curricula to enhance or add semiconductor-related courses and options. Dozens of faculty are already writing white papers and concept papers and consulting with nascent consortia to ensure UW-Madison is at the forefront of this emerging research area.

Shubhra Pasayat, an assistant professor in electrical and computer engineering, specializes in fabricating semiconductor devices, including new types of light-emitting diodes and ultraviolet lasers used in advanced communications. She says UW-Madison is one of a small handful of U.S. institutions with the facilities to fabricate and study next-generation semiconducting materials like the ones she handles.

"This will have a big, big effect on the College of Engineering," says Oliver Schmitz, college associate dean for research innovation and director of the Grainger Institute for Engineering. "There's a huge opportunity on the chip side that requires us to reorient and adjust our approach. And the science act touches almost everything we do in the college, including energy research, manufacturing technology, computer and data science, and almost every expertise our faculty have."

"There are a lot of tools available here that are not always available in an academic setting," says Pasayat, pointing out the college's Nanoscale Fabrication Center, Soft Materials Characterization Lab, large array of cleanrooms, and two metalorganic chemical vapor deposition systems (rarely found outside of industry) used to grow layers of semiconducting material.

With this equipment, she explains, researchers can transform an idea to an industry-ready product all on one campus; they can synthesize a new semiconducting material, test and characterize it, integrate it into circuits or devices, and try it out in a full electronic system. "We feel that UW-Madison is in the right spot where we have the existing infrastructure which we can leverage to advance our research," she says.

The university also has the talent to take advantage of the coming investment in next-gen semiconductors. Schmitz says that strategic hiring in the last few years has brought in new faculty with experience in semiconductor technology and manufacturing, including Pasyat; ECE Assistant Professor Chirag Gupta, a former engineer for the semiconductor device manufacturer Maxim Integrated; ECE Associate Professor Umit Ogras, a former research scientist at Intel; and others.

A large cohort of world-class researchers across the College of Engineering is already working on areas vital to the future of the semiconductor industry. For instance, Michael Arnold, the Beckwith Bascom Professor in materials science and engineering, is a world expert on carbon nanotubes, which are each about 1/10,000 the width of a human hair. Replacing silicon transistors on computer chips with these tiny tubes could boost the speed and efficiency of microchips five to 10 times. "That's a big deal, especially in mobile device computing and massive server farms that use tremendous amounts of electricity," says Arnold, who has patented a process for attaching and aligning these tubes on silicon wafers and is already working with industry partners. "Energy-efficient computing is pretty important these days."

The College of Engineering also has many faculty working on thin films and 2D materials, which are just one atom thick. When properly tuned or when layered with one another, these materials can be used as memory, sensors, solar cells and many other devices that currently rely on silicon. And because they are thin, they can be used in products like wearable devices, flexible displays and biosensors.

Other researchers are exploring classes of semiconductors that simply outperform silicon.

Pasayat and Gupta, for instance, are working with gallium nitride and gallium oxide, two semiconductors the industry is especially interested in. Their abilities to handle higher power than silicon makes them ideal for applications like ultrafast electric car chargers and more powerful components for 6G and 7G communications, as well as the ultraviolet lasers Pasayat has developed.

It's not just faculty who will help drive the reenergized semiconductor industry. UW-Madison students are already in high demand across the tech sector. According to *Inside Higher Ed*, the CHIPS Act will provide STEM-related higher education and workforce development at levels not seen since the era of the Space Race. Schmitz says the need for more highly qualified engineers will skyrocket. That's among the reasons the college is increasing its student body and is pursuing partnerships with technical schools, like Madison Area Technical College, that can help lead more students to four-year or advanced degrees.

Alumnus Dave Hemker (BSChE '84), a retired senior vice president and chief technology officer for Lam Research Corporation, which produces equipment for the semiconductor industry, says he expects the investment will help universities create a pipeline to the semiconductor industry of the best and brightest engineers from many disciplines, including electrical, computer, chemical, industrial, and materials science and engineering. "Having really, really good engineers that have been trained well in problem solving and who can work in teams and communicate is going to win the day," he says. "And that's what Madison's always done best, in my opinion, and across disciplines."

Applying science to the art of teaching engineers

A sharper focus on the scholarly side of learning benefits not only students, but the discipline as a whole.

BY RENEE MEILLER

“In research, taking risks is rewarded, because it may lead to breakthroughs,” says Civil and Environmental Engineering Associate Professor Andrea Hicks. “Teaching needs to be viewed through the same lens in order to produce the engineers we need for the future.”

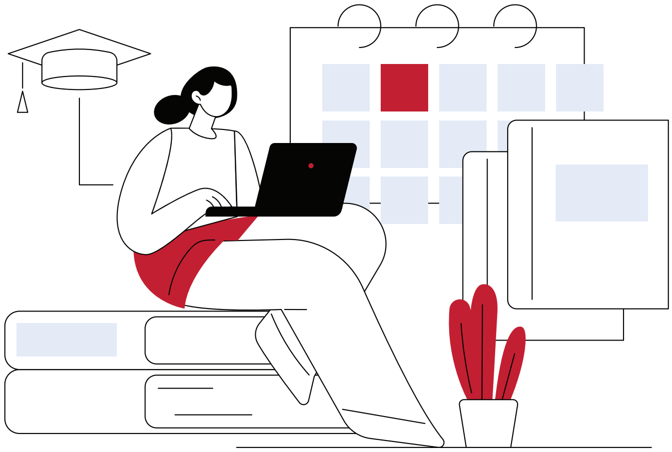
Bringing people, passion, knowledge, resources and research together in a singular effort, our new Center for Innovation in Engineering Education provides the opportunity for our faculty and staff to approach engineering education just as boldly.

A gift from Keith Nosbusch (BSEE ’74) and his wife, Jane, supports part of the center, which aims to advance learning for all and to equip engineers to positively impact the world.

Not just another Zoom

"When you think of innovation, you often think of technology," says David Noyce, college executive associate dean. "This isn't necessarily loading classrooms with technology. We're trying to do things in a better way."

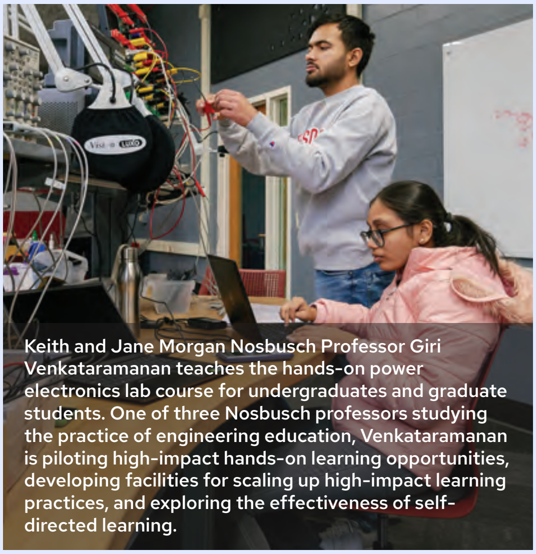
The landscape of education innovation is, in fact, expansive. Over time, it is transformative. The discipline itself is grounded in scholarly research, which then informs everything that follows: Aligning teaching methods and approaches with how diverse students learn and retain information best. Ensuring that our faculty, instructors and teaching assistants have the knowledge and support to implement best practices in their courses. Revisiting and revising our curriculum frequently to ensure our content remains relevant. Creating spaces that facilitate learning for all. Developing our students' confidence in their ability to succeed as engineers and offering supplemental instruction and advising when and how they need it. Teaching not only technical skills, but also how to communicate effectively, work successfully in teams, lead inclusively, and work ethically. Understanding the broader context in which engineers can appropriately and beneficially apply their skills. Enhancing the links between theory and real-world contemporary societal challenges relevant to our students' lives. Connecting students with community members.



Hicks is among several engineering faculty who are testing potentially transformative educational practices. For several years, she has worked with the UniverCITY Year program at UW-Madison to teach her *Environmental Sustainability Engineering* course. Her students work on a semester-long team project in partnership with community members who have identified a challenge they need help solving.

"As a professor, I have the unique opportunity to shape how a student thinks about an idea or concept," says Hicks. "It is my firm belief that I am helping to create my future colleagues."

Hicks also disseminates best practices in sustainability education for engineers via published peer-reviewed research papers. She, and Electrical and Computer Engineering Professors John Booske and Giri Venkataraman hold Keith and Jane Morgan Nosbusch professorships, created to support faculty passionate about advancing the theory and practice of engineering education.



Keith and Jane Morgan Nosbusch Professor Giri Venkataramanan teaches the hands-on power electronics lab course for undergraduates and graduate students. One of three Nosbusch professors studying the practice of engineering education, Venkataramanan is piloting high-impact hands-on learning opportunities, developing facilities for scaling up high-impact learning practices, and exploring the effectiveness of self-directed learning.

Joel Hallberg

A tradition of education innovation

Announce that you've founded a center focused on innovation in engineering education, and that declaration might beg the question, "What were you doing before?"

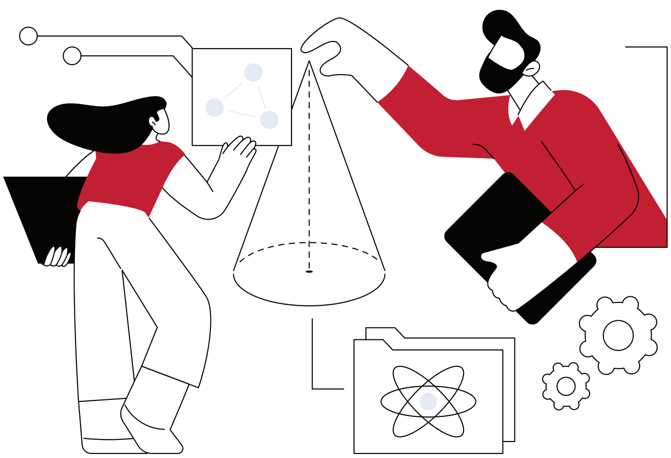
In the case of the College of Engineering, that answer is "lots."

"Seeking to improve the way that we're innovative in how we educate students doesn't mean we're bad at it currently," says Grainger Dean Ian Robertson. "We're actually pretty good at it. And part of our contribution to engineering education is helping develop its future."

In tandem with groundbreaking research, our engineers have been pioneers in advancing engineering education over the course of the college's history.

Looking back several decades, for example, are Bird, Stewart and Lightfoot; in 1960, the internationally renowned trio of chemical engineering professors published the landmark textbook *Transport Phenomena*. Their approach fundamentally changed the organizing principle in chemical engineering curricula at UW-Madison and around the world.

"I want to inspire the students in my courses to change the world and make it a better place through engineering," says Hicks. "In creating future engineers, we need to align how students are evaluated with the actual engineering jobs they could have. This moves away from the idea of rote memorization to applying the skills and concepts they have learned in a meaningful manner."



A growth model

Teaching and learning scholar and advocate Chris Dakes became the Center for Innovation in Engineering Education's inaugural director in spring 2022. He joined a college brimming with faculty and instructors who, like Hicks, are passionate about doing everything they can to ensure their students' success. The center will grow efforts in three initial areas of focus: teaching and learning scholarship, faculty development and instructional support, and student leadership education.

Center resources will support and advance educational research and broadly share findings to inform teaching and learning decisions right here in our college and beyond campus. Through the college's Collaborative for Engineering Education and Teaching Effectiveness, led by director Erica Hagen, the center will enable a growing number of faculty and instructional staff to create effective learning environments in which all students can succeed. And Angela Kita, hired under the center as director of leadership education, will head work to advance student leadership education through in-class and beyond-the-classroom experiences—among them, our National Academy of Engineering Grand Challenges Scholars Program.

That's just to start. "We're all looking for ways to continuously improve and build on the strong foundations that already exist," says Dakes. "We're starting by connecting the dots of the existing areas of progress and innovation and building the supporting infrastructure necessary to sustainably propel us into the future."

And of course, education innovation begins and ends with preparing people who are the future of our field. "We need to keep making sure our engineering students are at the forefront," says Grainger Dean Ian Robertson. "At the end of the day, do employers keep coming back here and saying, 'This is where we get really outstanding engineers'? That, to me, is what makes us successful."

Five years before YouTube's debut (2005) as a video-sharing platform, now-emeritus Engineering Physics Professor Greg Moses and colleagues engaged in a revolutionary redesign of the traditional lecture mode. Their eTEACH software enabled instructors to record and create multimedia lectures. Students watched these videos on their own time; in class, they worked together to solve problems based on each lecture, while the instructor circulated, answered questions and clarified concepts. Today, this approach is ubiquitously known as blended learning.

In 2012, the first of many facilities devoted to active learning debuted at UW-Madison in College Library and in Wendt Commons. Together known as the Wisconsin Collaboratory for Enhanced Learning Center, or WisCEL, the flexible technology-rich spaces bring students together to solve problems in class and facilitate lively small-group discussion, peer-to-peer learning, and tutoring. John Booske, a professor of electrical and computer engineering and a Keith and Jane Morgan Nosbusch professor, spearheaded the creation of this learning environment.

Formed in fall 2015 with three mentors and 15 students, Informatics Skunkworks today engages approximately 100 undergraduates from four institutions in applied research at the intersection of data science and materials science. "The program seeks to provide authentic research, engaged personal learning and professional development while also being efficient, accessible and scalable," notes its founder, Spangler Professor in materials science and engineering Dane Morgan in the abstract of a paper he and colleagues presented at the American Society for Engineering Education 2022 Annual Conference and Exposition.

Today, Alain H. Peyrot Assistant Professor in structural engineering Hannah Blum blends augmented and virtual reality to help her structural engineering students visualize everything from fractures in bolted steel connections to entire construction sites.

There are countless other examples woven throughout the college's past and present.

Photo: Joel Hallberg

Great minds converge here

We're expanding our faculty expertise in energy storage, semiconductors, autonomous systems and data science … and we're planning to grow for greater impact.

BY THOMAS ZIEMER

Fang Liu arrived on the UW-Madison campus in fall 2022, bringing with her a bold research agenda.

The chemical engineer-turned-materials scientist (pictured) wants to develop more energy-dense rechargeable batteries that could power heavy trucks and even airplanes—the kind of technology that could make a significant dent in greenhouse gas emissions. She's also hoping to work toward long-duration batteries for grid-scale storage, expanding the reach of renewable energy.

"This is becoming more and more important as time moves on," she says. "How can we power the whole city or whole country with battery capacity? How can we store the energy from wind and solar sources to provide the energy that we need in daily life?"

To chase those lofty aims, she'll build upon the college's longstanding tradition of excellence in fundamental materials research, while collaborating with a growing number of colleagues using data science to accelerate progress.

Liu typifies the kind of ambitious researcher the college looks for when hiring new faculty members: inquisitive thinkers who are willing to work across the boundaries of traditional engineering disciplines.

She's also tackling a looming global challenge, and that's no coincidence: The college is investing in strategic research clusters like energy storage and batteries, addressing key technical hurdles that will help further realize the potential of renewable energy systems against the backdrop of climate change.

Another group of recent faculty hires is pursuing emerging solutions in semiconductor development—engineering the future of electronics in the midst of a growing global need. The college has also added expertise in autonomous systems and robotics to accelerate progress in areas that include connected and automated vehicles, transportation safety and next-generation manufacturing.

And across all those specific research focus areas and its academic departments, the college is prioritizing collaborative engineers who harness the latest data science methods to discover new materials, improve healthcare treatments and much, much more.

"Solving some of the world's grand challenges is going to require engineers who can work across traditional academic boundaries," says Ian Robertson, Grainger Dean of the College of Engineering. "We're adding faculty members who fit that mold and excel in both basic and applied science that can contribute to those solutions."

In all, the college has added 19 new faculty members across seven departments during the 2022-23 academic year. Over Robertson's nine-year tenure, nearly 120 researchers have joined the college's faculty. Sixty-five of those hires have come in the last five years, even amid pandemic disruptions.

Several new faculty hires in 2022-23 have brought established research labs from other institutions to the UW-Madison campus.

Ying Li, an associate professor of mechanical engineering, came from the University of Connecticut after earning an NSF CAREER Award related to his work using computational modeling to better understand and design advanced polymers. He's already building collaborations with the college's Polymer Engineering Center, which created the world's first plastics engineering course in 1946.

Xiaopeng Li, an associate professor of civil and environmental engineering, joined from the University of South Florida, where he started U.S. Department of Energy- and National Science Foundation-backed projects developing connected and automated vehicle technologies.

Hantang Qin, an assistant professor of industrial and systems engineering, brought an active collaboration with NASA to optimize 3D printing for in-space manufacturing of electronic components from Iowa State University.

They join the likes of previous mechanical engineering faculty hires Christian Franck, who came from Brown University in 2018, and Katherine Fu, who moved north from Georgia Tech in 2021. Like Ying Li and Xiaopeng Li, Franck and Fu had earned tenure before choosing to relocate to UW-Madison.

"I'm so excited about all that is happening at the university," says Fu, an associate professor who uses cognitive science to improve engineering design. "The makerspace, collaborations across campus and with local industry partners, and being able to meet and work with students who are passionate about engineering design—to name a few."

Franck, the Bjorn Borgen Professor, leads a large-scale research effort across academia, industry and government to study traumatic brain injury down to the molecular level.

"UW-Madison has world-class expertise in a wide range of disciplines, including neuroscience, neurophysiology and biomedical engineering, as well as a top medical school, so I feel the ground is very fertile," says Franck, whose interdisciplinary research program has racked up multimillion-dollar grants from the U.S. Office of Naval Research.

That's just one tangible signal of the college's success in faculty recruitment among many.

Over the past five years, UW-Madison engineers have also claimed 29 National Science Foundation CAREER Awards to support their early-career research. Others have received the Presidential Early Career Award for Scientists and Engineers, the National Institutes of Health Director's New Innovator Award, the U.S. Department of Energy Early Career Award and the Beckman Foundation's Young Investigator Award.

The college's annual research expenditures have grown to roughly $100 million, driven in part by the energy of the more than 60 assistant professors on the faculty.

To better support those ambitious researchers, the college has plans to construct a massive new building, adding state-of-the-art research labs. The proposed new multidisciplinary facility would also allow the college to significantly expand its enrollment at both the undergraduate and graduate levels.

"The new facility will stimulate collaboration, spark research discoveries and serve as the focal point of our engineering campus," Robertson says. "Most importantly, it will allow our college to educate many more engineering leaders to provide technology solutions to the world's challenges."

Hires for our 2022-23 academic year

Rose Cersonsky, assistant professor, chemical and biological engineering

Sikai Chen, assistant professor, civil and environmental engineering

Jeremy Coulson, assistant professor, electrical and computer engineering

Juliana Pacheco Duarte, assistant professor, engineering physics

Robert Jacobberger, assistant professor, electrical and computer engineering

Eric Kazyak, assistant professor, mechanical engineering

Xiaopeng Li, associate professor, civil and environmental engineering

Ying Li, associate professor, mechanical engineering

Fang Liu, assistant professor, materials science and engineering

Whitney Loo, assistant professor, chemical and biological engineering

Allison Mahvi, assistant professor, mechanical engineering

Luca Mastropasqua, assistant professor, mechanical engineering

Anthony McDonald, assistant professor, industrial and systems engineering

Pedro Morgado, assistant professor, electrical and computer engineering

Hyunseok Oh, assistant professor, materials science and engineering

Hantang Qin, assistant professor, industrial and systems engineering

Eric Tervo, assistant professor, electrical and computer engineering

Jinlong Wu, assistant professor, mechanical engineering

Xiaobin Xiong, assistant professor, mechanical engineering

Haoran Wei (right), Mohan Qin and Ziyan Wu (left) are tracking the quantity of tiny plastic particles floating around the Great Lakes. Photo: Alex Holloway.

An inventory of invisible plastic

Smaller than a single speck of dust, tiny pieces of plastic are everywhere—throughout the natural environment and even in our own bodies. “We can detect this in human blood or even in the poop of babies, so these plastics are getting into children before they’re even born,” says Mohan Qin, assistant professor of civil and environmental engineering.

We don’t know how long these microplastics stick around—but using the world’s largest group of freshwater lakes, a duo of civil and environmental engineers aims to find out. “There are 22 million tons of plastic flowing through the Great Lakes every year,” says Haoran Wei, an assistant professor of civil and environmental engineering. “They will slowly disappear, but it’s not like they are completely degrading. They release a lot of invisible plastic particles, and we currently don’t know how much of that stuff there is.”

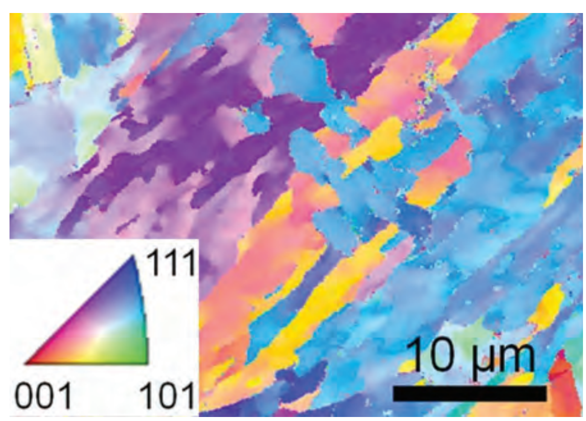
Wei and Qin are studying how sunlight and radiation release plastic particles from “whole” plastic products floating on the water’s surface, and then they’re tracking how those microplastics proliferate. They plan to standardize a method environmental researchers can use to monitor water-borne microplastics anywhere.

Strong stainless steel, perfectly printed

Many airliners, cargo ships, nuclear power plants and other critical technologies contain a remarkably strong, corrosion-resistant alloy called 17-4 precipitation hardening (PH) stainless steel.

Now a major advance will make manufacturing this strong alloy much easier and more cost-effective. A research team that includes Charles Ringrose Associate Professor of Mechanical Engineering Lianyi Chen and scientists from the National Institute of Standards and Technology and Argonne National Laboratory has identified particular 17-4 steel compositions that enable them to consistently 3D print the alloy so that it has the same properties as its conventionally manufactured counterpart.

The approach they used to examine the material could also set the table for a better understanding of how to print other types of materials and predict their properties and performance. The team is patenting its technology through the Wisconsin Alumni Research Foundation.



A microscopic image of 3D-printed 17-4 stainless steel. The colors of the image represent the differing orientations of crystals within the alloy. Credit: Qilin Guo and NIST.

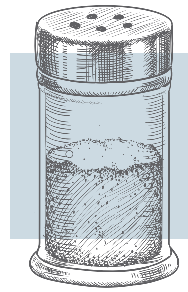
On the job, reliable robots lend a helping hand

"We envision a workplace where workers won't be replaced by robots, but rather where robots will assist workers in their jobs," says Robert Radwin, the Duane H. and Dorothy M. Bluemke Professor in industrial and systems engineering.

Collaborating with companies like Mercury Marine, General Motors and Boeing, along with UW-Madison researchers in industrial and systems engineering, computer science, mechanical engineering and labor economics, Radwin is working on several projects to devise strategies for introducing collaborative robots (or "cobots") into manufacturing jobs in ways that enhance work, boosting overall productivity while reducing physical and mental workloads for human workers.

Cobots are designed to operate in concert with humans. They move slower, deliver less brute force and include more sensors to avoid causing injury. Yet they can endlessly perform repetitive motions, relieving physical stress for human workers. "Today employers are challenged to find employees," says Radwin, who has a long track record of using his ergonomics research to assist industry partners. "Right now, there's a shortage of workers. It's natural to think of trying to substitute workers with robots. But we think that, in fact, we can gain productivity and some of the benefits that employers are seeking by creating a better match between existing employees and automation."

Collaborative robots could be the co-workers of the future. Here's one that could work in aviation manufacturing, along with industrial and systems engineering PhD student Anna Konstant. Photo: Joel Hallberg.



Efficient energy

Solid at room temperature and liquid at high temperatures, molten salts could be a game-changer for clean energy; not only can they store heat from the sun, but they also can cool next-generation nuclear reactors.

Salt, however, is corrosive—and we're pioneers in developing and testing materials that can withstand harsh conditions. We're also a go-to partner for industry. That's why the California-based Palo Alto Research Center came to our college to test a ceramic matrix composite material it's hoping will perform well in a concentrated solar power plant.

Grainger Institute for Engineering and Engineering Physics Associate Professor Adrien Couet and Grainger STAR Professor Kumar Sridharan performed the tests, which will help the company scale its manufacturing processes for the material. "UW-Madison is internationally recognized as a leader in testing materials for molten salt technologies in extreme environments due to the expertise of our researchers, our facilities and the high quality of our materials testing systems," says Couet.

He and Sridharan also are leading efforts to develop new materials and testing processes, study molten salt's effect on materials, and understand how irradiation and corrosion affects materials. "It's exciting to be making key contributions to move these energy technologies forward," Couet says.

New hope for treating tumors

Chimeric antigen receptor (CAR) T cells are biological assassins specifically engineered to attack cancer cells, particularly in patients with blood cancer. Thanks to a new way of manufacturing them, these white blood cells show promise in the fight against solid tumors stubbornly resistant to the body's immune system.

Instead of using the standard viral manufacturing approach, Biomedical Engineering Associate Professor Krishanu Saha and collaborators are genetically editing the cells with CRISPR technology. The molecular-level cut-and-paste method precisely inserts DNA into the T cells, where it encodes the chimeric antigen receptor and empowers T cells to target cancer cells. "It's a much cleaner way to put in our functionality," says Saha.

Next, the team is seeking FDA approval for an investigational new drug application needed to start a clinical trial for the treatment, exploring collaborations in the biomanufacturing industry, and pursuing even more research. "The challenge in my mind is to get it into the clinic," says Saha. "And we're working night and day on that."

Postdoctoral research associate Komal Chawla studies the architected vertically aligned carbon nanotube foam in the lab.

Joel Hallberg

A superior cranium cushion

A new lightweight foam made from atom-sized carbon cylinders could make a big impact in helmets designed to protect people from strong blows.

Created by Engineering Physics Assistant Professor Ramathasan Thevamaran and his students, the new material shows 18 times higher specific energy absorption than the foam currently used in U.S. military combat helmet liners. The material, made from carbon nanotubes 10 or fewer microns thick, arranged close to each other, is also stronger and stiffer, adding even more impact protection. The researchers are patenting their innovation through the Wisconsin Alumni Research Foundation.

Industry partner Team Wendy, a helmet manufacturer, is experimenting with the new material in a helmet liner prototype to study its performance in real-world scenarios. That collaboration is part of the UW-Madison PANTHER program; led by Bjorn Borgen Professor of Mechanical Engineering Christian Franck, it is an interdisciplinary initiative focused on solutions that better detect and prevent traumatic brain injuries.

For real materials advances, count computation in

We've discovered a new material that can improve the performance of electrodes in solid oxide fuel cells, which convert fossil fuels or hydrogen into electricity and are a promising tech option for using conventional and emerging fuels more efficiently.

That alone is a breakthrough. But equally important is that the team, led by Materials Science and Engineering scientist Ryan Jacobs and Harvey D. Spangler Professor Dane Morgan, used advanced quantum-mechanics-based computational methods to quickly identify candidate materials. In the lab alone, synthesizing and testing the sheer quantity of material options available might have taken decades. "We searched through thousands of materials computationally," says Jacobs.

That search yielded several potentially interesting materials, which the researchers narrowed further based on how easily they felt they would be able to make them in the lab.

"The calculations provide a much more targeted list to study experimentally than just using intuition," says Morgan. "This list reduces the number of possible systems from thousands to just tens, provides suggestions that might be new compared to those derived from our previous experience, and greatly increases the chance that an experiment will find a system that can meet performance targets."

Ultimately, the researchers landed on one material—a perovskite comprised of barium, iron, cobalt, zirconium and oxygen—which they synthesized and tested with collaborators at the U.S. Department of Energy's National Energy Technology Laboratory.

From isotopes to internships, partnership energizes growing Wisconsin company

A technician works with radioisotopes. Photo courtesy of NorthStar Medical Radioisotopes.

In late 2019, staff at Beloit, Wisconsin-based company NorthStar Medical Radioisotopes received a package filled with radioactive materials. It was a welcome delivery—one that sparked an ongoing research collaboration with UW-Madison that's accelerating the company's emergence into an increasingly important healthcare market.

NorthStar produces medical radioisotopes and radiopharmaceuticals for diagnostic imaging procedures and targeted disease treatments, including cancer. The company had been looking for a convenient way to analyze the composition of materials through a process called neutron activation analysis.

NorthStar found that capability in the UW-Madison Nuclear Reactor, less than an hour's drive away.

The facility is an exemplar of the Wisconsin Idea. Used in teaching engineering students and for a wide range of research applications, the reactor also provides a variety of services to both campus and off-campus users; in fact, over the reactor's 50-plus-year history, its staff have irradiated materials for researchers studying everything from historical artifacts to bovine waste.

In their first project with NorthStar, reactor staff exposed proprietary materials to neutrons, then returned the materials to the company for analysis.

"It was really beneficial to have a research reactor just down the road that could activate these materials for us, rather than having to ship samples across the country and rely on other labs to do the analysis," says Dan De Vries, who directs medical radioisotope product development at NorthStar and spearheaded the collaboration.

That first project grew into multiple projects underway with the UW reactor, as well as a laboratory-use contract with UW-Madison. The contract enables qualified NorthStar employees who complete radiation safety training to conduct radioisotope experiments in the UW-Madison Characterization Laboratory for Irradiated Materials.

"This agreement expanded the amount of laboratory space that NorthStar can take advantage of, and our employees now have the ability to work semi-independently in the UW-Madison lab to advance company projects," says De Vries. "This relationship with UW-Madison is enabling NorthStar to advance our progress, and it's very valuable for us to have this resource and reactor expertise close by."

One of NorthStar's more recent projects with UW-Madison has focused on copper-67, an emerging medical radioisotope. Radiopharmaceuticals using copper-67 could deliver targeted radiation that damages cancer cells' DNA and destroys them, while minimizing harm to normal cells. Clinical human trials with copper-67 are currently underway; however, the chronic short supply of copper-67 and other emerging radioisotopes presents a big challenge in advancing potential therapies. There are only a small number of facilities that can produce copper-67, and none that can yet produce it at commercial scale.

"For a lot of these up-and-coming radioisotopes, the supply has always been the challenge," says Jim Harvey, NorthStar's senior vice president and chief science officer. "You can't effectively get clinical trials going if the supply is not there to support the trial. Having this relationship with UW-Madison and the research reactor helps us move our projects forward more quickly. NorthStar's goal is to get some of these critical radioisotopes out on the market at the quantities that are needed, with a path forward to reach ever-increasing commercial scale, if the research and regulatory approvals are successful."

NorthStar also is working with staff at the UW cyclotron and the Department of Medical Physics to produce and experiment with radioisotopes.

In the future, the company may grow its relationship with UW-Madison into areas that include recruiting students for internships and graduates for full-time positions. "In this specialized industry, it can be challenging to find qualified candidates who have experience in this area, ranging from the engineering side to radiochemistry," DeVries says. "So we also see this relationship as a way to grow the pipeline of qualified candidates who might work at NorthStar in the future."

Rising STARs

A new scholarship program invests in students who bring a wider range of experiences and perspectives to engineering.

Merci Schneider is a first-year biomedical engineering student who plans to use her childhood experience with severe scoliosis to fuel her interest in devising healthcare solutions.

She's gotten an early taste of that work through the college's first-year interdisciplinary design practicum, 3D printing prototypes of a device to help a local community member with Dupuytren's disease, a condition that impairs hand function.

"I love what we're doing," says Schneider, pictured above.

It's an experience she wouldn't be getting without the Strategic Targeted Achievement Recognition (STAR) Scholarship, which made it possible for her to come to UW-Madison from her home city of Denver.

"Honestly, it was the reason I could come to this school," she says. "I just felt so honored to get it, but also I wanted to go to a school that really wanted me. I felt like they valued me and saw me for my worth."

And that's precisely the point behind the STAR Scholarship Program: investing in talented students from across the country who will bring a diverse range of identities, perspectives and lived experiences to the field of engineering. The program, which doubles donors' impact via matching funds from The Grainger Foundation, annually supports around 50 students from groups traditionally underrepresented in STEM fields, including a range of racial and gender identities, first-generation college students and those from rural areas.

While STAR Scholars take classes, join student organizations and do plenty more alongside the rest of their college peers, they also form their own networks within the program. They gather for special study nights, for example, at the college's Undergraduate Learning Center, as well as in smaller cohorts based on housing assignments and shared coursework. Scholars can also access free one-on-one tutoring and holistic guidance from program advisor Keeley Meier on top of regular academic advising services.

The idea is to instill a strong sense of both community and support, particularly as students navigate the transition to college.

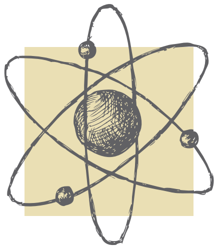
Sophomore Alexis Garbisch meets with Meier every other week. She says those sessions have helped her with both immediate logistical challenges, like fitting volunteer work with the campus Amnesty International student org into her schedule, and big-picture questions—namely, connecting her chemical engineering major to her long-term interest in pursuing research into the treatment of neurodegenerative diseases and neurodevelopmental disorders.

"My path in chemical engineering, and in engineering, is a little bit less conventional," says Garbisch, who's from Grafton, Wisconsin. "Keeley's been a huge help in allowing me to keep my passion and motivation."

Each semester, the college also offers STAR Scholars several chances to visit local companies, such as Madison-based construction firm Findorff, where in fall 2022 president and CEO Jim Yehle led the students on a tour before they visited a job site and talked with working engineers. Students also get an early sampling of the resources at the college's makerspace through special programming, plus workshops to support accessing research and professional opportunities.

"I see these students wanting to tackle those big problems that our country and world are facing," says Meier. "These are people who are going to have those innovative thoughts and ideas that make change in ways that we don't know yet is possible."

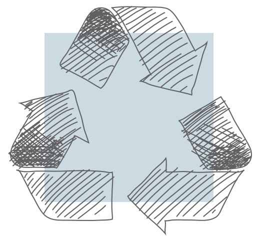
There are still matching funds available. To learn how to support a STAR Scholar, contact Kyle Buchmann, senior managing director of development, at kyle.buchmann@supportuw.org.



Nuclear reactions

"We can teach our students to be great nuclear engineers," says Grainger Institute for Engineering and Engineering Physics Associate Professor Adrien Couet. "We need to also teach them the sociological aspects of nuclear energy and build that understanding into their educational experience."

That's what motivated him, Assistant Professor Stephanie Diem and Grainger Professor Paul Wilson to create NE 231: *Introduction to Nuclear Engineering*. In the class, students collaborate on a challenge involving the UW Nuclear Reactor (for example, a submersible detector that measures the intensity of the operating reactor's blue light and correlates it with the reactor's power level). They meet working nuclear engineers and learn about the variety of career paths available to them as nuclear engineers. They study topics that range from energy markets and medical radioisotopes production to nuclear fusion and ethics in nuclear engineering. And they also explore controversies related to nuclear energy, such as U.S. uranium mining and its impact on Native Americans. "It's very important for a nuclear engineering education to address the reality that there are challenges related to community acceptance of nuclear energy, and students need to understand that," says Couet. "However, this issue is not often talked about in nuclear engineering curricula. To my knowledge, this introduction to nuclear engineering course is the only one of its kind that really covers these important areas."



Plastics class, take two

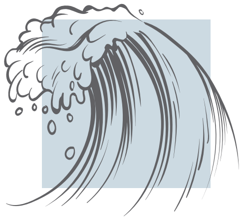
Undergraduates and graduate students in CBE 562: *Technology for Plastic Recycling*, might be surprised to learn that most plastic items can't be recycled—despite the triple arrow symbol that indicates otherwise. Furthermore, less than 10% of all plastic produced since the 1950s has actually been reused.

Created by George Huber, the Richard L. Antoine Professor in chemical and biological engineering, the new course opens students' eyes to the recycling industry's challenges and opportunities and enables them to view the industry from a chemical engineer's perspective.

In the course, students study current recycling techniques and explore a wide array of potential chemical solutions for recovering and reusing plastic polymers more sustainably. They learn not only from Huber, who's pioneered chemical plastic recycling methods, but also from experts from academia and industry in areas that include polymers, plastic packaging, performance plastics, upcycling waste materials, and mechanical recycling.

At nearly 1,500 students, our fall 2022 incoming class was one of the largest in recent memory—bringing our total undergraduate enrollment to approximately 4,900 engineers. This rise in enrollment is part of the college's ambitious plan to grow. We need to admit and educate a larger and more diverse student body, graduate more excellent engineers to help meet workforce demand, and accelerate advances to help solve urgent challenges in areas that include clean energy, human and planetary health, manufacturing, information security, and more.

Photo: Joel Hallberg



There's an undercurrent of excitement in our renovated fluid mechanics lab

Located in Engineering Hall, the Kenneth R. & Ruth M. Wright Fluid Mechanics and Water Resources Teaching Collaboratory is a combined classroom and laboratory in which civil and environmental engineering undergraduate students can learn how physics drive interactions in fluids.

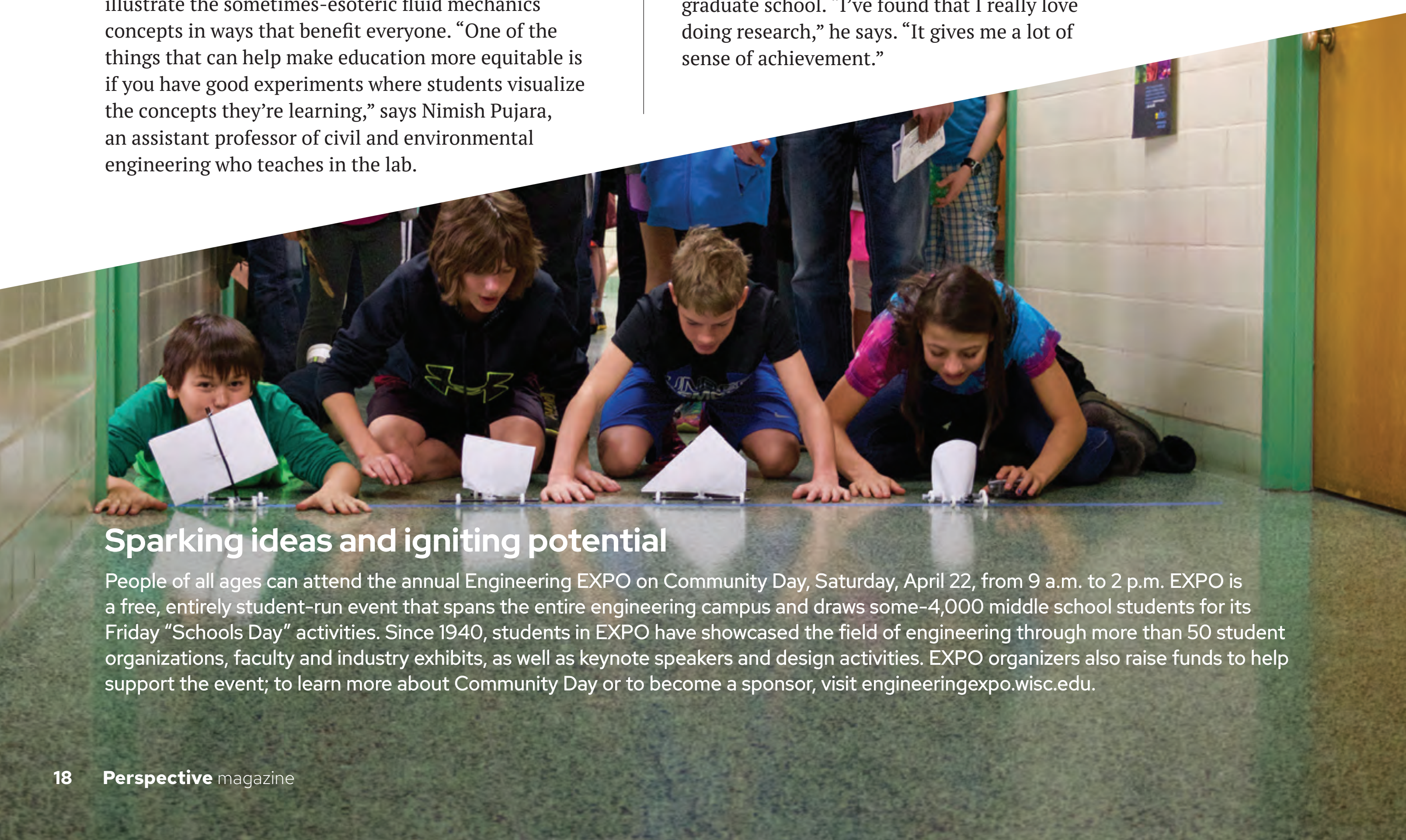
Recent updates to the lab added an array of instruments, including a wavemaker and a rig that enables instructors to demonstrate hydraulic jumps, which happen when fast-moving water suddenly encounters slower-moving water. The lab's safe, state-of-the-art LED lights allow undergraduate students to conduct particle image velocimetry experiments, which help them understand how flow speed varies in space by tracking small particles within the flow. New flow meters, thanks to alumnus David Benett (BSCEE '78, MSCEE '80), enable students to measure flow they can't directly see—for example, within a building's pipes.

All of this technology will help instructors illustrate the sometimes-esoteric fluid mechanics concepts in ways that benefit everyone. "One of the things that can help make education more equitable is if you have good experiments where students visualize the concepts they're learning," says Nimish Pujara, an assistant professor of civil and environmental engineering who teaches in the lab.

In research, undergrads encouraged

There are lots of opportunities across our campus to participate in undergraduate research—and that's a big advantage for students thinking about graduate education or a career in research and development. In Chu Ma's lab, for example, undergrads are key contributors to her research in acoustic sensing and functional materials. "Undergraduate students have a role in every project in my lab, and I really appreciate their help," says Ma, an assistant professor of electrical and computer engineering.

When Xiaohong Zhang began working in Ma's lab in fall 2021, Ma and her graduate students took extra time to introduce him to the equipment and show him how to run computer simulations or understand theory. Now he's helping to develop non-line-of-sight acoustic imaging, a sensing technology that can see around corners. He feels like a true, contributing member of the lab and will pursue a career in academia, starting with similar research in graduate school. "I've found that I really love doing research," he says. "It gives me a lot of sense of achievement."



Sparking ideas and igniting potential

People of all ages can attend the annual Engineering EXPO on Community Day, Saturday, April 22, from 9 a.m. to 2 p.m. EXPO is a free, entirely student-run event that spans the entire engineering campus and draws some-4,000 middle school students for its Friday "Schools Day" activities. Since 1940, students in EXPO have showcased the field of engineering through more than 50 student organizations, faculty and industry exhibits, as well as keynote speakers and design activities. EXPO organizers also raise funds to help support the event; to learn more about Community Day or to become a sponsor, visit engineeringexpo.wisc.edu.

When capstone throws them a curveball, seniors knock it out of the park

Overcoming roadblocks, a team of IE seniors developed recommendations for how GE Healthcare could revamp a product line. Pictured: seniors Jasmine Brewer (left) and Josie Beres and E-Business Chair Professor Raj Veeramani at GE Healthcare's manufacturing facility in Madison. Photo: Tom Ziemer.

Less than a month away from the conclusion of their senior design project for their capstone course, ISyE 450: *Industrial Engineering Design II*, industrial engineering students Josie Beres, Conner Boldt, Jasmine Brewer and Will Gallagher uncovered a considerable problem: Their analysis showed their client's desired goal for their project wasn't actually feasible. "Our team was kind of panicked," says Brewer, whose group was tasked with reducing manufacturing lead times by implementing generic configurations for anesthesia delivery systems at GE Healthcare.

The students regrouped, plotted a path forward, and found a way to still impress their client.

GE Healthcare had asked the team to recommend a production approach that would allow the company to move away from making fully customized products for specific customer orders to producing 10 generic configurations that could be rapidly adapted as needed to meet 80% of customer demand. But after analyzing the relevant data on GE Healthcare's high variety of anesthesia system configurations, the students discovered that scenario wasn't possible.

Undeterred, the students sought guidance from E-Business Chair Professor Raj Veeramani, longtime lead instructor for the senior design course. He helped them consider design changes that could consolidate the number of configurations and optimize the manufacturing line workflow to achieve a significant reduction in lead time for demand fulfillment. The foursome pushed forward with their project, sitting down with manufacturing line workers to gain a better understanding of the build process for anesthesia systems and the feasibility and potential impact of their design simplification ideas.

In the end, they presented a set of recommendations that would allow for any customization to happen near the end of the manufacturing line, with 11 generic configurations covering 70% of customer demand. They also provided GE Healthcare with their data analysis model, allowing the company to adjust parameters to reflect its priorities. As a result, one of GE Healthcare's regional sales teams has already reduced the number of configurations it's offering.

Mark Brown, senior lean manufacturing leader at GE Healthcare, says the project has also spurred the company to consider changes at regional distribution centers to accommodate region-specific configurations, as well as how it should devise future designs to better align with customer needs. "Their investigation allowed us to really question what we were doing from a customer supply standpoint and why we had so many configurations to start with," says Brown. "What we expected to find, we didn't find. And so they had to pivot and dig deeper into the data. It maybe didn't end with the conclusion that we expected, but probably has a bigger impact to the organization than what we expected."

The experience was just as beneficial for the students. "I feel like that's the best way to learn: getting that actual, tangible experience," says Beres. "Because, yes, you can learn all the concepts in school, but actually being able to apply them and see them in action in the manufacturing line or just a company in general was a great experience."

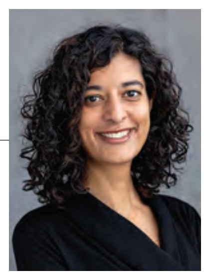
Quality, assured

Our alumni are among our greatest ambassadors—and in their careers, they've shown time and again how their College of Engineering education prepared them to be thought leaders, risk takers and game changers. In fall 2022, we honored these 14 alumni for their exceptional accomplishments and distinguished service to their fields, to our profession, and to society.

MERGER MANAGER

Kevin Yttre, BSChE '03 • President, Grace Matthews

As president and managing director of Grace Matthews, a global merger and acquisition advisory firm, Yttre leads execution of buy-side, sell-side and complex corporate carve-outs for companies in the specialty chemicals and materials industry. In short, he advises companies that want to sell, bring on additional equity partners, or buy another company. Grace Matthews advises net transactions of approximately $1 billion in enterprise value annually, and Yttre calls it an awesome responsibility to guide someone through their transaction. He also has held a number of management and engineering positions at chemicals businesses in the United States and the Netherlands.



HEAD STARTER

Riki Banerjee, BSEE '00
Vice president, R&D, Synchron

Banerjee has spent her career helping to develop healthcare technology solutions for patients worldwide, and to blaze commercialization pathways to benefit people with neurological diseases. At Medtronic Neuromodulation, her team focused on neurotechnologies for people with Parkinson's Disease, chronic pain, tremor disorders, gastric problems, and incontinence. Currently, she and her teams are advancing a brain-computer interface that will enable severely paralyzed people to communicate using their brain signals.

VALUE ADDER

Jacob Brunsberg, BSMS&E '09
President and CEO, Sigma Additive Solutions

Brunsberg's company focuses on the scale and acceleration of additive manufacturing by setting the standard for quality in the global 3D printing industry. He began his career in product development and sales for powder metallurgy and coatings, but quickly realized the potential of additive manufacturing. Today, he's on the leading edge of innovations that move additive manufacturing technologies forward. Already, these technologies are shaping the future of powertrains, mobility structures, electrification, space travel, medical implants and much more—and Brunsberg envisions advanced new products that can be 3D-printed on demand, and produced by a wider range of manufacturers.

BEER BARON

Zak Koga, BSCEE '08 • Co-founder, Karben4 Brewing

Koga balanced rigorous work as project manager with construction firm Findorff while also working with his brother, Ryan, and friend Alex Evans to co-found Karben4 Brewing in Madison. A decade later, the company has expanded its footprint across Wisconsin and comprises manufacturing, marketing and retail operations. Not only does the trio influence the beer world and social culture through its approach to beverages and events, the partners also focus heavily on giving back to their community.

CULTURE CONNECTOR

Michelle Ranavat, BSIE '03
Founder and CEO, RANAVAT

Early in her career in the financial and sales industries, Ranavat made a big shift. Fueled by a desire to represent Indian culture and beauty practices in mainstream retail, and to connect others with their culture, she founded RANAVAT, a global skincare line inspired by Indian beauty rituals. Five years later, her award-winning line is available at top global retailers, and she's on fashion magazine *Vogue's* list of the "Top 50 Influential Global Indians." She invests a portion of her company's proceeds in the Desai Foundation, a nonprofit organization in India that offers community programs to empower women and children to elevate their health and livelihood.

BEYOND REASONER

Saigopal Nelaturi, MSME '10, PhDME '11
Director of software research, Carbon

A pioneer in developing computational design tools, Nelaturi is recognized as a leader in the next generation of extreme innovators. His work in automated reasoning enables computers and people to participate as almost equal partners in the design thinking process, with each leveraging their distinct strengths to produce better engineering designs together. Previously, as research director for 3D technologies at the Palo Alto Research Center (PARC), he founded and grew a new research area that developed next-generation representation, modeling and analysis tools to support automation in systems engineering, design and fabrication.

HEALTH CHECKER

Marie Lotto, BSBME '02, MSBME '03

Vice president for business development, Hologic

For more than two decades, Lotto has played a major role in her companies' ability to deliver innovative health products and medical technologies to doctors and clinics around the world. With Hologic, a global women's health medical device and diagnostics company, she has worked in areas that include strategy, marketing, operational excellence and new product development, and she has collaborated across the organization to identify the best approach for integrating acquisitions into Hologic quickly and seamlessly.

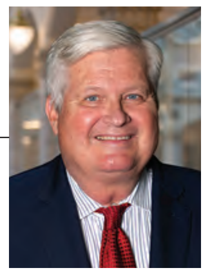
ELECTRONICS ENABLER

David Hemker, BSChE '84

Senior vice president and CTO (retired), Lam Research Corporation

These days, we'd struggle to live without any of our electronic devices, which contain tiny, advanced microchips that give them their many functionalities. Hemker has spent much of his career driving semiconductor breakthroughs—and thanks to his long-range vision and innovation in semiconductor processing solutions, the world's leading semiconductor companies have been able to manufacture generations of increasingly smaller, more advanced microchips.








CIVIL SERVANT

John Kissinger, MSCEE '83

President and CEO, GRAEF

If you ask Kissinger to summarize the impact of his work, he'll talk about its benefits for society. That's also his mission in his role as president and CEO of GRAEF, an international engineering, planning and design firm headquartered in Milwaukee. Company clients have ranged from communities to universities and corporations to cultural organizations, and Kissinger is proud to have led projects that include the Wisconsin Center in Milwaukee, the McCormick Place West addition in Chicago, the Lambeau Field redevelopment in Green Bay, and the Milwaukee Art Museum addition, which *Time* magazine named the No. 1 design of 2001.

TARGET AUDIENCE

John Mulligan, BSECE '88

COO, Target Corp.

Many Americans turn to Target to purchase everything from groceries and household needs to clothing and furniture. It's no wonder: Three quarters of us live 10 miles or less from the company's 1,800 stores. Mulligan has continuously improved Target's stores, same-day delivery service, and supply chain—so whether you are shopping online, in store, or a mix of both, you have a seamless and inspiring experience, every time. Mulligan joined Target in 1996 and worked primarily on the company's financial side for nearly 20 years. He also served briefly as its interim president and CEO before being promoted to his current position.

WELL VERSED

Bruce Dale, BSEM '79, MSEM '80

Chief engineer (retired), ExxonMobil

In a career with ExxonMobil that spanned nearly 30 years, Dale worked with company affiliates, industry partners and governments in field operations worldwide, and he directed research collaborations with industry, universities, national laboratories and research institutes. His technical impact is evident in dozens of technologies rapidly implemented for safe, efficient and environmentally responsible well drilling, completion and production.

PRODUCT PLACEMENT

Ernest Nicolas, MBA '02, MSMSE '05

Chief supply chain officer, HP

In a career spanning more than a quarter-century, Nicolas has contributed his talents and passion to industries ranging from automotive to automation to personal digital technology. In the process, he's ensured that hundreds of millions of products fly through logistical hoops and ultimately land in customers' hands—or on their loading docks—on time. At HP, Nicolas also drives the social and environmental sustainability efforts tied to the company's reputation and business growth.

TALENT SCOUT

Marion Gilbert Wells, BSMetE '81

Founder and managing partner, Human Asset Management

With her passion for materials engineering and strong desire to develop the field's future workforce, Wells truly is a champion for engineering—and in particular, for convincing people from underrepresented groups that they can contribute to and succeed in engineering. She's an ideal role model: She began her career as a traditional metallurgical engineer and progressed through technical and sales positions before ultimately founding her own company, Human Asset Management. Now her firm provides talent-development services to numerous small and midsize manufacturers—and Wells herself charges industry leaders to play a role in addressing the current and future shortage of engineers.

COMFORT ZONES

James Braun, MSME '80, PhDME '88

Herrick Professor of Engineering, Purdue University

Braun has devoted his teaching and research to designing, controlling and monitoring thermal systems. That research has applications in quite a few areas—most notably, in how buildings function most effectively and efficiently to keep their occupants comfortable. He's mentored more than 100 graduate students and postdoctoral researchers and also directs the Center for High Performance Buildings. Itself a testbed, the building is full of innovative technologies that he, his graduate students and other collaborators use to study and improve building performance.

Engineer reinvents himself

STEM ambassador excites kids worldwide about science

When Jay Flores isn't climbing and leaping through obstacle courses to train for NBC's *American Ninja Warrior* (he made it to the semifinals in 2022), or traveling internationally to deliver energizing keynotes, he spends a lot of time in his kitchen cooking up fun, interactive science experiments to teach kids about STEM.

He's also a member of the Mystery Science Team through Discovery Education, a digital learning platform that reaches K-12 students in tens of thousands of classrooms across the United States. More than a million students see Flores in Mystery Science videos, where he fosters curiosity by answering questions like "How were LEGO bricks invented?" and "Why don't people fall out of roller coasters when they go upside down?"

Inspiring youth to excel in STEM and become tomorrow's innovators isn't just a day job for Flores. Rather, he wears his STEM ambassador hat pretty much 24/7.

"I focus on leading with the passion behind STEM, finding the real-life examples that excite kids and then showcasing the science and math behind it," he says. "By nurturing kids' sense of wonder, I hope to inspire them to explore STEM and go on to use their knowledge to do cool things and make a positive impact in the world."

A Milwaukee native, Flores attended UW-Madison on a full scholarship as a Rockwell Scholar. He earned a bachelor's degree in mechanical engineering in 2021, along with certificates (minors) in international engineering and in leadership.

As a student, he became interested in STEM outreach, particularly as a member of the Society of Hispanic Professional Engineers (SHPE) student chapter, in which he participated in the group's K-12 STEM outreach efforts.

After graduation, Flores began his career at Rockwell, first in the company's global sales training program and later in a sales position based in south Florida. At the same time, he continued to bring his inspiring, inclusive message about the power of STEM to after-school programs and events.

In 2014, he gave a well received TEDx talk, "Growing with S.T.E.M."—and then everything changed. Flores happened to be staffing Rockwell's booth at the FIRST Robotics World Championship when he struck up a conversation with a Rockwell vice president who had seen the TEDx talk. "She said, 'You're like our STEM ambassador,'" Flores recalls. "And it occurred to us both that this kind of role could be good for the company and the industry overall by helping to strengthen and diversify the STEM workforce pipeline for the future."

That conversation set into motion a new Rockwell position—global STEM ambassador—a job specifically designed to leverage Flores's unique skills and passion. In the new role, Flores developed the global strategy for Rockwell's investments in STEM outreach to help increase diversity in technical fields. He focused on countries where Rockwell operates, such as Australia, Brazil, Mexico and Singapore, where he led STEM events—until the COVID-19 pandemic thrust virtually the whole world into lockdown.

Unable to travel, Flores realized there was an opportunity to support youth who were now attending school remotely and might lack access to enriching STEM activities. Within his own kitchen, Flores created a STEM education series called *It's Not Magic, It's Science!* The series consists of science experiments disguised as magic tricks to increase excitement and awareness in STEM.

As a charismatic presenter with a talent for video, it was natural for Flores to create short, entertaining videos for each "magic trick," which he posted on social media platforms (check him out at @JayFloresInspires on Instagram, TikTok and YouTube). Flores also created an at-home STEM kit that allows kids to perform experiments with low-cost or on-hand items. "After I spark the students' interest with the trick, I explain the science behind it in an engaging way and invite them to explore further," he says.

It's Not Magic, It's Science! took off, eventually racking up millions of views. At that point, Flores felt ready to leave his job at Rockwell—but not his calling as a STEM ambassador. In January 2021, he formed Invent The Change, a company with a mission to change the world by inspiring young minds to keep doing cool things in STEM.

Through the company, he collaborates with other STEM organizations to share best practices from *It's Not Magic, It's Science!* For example, he partnered with SHPE to host Noches de Ciencias (science nights) to bring the power of math and science into Hispanic households. He also hosts the PBS innovation show *Make48* and also works with FIRST, a global nonprofit that advances youth STEM education, partnering with the organization on its LEGO League and Robotics Competition events.

"I want every kid to have the opportunity to work on problems that interest them and to invent the change that they want to see in the world," Flores says. "And to unlock their potential and empower kids with STEM, we need to inspire more young kids from diverse backgrounds to pursue math and science learning opportunities and also support them to keep them engaged in STEM as they get older."

Jay Flores delivers a live performance of *It's Not Magic, It's Science!* at the Invention Convention U.S. Nationals in June 2022. Submitted photos.

College of Engineering
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1415 Engineering Drive, Madison, WI 53706

Honoring our past; engineering our future

Over the course of nearly 175 years of its history, the university has constructed, renovated, added onto, and demolished hundreds of facilities across its 936-acre campus. This dynamic environment of built and open spaces enables our mission and provides places that allow us to learn, discover, connect and serve.

Over the next five years, we'll see lots of earth-moving and construction: In 2023, we'll begin a $73 million state-funded project to upgrade the 100-plus-year-old infrastructure that snakes throughout much of our engineering campus. This project will provide us with updated thermal, electrical and civil utilities, along with gas and communications systems, and it will prepare us to construct a new engineering building to replace 1410 Engineering Drive.

Máquina became an icon, and designer-emeritus Phil Biebl included it on a whole range of products. It was even front and center on our former logo.

Also in 2023, we will retire Máquina. Designed by UW-Madison alumnus William Conrad Severson along with gifts from members of his family, the 18-foot-tall stainless-steel sculpture—popularly known as "the engineering fountain"—is nearly three decades old. Now, quite simply, Máquina has seen better days. When it was installed in 1994, it was meant to evoke the dynamic nature of engineering. On our ever-evolving campus, its departure will again do just that.