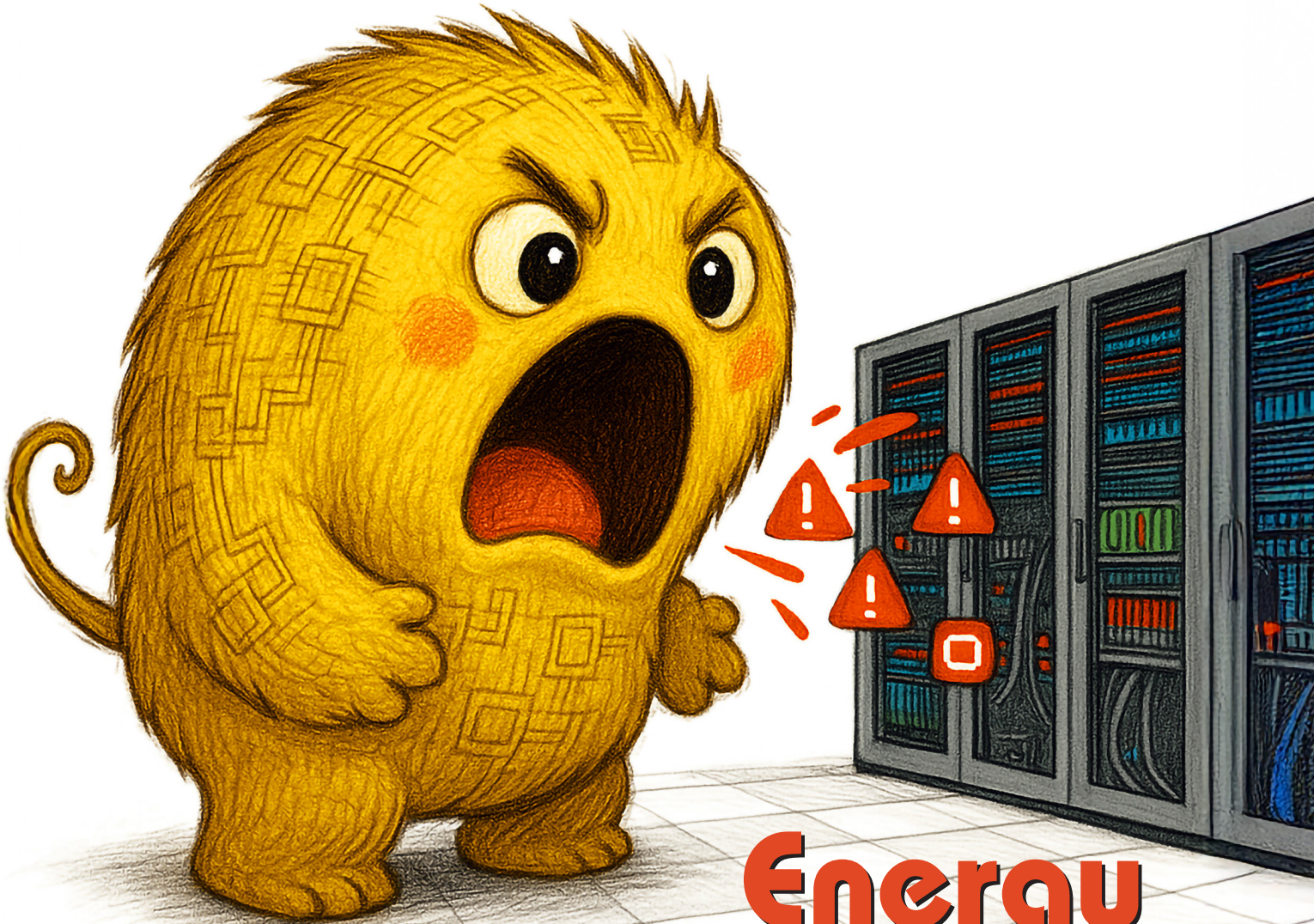


P R I S M

WINTER 2025

CABLES CURRICULUM

COLLABO-GLEANING



Energy Monster

Can AI's formidable
power appetite
be tamed?



Reversing Extinction Through Genetic Engineering

UT Dallas bioengineering alumnus Ben Collerton MS'23 is making what seems like science fiction a reality.

As a genome engineer, Collerton is using biotechnology to bring the dodo bird back to life. He now utilizes genetic editing tools that he studied in a Jonsson School lab, such as CRISPR-Cas9, to modify the phenotypes, or genetic characteristics, of a species' DNA.

Scientists were able to sequence DNA extracted from 500-year-old skeletal remains of a dodo bird. With a complete genetic blueprint in hand, the avian team at Colossal Biosciences, including Collerton, has set out to revive the species from extinction.



THE UNIVERSITY OF TEXAS AT DALLAS
ERIK JONSSON SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

More at: <https://utd.link/3ii>



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AI, SOLVE THYSELF

To address AI's immense energy needs, researchers turn to...AI.

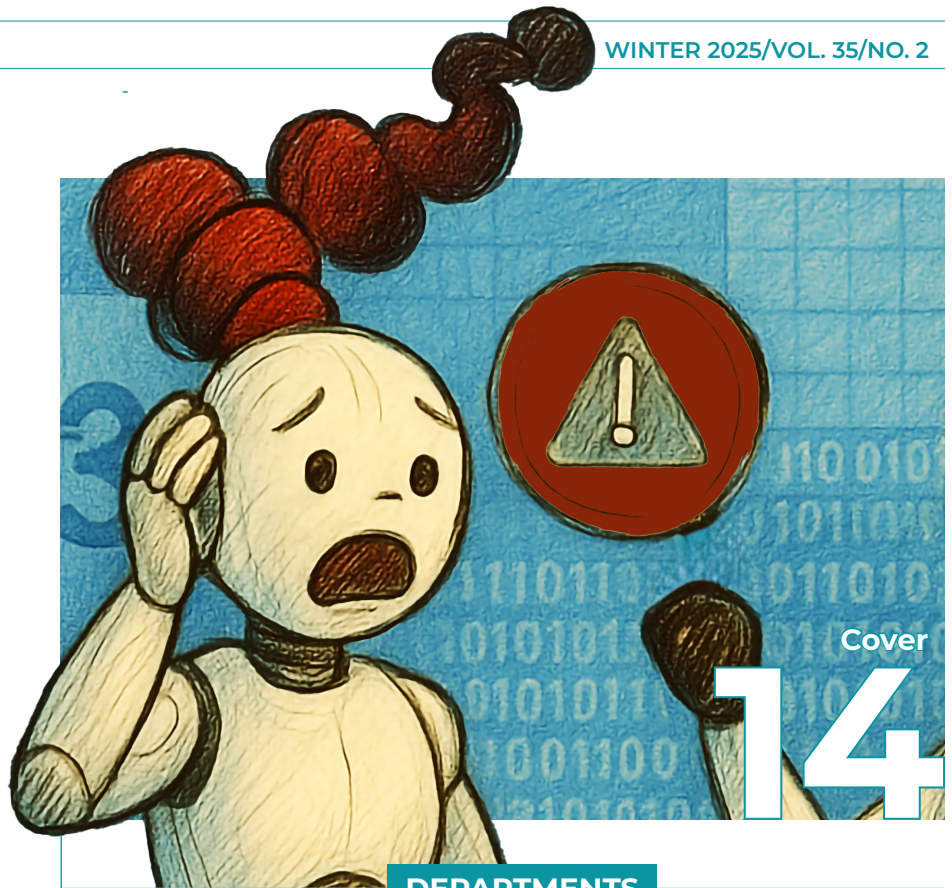
By Thomas K. Grose

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THE DEEP WEB

A new curriculum takes students below the surface of global connectivity.

By Tom Gibson, PE



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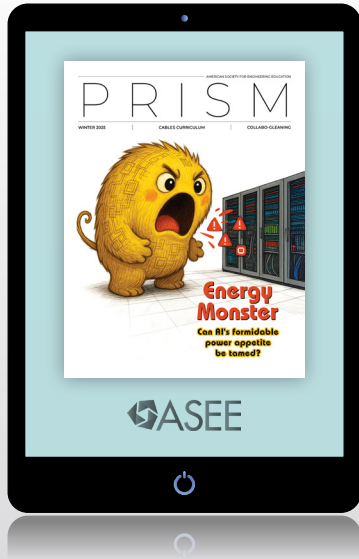
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THIS WAS NOT WRITTEN WITH AI*



Member
Exclusive

SCAN NOW
TO UNLOCK
YOUR
DIGITAL
COPY OF
THE LATEST
PRISM



In just a few years, generative artificial intelligence (AI) has evolved from a novelty to an almost-inescapable part of daily life, as it becomes embedded in an increasing number of platforms.

Prism doesn't need to cover the arguments for and against the technology—you can find those in a multitude of other places. However, knowing that engineers are problem solvers, we wanted to investigate how researchers are working to mitigate a major downside: the enormous amount of energy that generative AI requires, and the resulting price increases. Chief Correspondent Tom Grose has the story in our cover feature.

In our second feature, freelance writer and professional engineer Tom Gibson takes us on a fascinating journey under the seas, examining the infrastructure that makes our digital world—including AI—possible. Yes, physical cables are still necessary, tying continents together to ensure the constant, invisible connections to people and information that we've come to expect. A new interdisciplinary program at the University of California, Berkeley, is helping to grow the workforce needed for this undersea cables industry.

That's not the only industry putting out the "help wanted" sign. Despite the rise of AI and fears about it taking our jobs, Georgetown University experts are predicting an upcoming skills shortage for workers with postsecondary degrees. Engineering is among the professions that will feel the crunch, needing more than 200,000 additional people by 2032. Learn about the predictions and the underlying causes in *Databytes*.

As we head into the holiday season, don't miss the review of *The Art of Gathering* submitted by a reader to our On My Shelf page. And check out the great work the Society has done over the last year in our Annual Report, in the ASEE Today section.

Also in that section, interim executive director Ashok Agrawal writes his last letter to members as he transitions out and our new executive director Brian Novoselich takes the helm in January. All of us at ASEE are grateful for Ashok's wise and steady guidance over the last 10 months and are excited to welcome Brian, an experienced leader and longtime ASEE member. We also extend our condolences to everyone who knew another past interim executive director—and former *Prism* Editorial Advisory Board chair—Lyle Feisel. Read about his many years of service to the Society and some of "Lyle's Laws" in ASEE Today.

However you gather, we wish you warm and bright holidays.

(*Despite the use of em dashes, my favorite punctuation mark.)

EVA MILLER
e.miller@asee.org

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RETHINKING PHD TRAINING

As engineering educators, we share a common goal: to prepare students for meaningful and impactful careers. Yet there is a widespread feeling among potential employers that the traditional PhD model—largely unchanged since the years after World War II—no longer fits the world that our graduates are entering.

Nearly nine in ten engineering doctorates today build their careers outside academia—in corporations, national labs, start-ups, and government agencies. Their technical preparation is strong. However, most of these roles demand additional skills: collaboration across sectors, communication, leadership, and the ability to translate research into practical solutions. Unfortunately, our doctoral programs too often continue to train for the academic path alone.

The need for reform has been well documented, from the National Academies' early calls for change to the more recent recognition that innovation itself is reshaping research. Encouragingly, momentum is growing.

This past August, 77 leaders representing academic institutions, corporations, national laboratories, federal funding agencies, professional societies—including ASEE—and nonprofit organizations met at the National Academies in Washington, DC, for the National Workshop on the Formation of Industry-University Partnerships for Doctoral Training. It was the fourth such workshop since 2020 supported by NSF's Innovation in Graduate Education program, and the discussions reflected both realism and resolve.

Participants identified persistent barriers that limit collaboration, such as misaligned research timelines, complex intellectual property agreements, and difficult-to-realize financial models for sustaining long-term partnerships. Through unwavering focus on these challenges, nine actionable directions emerged:

- involve graduate students in shaping their programs
- increase flexibility in project start dates
- improve the process for forming partnerships
- streamline coursework and reexamine milestones to shorten PhD timelines
- revise faculty reward structures to recognize collaboration and applied impact
- develop standardized national templates for agreements
- establish upfront alignment between academic and industry researchers
- build durable, institution-to-institution partnerships with industry
- form consortia to address STEM graduate education collectively

Some of these action items can be adopted by universities individually; others will require cross-sector coordination as well as support and leadership from funding agencies.

At Lehigh University, we have piloted one such approach—the Pasteur Partners PhD (P3) model—which combines “use-inspired” research with structured university-industry mentorship. Student response has been overwhelmingly positive, underscoring the potential

of partnership-based doctoral training. But like similar efforts elsewhere, P3 also revealed systemic challenges to broader implementation.

The lessons learned from the recent workshop are now published in its Outcomes report (see go.lehigh.edu/phdworkshop). They constitute a road map to address these challenges with specific recommendations for academia, industry, government, and doctoral students.

Our call to the engineering education community is straightforward: Engage in this conversation and help shape what comes next, especially in times when public confidence in higher education is waning. Pilot new partnership-based PhD pathways. Encourage graduate students to act as co-designers of their training. Work through professional societies like ASEE and with other stakeholders to share models, align incentives, and advocate for a more connected national framework.

Doctoral education has always evolved to meet the needs of its time. This is our opportunity—and responsibility—to guide its next transformation, ensuring that the PhD remains both rigorous and relevant in an era of rapid discovery and innovation.

HIMANSHU JAIN

*T.L. Diamond Distinguished Chair in Engineering and Applied Science
Lehigh University*

NATHAN URBAN

*Provost and Senior Vice President for Academic Affairs
Lehigh University*

Editor's note: For more from Jain and Urban on this topic, see “Change of Plans,” InSights, Summer 2024 Prism.

INSIGHTS BY HIMANSHU JAIN, NATHAN URBAN, AND GARY CALABRESSE

CHANGE OF PLANS

It's time to rethink the research-focused PhD.

THE STEM PhD was a product of its time, a career path that has long been valued for its rigorous training and the intellectual freedom it provides. But today's graduate students face a different world. They are entering a workforce that values collaboration, communication, and the ability to translate research into practical solutions. The traditional PhD model, largely unchanged since the years after World War II, no longer fits the world that our graduates are entering.

At Lehigh University, we have piloted one such approach—the Pasteur Partners PhD (P3) model—which combines “use-inspired” research with structured university-industry mentorship. Student response has been overwhelmingly positive, underscoring the potential of partnership-based doctoral training. But like similar efforts elsewhere, P3 also revealed systemic challenges to broader implementation.

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WE ENCOURAGE OUR FELLOW ENGINEERING EDUCATORS TO JOIN WITH US IN REIMAGINING GRADUATE EDUCATION.

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MEDICAL TECHNOLOGY

LIVING COLOR

X-rays are generated when a stream of high-energy electrons batters a metal target. Gathered into a beam and fired at a material such as the human body, x-rays are absorbed by the densest tissues, such as bone, but pass through less dense tissues, like those that comprise organs. A detector records the pattern and creates a black-and-white image for use in medical diagnosis. The basic concept hasn't changed much since 1895, when German physicist Wilhelm Röntgen accidentally discovered x-rays while experimenting with cathode ray tubes. Soon, though, thanks to engineers and materials scientists at Sandia National Laboratories, x-ray technology may get a major update. The changes will not only improve the resolution and clarity of images but also enable color. To sharpen an x-ray image, the researchers reduced the size of the x-ray focal point by designing an anode, or target, with a pattern of metal dots collectively smaller than the beam. The team used different metals for each dot, including tungsten, molybdenum, gold, and silver, because each metal emits a different color of x-ray light. An energy-discriminating detector allowed the researchers to characterize the elements of the object being x-rayed. The colorized images offer "revolutionary" clarity and better reveal an object's composition, the researchers say. They expect their new and improved x-rays will enhance medical diagnostics as well as have broader applications, including in airport security screening and advanced manufacturing.

CHEMICAL ENGINEERING

EAVESDROPPING ON BATTERIES

Over the years, batteries have become much more efficient and long-lasting, but eventually they degrade. That can cause them to lose power, fail, or even burst into flames. Researchers have known that a battery's degradation processes emit faint sounds, but didn't know how to interpret the sounds or separate them from background noise. Now a team of MIT chemical engineers has devised a detailed analysis of sounds emitted from lithium-ion batteries and can match those acoustic patterns with the internal battery processes that cause wear and tear—namely, gas generation and fracturing. The researchers performed electrochemical testing while they recorded the acoustic emissions, then used signal processing techniques to correlate the electrical and acoustic data. They also encoded the frequency and duration of each acoustic signal, which provided distinct signatures easily extracted from background noise. Their cost-effective method enables investigation without destroying the batteries. In a related study with researchers at Oak Ridge National Laboratory, the MIT team used acoustic emissions for early detection of dangerous thermal runaway, the chain reaction that can cause a battery to ignite. With this new knowledge, the team hopes to develop an inexpensive passive monitoring system that could track the health of batteries used for running electric vehicles or storing grid-scale electricity and forecast failures well before they happen.



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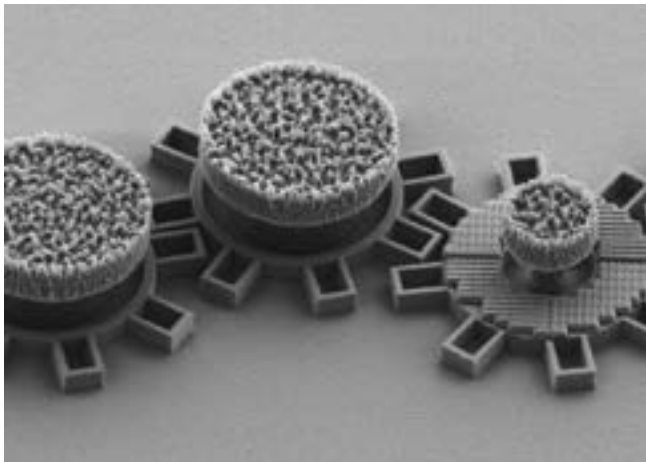
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ROADWAY CONSTRUCTION

PREEMPTING POTHOLES

Asphalt is the world's most ubiquitous road-paving material because it's cheap, robust, and easy to repair—and repair is needed constantly. Broiling or freezing temperatures, rain or snow, road salt or heavy traffic can cause asphalt to crack and allow water to seep in. The result is potholes. Often perceived as just nuisances, potholes cost an estimated \$3 billion in annual repair in the US and cause vehicle damage, accidents, and pedestrian injuries. Solving the problem isn't simple, however. Blacktop roads are actually constructed like multilayer sandwiches. Typically, there's a base layer of compacted earth, a subbase of rubble, a covered base layer of asphalt, and finally a top layer of water-resistant asphalt. To monitor how well a road is faring below the surface, maintenance crews must close roads to take core samples, which is time-consuming, destructive, and labor-intensive. Now, researchers at Germany's Fraunhofer Institute for Wood Research have a better idea: using artificial intelligence with a continuous monitoring system to track subsurface degradation in real time, according to technology news website New Atlas. The team designed a new layer to embed: a thin fabric made from flax fibers with an electronic sensor wire woven into the material. Now being road tested on a highway in Germany, the fabric is laid atop the base layer during road construction, with the sensor wire physically connected to a roadside measuring unit. When cracks start to form, even before a surface pothole appears, the new material expands and places pressure on the wire. That changes its electrical resistance, which is being measured by the roadside unit. The unit's AI algorithms decode the wire's signals to determine when subsurface damage is occurring and forecast how quickly it will worsen. Such preemptive monitoring of asphalt roads could improve maintenance management to save time and money and prevent accidents and casualties.



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NANOTECHNOLOGY

NANO GEARS UP

Gears make everything from clocks to cars to wind turbines run. For many new and future technologies, engineers want to use micro- and nano-sized machines, but in 30 years no one has been able to build a mechanical drive train smaller than 0.1 millimeters. Now a breakthrough is at hand, the website Interesting Engineering reports. Bypassing conventional mechanics, researchers at the University of Gothenburg in Sweden have invented a gear moved by laser light and tiny enough to fit inside a strand of hair. Constructed from a special optical meta-material directly on a microchip, the gear is covered in patterned structures that can capture and control light on a nanoscale. Shine a laser light on the gear and it spins, its speed controlled by the intensity of the light. Alter the light's polarization and the direction of the gear's rotation changes instantly. These gears have a promising future for use in nanomachines as small as 16 to 20 micrometers, which are minute enough to fit inside some human cells. Such super-small machines could lead to advances in fields ranging from robotics to optical systems. They're also key to microfluidics, a medical technology used for disease detection; development of new medicines; and potentially drug and nutrient delivery, according to *Discover* magazine.

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SPACE ENGINEERING

MINING THE MOON

A key component of NASA's Artemis mission is to mine our lunar neighbor for rare earth metals, under international agreements on natural resource extraction in space. Meanwhile, Interlune, a start-up founded by an ex-astronaut and former executives of the space technology company Blue Origin, plans to mine the moon for another scarce substance: helium-3 gas, the *Washington Post* reports. Unlike commonly used and plentiful helium-4, helium-3 mainly comes from the decay of tritium in nuclear weapon stockpiles; only 22,000–30,000 liters of helium-3 are recovered annually on Earth. But the moon is loaded with the stuff, in the upper layer of the rocky, dusty lunar regolith. With the advent of quantum computing, demand for helium-3 could soon soar well beyond supply levels. That's because qubits, the quantum bits of information used in quantum computers—which are much more powerful and faster than today's supercomputers—can't tolerate heat. Finnish company Bluefors has designed a cooling system using helium-3 that keeps qubits at temperatures close to absolute zero. Future quantum computers will each need thousands of liters of helium-3 to work. Bluefors estimates the moon could provide at least a million metric tons and has already placed a more than \$300 million order with Interlune for up to 10,000 liters annually, with delivery commencing between 2028 and 2037. At least two other companies have signed up as well. While some experts say mining the moon's helium-3 isn't feasible, Interlune says its engineers have invented and tested the processes and machines needed to extract the gas.



© Gettyimages

MATERIALS SCIENCE

SMART WINDOW OF OPPORTUNITY

Smart window technologies vary, but their central selling point is the same: they can transform from transparent to opaque and back again. When it's hot outside, they darken to protect interiors from heat and sunlight, thus reducing the need for air conditioning. When it's cold out, they clear to allow more warming sunlight in and help cut heating costs. But the current versions of smart windows aren't fully resistant to liquids, and they are inflexible. So a team of materials science and engineering researchers at China's Hefei University of Technology is developing a smart window that repels liquids, is self-cleaning, and is flexible enough to be used on curved surfaces. The team's version, reported in the *International Journal of Extreme Manufacturing*, sandwiches a hydrophobic silver nanowire heater within a thermo-responsive hydrogel. A small electric current causes the hydrogel to quickly shift between transparency and opacity, so heat and light can be regulated. The device's coating is superhydrophobic and can repel a range of liquids from water to organic solvents, the researchers say. The glass is also self-cleaning. Unlike current smart windows, it can be defogged and potentially used for encrypted display screens. Ultimately, the researchers claim, their glass would not only be a tool for net-zero building construction but also could enable production of water-resistant vehicle surfaces. The team is now subjecting their invention to real-world impacts including UV exposure, repeated use, and weathering.

Less a Gap THAN A CANYON

Georgetown University’s workforce research and policy institute is sounding the alarm about a coming US skills shortage. According to the university’s Center on Education and the Workforce (CEW), by 2032, the country will need an additional 5 million workers with postsecondary education.

Not only are workers retiring in greater numbers than younger replacements are entering the labor market, but also the country is expected to add almost 700,000 new jobs that require at least some postsecondary education in the next seven years. In addition, factors such as lagging attainment of postsecondary degrees and a decline in immigration due to increased restrictions will add to the squeeze. (The use of technologies such as generative AI is unlikely to resolve these predicted shortages, the authors write, because “some occupations are more open to AI than others.”)

Falling Behind: How Skills Shortages Threaten Future Jobs identifies 171 professions that will come up short. Engineering, which will need an additional 210,000 workers according to the center’s calculations, is among the professions spotlighted.

The report notes that engineers “drive innovation, technological advancements, and infrastructure development—key factors in economic growth and global competitiveness.” But as CEW chief economist Nicole Smith explains, “Not enough

young people are both qualified and interested in these careers.” Adding to that challenge, “there is tremendous political pressure to reduce immigration, despite the fact that the US has increasingly relied on immigrants to fill advanced technical occupations.” Current efforts to boost the engineering workforce, Smith says, “aren’t keeping pace with these trends.”

To ensure US competitiveness and a robust economy, CEW’s report says, government, business, education and training providers, and workers must act. Suggested strategies include growing education and training opportunities—particularly for members of underrepresented groups as the US becomes a minority-majority population; investing in reskilling for existing workers; and expanding visa programs to prioritize immigrants with in-demand skills.

Access the report at <https://cew.georgetown.edu/skills-shortages>.

Numbers Crunch

According to the Center on Education and the Workforce, by 2032:

72 percent of jobs will require at least some postsecondary education and training (compared to 68 percent in 2022 and 32 percent in 1983).

The U.S. Will be Short

4.5 MILLION

workers with a bachelor’s degree or higher

750,000

workers with an associate’s degree, a postsecondary vocational certificate, or some college but no degree

18.4 million workers with postsecondary education will retire between 2024 and 2032, but new workers with the same qualifications entering the job market will number only 13.8 million.

Engineers Wanted

Projected deficits through 2032, bachelor’s degree or higher:

-19,700

AEROSPACE ENGINEERS

-33,300

CIVIL ENGINEERS

-35,000

MECHANICAL ENGINEERS

-35,900

ARCHITECTURAL & ENGINEERING MANAGERS

-36,300

ELECTRICAL & ELECTRONICS ENGINEERS

-55,900

ALL OTHER ENGINEERS

LIVE WIRE

ASEE's teaching award winner sparks student learning and success.

It's not every day a college professor emails students to say he'll miss the first few days of the semester. But in January, Brock LaMeres had a good excuse. A radiation-tolerant computer he developed, called RadPC, was being launched to the moon, and he was going to the Kennedy Space Center in Florida to watch.

When LaMeres eventually showed up to class at Montana State University, he looked like he "hadn't slept in a week," the electrical and computer engineering professor recalls. "If I stopped talking about it, the students asked about it. It was one of the coolest semesters of my career."

LaMeres created learning material based on that accomplishment, 15 years in the making, to demonstrate the real-world application of engineering concepts. His ingenuity and tenacity—exhibited in both his contributions to the field of engineering and "bordering on obsessive" teaching style—earned the professor ASEE's 2025 Outstanding Teaching Award.

That dogged spirit isn't lost on his students, one of whom remembers building a "magnificent, insanely fast" robot that ultimately ran "full throttle" into a wall. Sharing in his nomination letter that LaMeres had given him a B for effort and a \$10 gift card

for innovation, Montana State PhD student Hezekiah Austin noted, "It was the first time I had been rewarded for trying something that failed quite so spectacularly."

In his 19 years at Montana State, LaMeres has taught 11 different courses across 100 sections to more than 3,200 students.

In addition, he spearheaded the creation of the university's Montana Engineering Education Research Center, where he serves as director. The center's mission is to transform engineering education through interdisciplinary, empirical research. Since the center's founding in 2016, the number of MSU engineering faculty engaged in education research has grown from six to 30, and external funding has increased from \$800,000 to more than \$10 million.

In his letter of recommendation for the Outstanding Teaching Award, then-electrical and computer engineering department head Todd Kaiser praised LaMeres's creation of online computer engineering classes that provide flexibility for students as well as the winner's vast library of instructional YouTube videos. The professor's innovative efforts to "modernize" the computer engineering curriculum were made possible with grant funding that he won, which reaped unintentional benefits, Kaiser wrote: "These

grants produced knowledge on how to effectively teach computer engineering but had the side effect of completely replacing the lab equipment that our department used to teach [the discipline]."

LaMeres has published more than 100 peer-reviewed journal articles and papers in conference proceedings as well as five textbooks on digital logic circuits that have been adopted by other universities. Among the 14 teaching awards he has earned at MSU are seven Outstanding Instructor awards—including those won during his latest, unprecedented, six-year winning streak.

Under his mentorship, a record 44 students have also won competition-based awards, with prize money topping \$10,000.

LaMeres says his previous "real job" designing digital circuits for HP helps with credibility in the classroom. Understanding why digital circuits act the way they do can be challenging, so he not only overhauled the curriculum to include responsive e-learning content but also developed portable lab kits for students to build and test circuitry from anywhere. The result: "When they come to the real lab, they're much more prepared for—and engaged in—the complex stuff," he says.

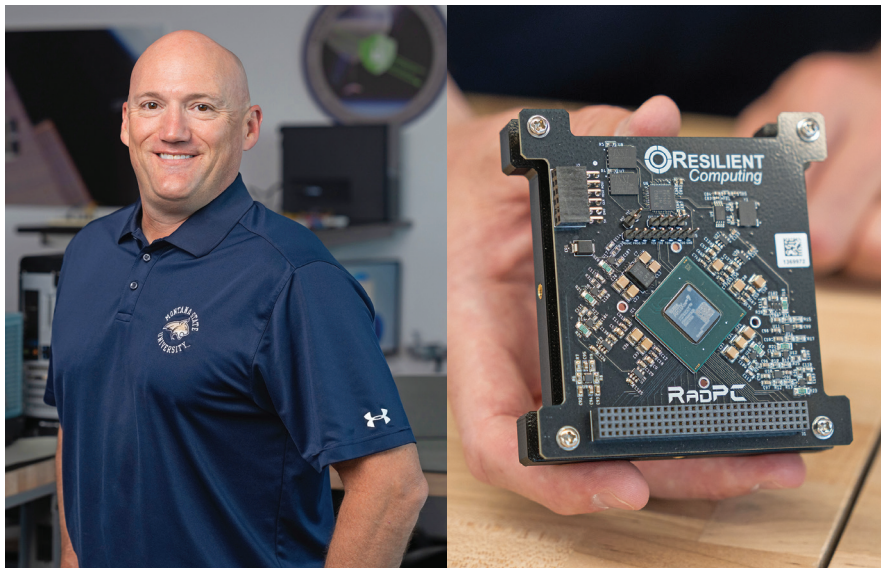
Student evaluations over the past year have described the "influential" lecturer as "approachable and relatable," "the best advocate you can have," and "entertaining."

To that last point, LaMeres admits to sprinkling in "stupid jokes" to keep students' attention. (Example: A neutron walks into a bar and says, "I'll take a beer. How much?" and the bartender says, "For you? No charge.")

Also lauded for getting more faculty involved with ASEE, the professor says that the purpose behind all of his work—whether with younger colleagues or students—is to impact the future of engineering.

Says LaMeres: "You need to make sure they can build a future society where everyone can thrive."

Robin L. Flanigan is a freelance journalist and author based in Rochester, New York.



Photos courtesy of Tyson Krinke

MICHELE YATCHMENEFF

Photo courtesy of Chris Arend Photography



November was **National Native American Heritage Month**, celebrating the achievements of Native Americans, Alaska Natives, and Native Hawaiians.

Michele Yatchmeneff (Unangax/Aleut) is the chief operating officer of the Alaska Native Science and Engineering Program (ANSEP), part of the University of Alaska system. She holds a doctorate in engineering education from Purdue University. She is also an ANSEP alum.

This interview has been edited for length.

Can you give an overview of ANSEP?

Our founder was an engineering faculty [member], and he didn't come across many Native students in engineering. [He thought], "I'm going to work with the university and try to fix that."

We started off as a scholarship program [in 1995. Now we're] working with students from kindergarten to PhD, trying to encourage them to consider STEM as a professional pathway.

In Alaska, we have natural resources that we want our students to be able to help manage, and be part of the economy.

ANSEP tries to ... encourage students, not just with inspiration but also education. Letting students know, to be on track to become an engineer, you need to have the right math [and science]. That's not always easy in rural Alaska.

Talk about how you first got involved.

I went out of state to get my [undergraduate] degree, to Arizona State. It got to be more expensive; I was living away from home. I came back to the University of Alaska Anchorage, and [a friend told me about ANSEP].

Mainly it was the connections to internships, but also to a community. There were students that look like me. There was this family or home-away-from-home on campus that I was able to be part of, whereas before I felt like an isolated student roaming around. Now I had a big group of students to help me, but also to be Native with, enjoy cultural foods and activities on campus.

After that, I went off to work for a little while, and then they asked me to come back to grow the program. I never thought about a PhD, and that was the group that helped me consider going on and becoming faculty.

You hear this a lot from Indigenous STEM folks, that they want to use their degree to help their community. It's usually not a singular activity where you're getting your degree [for your own] professional path. I help a lot of students who are like me that didn't see themselves in engineering ... that was where I knew I could fit.

The plan was always that I would come back to ANSEP. I had to take a leave, and ANSEP helped me get my PhD. I went off to Purdue, and right now, I'm the only Alaskan Native in the world with an engineering education PhD.

It's been a long journey, and I didn't know how long or how challenging it was going to be. When you're the first and only in anything, blazing that pathway is super challenging. A lot of students, they look at me like I'm a substitute teacher. I don't know if it's because I'm female or Native or I come from Alaska. And then fellow faculty. I was the first and only one to get an NSF CAREER award at my institution. It wasn't celebrated. But now that I've gotten through all those steps, I'm extremely happy.

How do we get more Native engineering PhDs?

A lot of it is removing those barriers. Like students being able to take math and science courses. In high school, it's not usually available or they're excluded from it. A teacher will say, "Oh, that's really challenging. Maybe go down this pathway instead." I received that a lot as a student. Removing those barriers wherever we can, and realizing that this is for everybody.

Alaska just went through some massive western storms. It displaced whole communities. They need to be part of the conversation when it comes to engineering those communities, whether it's water/wastewater engineering, transportation, building their homes, building their water tanks.

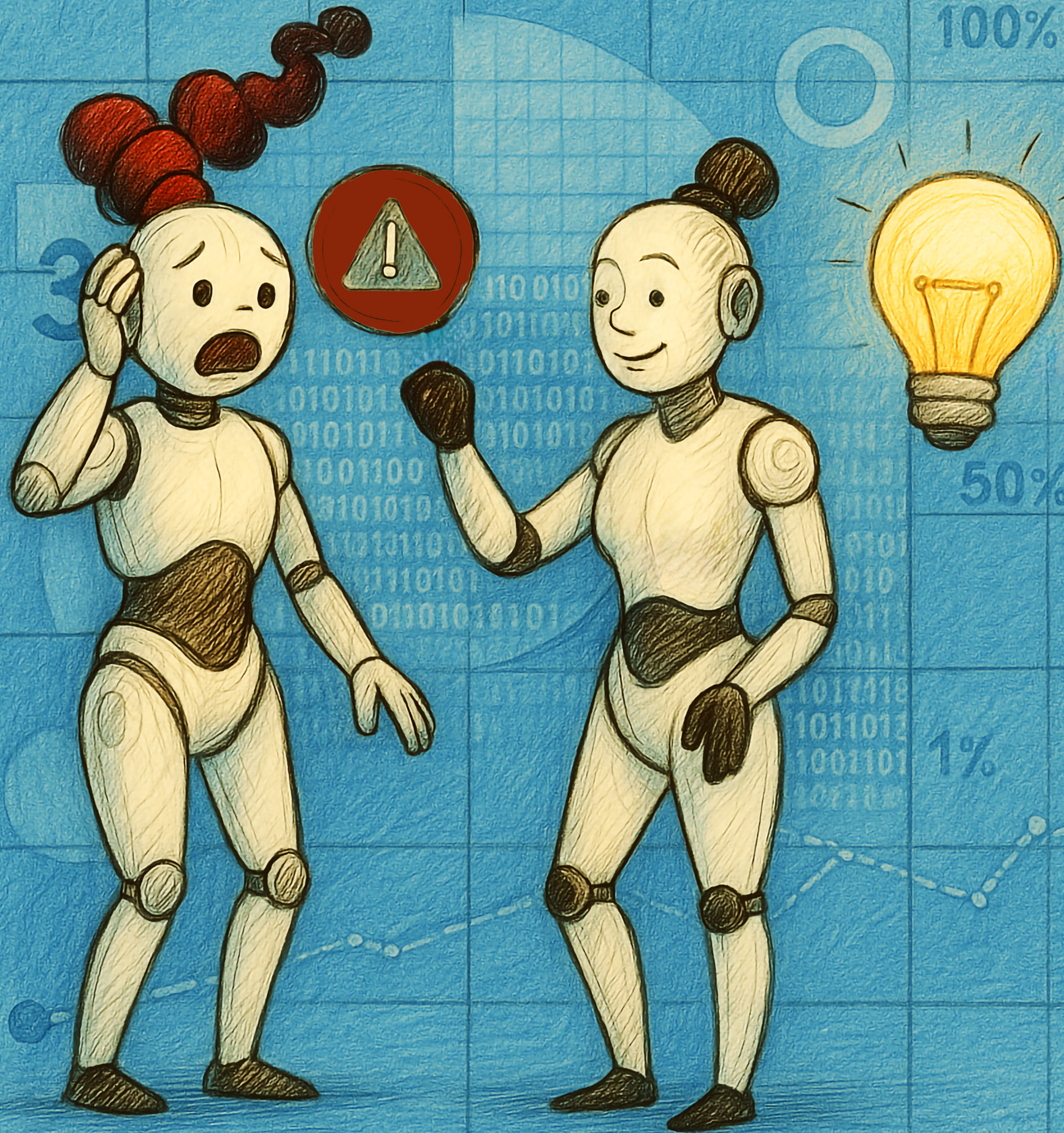
What are some of your future plans as COO?

We're trying to pilot our K-5 programming. That's going to be one of the expansion areas. We're hoping to start doing hands-on activities with those students, [such as] sea life activities. Partnering with our Alaska Native charter schools [on] STEM activities, but also culturally ingrained activities as well.

Anything else?

I wouldn't be here without [ANSEP]. I think that more and more students will be pursuing this pathway. I'm excited for that, having it grow and grow.

Learn more at <https://www.ansep.net>.



AI, Solve Thyself

To address AI's immense energy needs, researchers turn to...AI.

By THOMAS K. GROSE

To say that artificial intelligence is surging is the mother of all understatements. Within the last three years, AI has become fully woven into our lives as millions of users—including consumers, industries, governments, scientists, and educators—rely on it to perform countless tasks, from providing instant information to designing new products, speeding medical diagnostics, bolstering cybersecurity, planning trips, and writing code. Enthusiasts promise it will prove to be a boon for humanity, improving lives and generating unfathomable economic, scientific, educational, and national security breakthroughs. Perhaps they're right. In the meantime, though, AI is creating colossal problems.

The thousands of data centers needed to store, crunch, and transmit the voluminous amounts of data the technology requires suck up unprecedented amounts of power, outstripping supply. As a result, the mismatch between supply and demand will, at least in the near to medium term, raise electricity prices and destabilize regional grids. It will also set back efforts to limit greenhouse gas emissions, since most of the electricity currently going to AI data centers comes from fossil fuels, mainly natural gas.

Nevertheless, engineering experts say, there are technologies and computational methods at hand or in the works that may mitigate these problems in ways that won't hinder AI's growth and potential.

One of the best things the data centers can do, these experts say, is to become more flexible with their energy demands so they align better with grid supply. That's the solution Ayse Coskun, a professor of electrical and computer engineering at Boston University, is pursuing. "If the data centers were to adjust their power [consumption], depending on the power grid program, that's good for the grid because they'll have an easier time matching supply and demand. And it's good for the data centers, because they'll pay less for electricity," she explains. With a three-year, \$600,000 National Science Foundation grant, Coskun and her departmental colleague, associate professor Emilian Dall'Anese, are aiming to develop a prototype process for data centers to use "flexible computing" in tandem with emerging smart-grid technologies. While their project looks ahead to developments over the next five to 10 years, the results achieved so far are ready to be put into action now, Coskun says. Emerald AI, a Washington, DC, startup where Coskun is chief scientist, is offering flexible-computing software based on her work.

But how flexible can data centers be when millions of users demand results from AI around the clock? “Not everything is urgent,” Coskun responds. “A data center doesn’t have to be one hundred percent 24/7. That’s where the flexibility comes in.” For example, many long scientific simulations take days or weeks to run, so occasionally slowing things down or hitting pause for a few hours won’t matter to the end user. And shaving a few hours off here and there from many thousands of users adds up to a lot of flexible time that will ensure urgent jobs still get done while less power is used at peak times.

Then and Now

Historically, data centers were not huge consumers of power. Their main users—systems to process social media and online shopping data—sipped energy. All that changed dramatically three years ago when OpenAI released ChatGPT, the first commercial generative AI chatbot. Before ChatGPT, a typical data center rack with conventional central processing units (CPUs) needed at most a few hundred watts of power. Now, a rack for AI can consume “up to 10 times that, depending on the configuration,” says Eric Masanet, a professor of mechanical engineering at the University of California, Santa Barbara, who researches sustainability in science and emerging technologies.

Generative AI chatbots use large language model (LLM) technology. They vacuum up everything on the public web, learn to understand a language and context from the collected data, and then answer queries within seconds. Chatbots can write everything from essays to novels, generate computer code, and work with other

an associate professor at the University of Michigan who studies large-scale data systems. “So, an AI data center is basically a big warehouse full of ... those ‘refrigerators,’ the hardware devices, and they consume a lot of power.” Indeed: According to the International Energy Agency, ChatGPT needs 10 times more electricity to process and answer a single query than does a standard Google search. Moreover, data-center racks generate tremendous amounts of heat, and the air-conditioning systems used to keep the machines from overheating are power-hungry, too.

Utilities Can't Keep Up

Chatbots represent just a fraction of the explosive demand for data generated by AI. Companies like OpenAI, Microsoft, Apple, and Google are spending billions of dollars on many hundreds of new AI data centers on top of the 5,400 that Big Tech already has in the United States. “These systems are far more demanding than anything the electrical grid was originally built to handle,” says Mahmut Kandemir, a professor of computer science and engineering at Penn State University. Although utilities are investing heavily and expanding their workforces to keep up with new infrastructure needs to handle this surge, the risks of brownouts and blackouts are increasing, he says. “It’s not a sign of an imminent nationwide collapse. The more realistic concern is localized problems during periods of heavy demand.”

Until recently, the tech industry sought to limit its carbon footprint and tapped renewable energy sources when it could. That’s no longer the case with most of the power plants coming online to handle AI demand. They burn natural gas, which emits both carbon



"A COMPELLING POSSIBILITY IS EMERGING: THE VERY TECHNOLOGY DRIVING THIS ENERGY DEMAND MAY HOLD THE KEY TO ITS OWN SUSTAINABILITY AND INDEED THE SUSTAINABILITY OF THE PLANET."

— MAHMET KANDEMIR, PROFESSOR OF COMPUTER SCIENCE AND ENGINEERING
AT PENN STATE UNIVERSITY

AI technologies to produce, among other things, music, images, and videos. The computational muscle needed to train the algorithms that respond instantly to queries demands gargantuan amounts of power. In the United States alone, there are now around 900 energy-hungry chatbot platforms. And AI technologies are also being embedded in a range of hardware and software, including smartphones and social-media apps. It’s estimated that AI data centers will suck up 5 percent of all power produced in the US this year; by 2030, that proportion could climb to 12 percent.

Today’s AI data centers are filled with refrigerator-sized racks of graphics processing units (GPUs), electronic circuits that can perform huge parallel computations on vast amounts of data, and accelerators, specialized hardware used to speed up AI operations. “You need thousands” of these racks, explains Mosharaf Chowdhury,

dioxide and methane, even though energy from natural gas costs more nowadays than renewable power. Masanet says the reason is speed. Tech companies want to build data centers much faster than the time it takes to add new renewable capacity. “These data centers are going wherever they can find the power, posthaste, because it’s really a gold rush or an arms race.”

Another reason for the reliance on natural gas: Renewables are still intermittent sources of energy, and that can hinder grid stability. While more and better storage and smart-grid technologies are making it easier to add renewables to the grid, not all of the stability problems have been solved—at least not yet.

AI, however, may help utilities bring more renewables online faster. It’s still a research challenge to develop computational systems that allow a grid to adapt to the availability of renewables without

sacrificing performance and reliability, Penn State's Kandemir says. But, he adds, AI may be able to process real-time data on renewables' availability, grid load, and computational needs so that utilities can use these energy sources and still keep their transmission lines stable. "A compelling possibility is emerging: The very technology driving this energy demand may hold the key to its own sustainability and indeed the sustainability of the planet," he says.

The ongoing grid investment is expensive, and utilities usually spread those costs out to all ratepayers, raising electricity bills. Since 2020, the average residential rate in the United States has jumped more than 30 percent. To be sure, much of that hike resulted from replacing storm-damaged systems and updating an aging grid. But as utilities add more grid infrastructure and bring new power plants online to accommodate the unparalleled demand from AI data centers, electricity bills are bound to soar. An analysis this summer by Carnegie Mellon and North Carolina State Universities estimated that AI will cause the average US electricity bill to rise 8 percent by 2030.

Coskun says her flexibility technology will be able to help, by slowing the need for utilities to add new infrastructure. If data centers could be flexible, the power grid could handle more of them without immediately needing new power plants or transmission lines. "That means lower costs compared to building all that new infrastructure," she says.

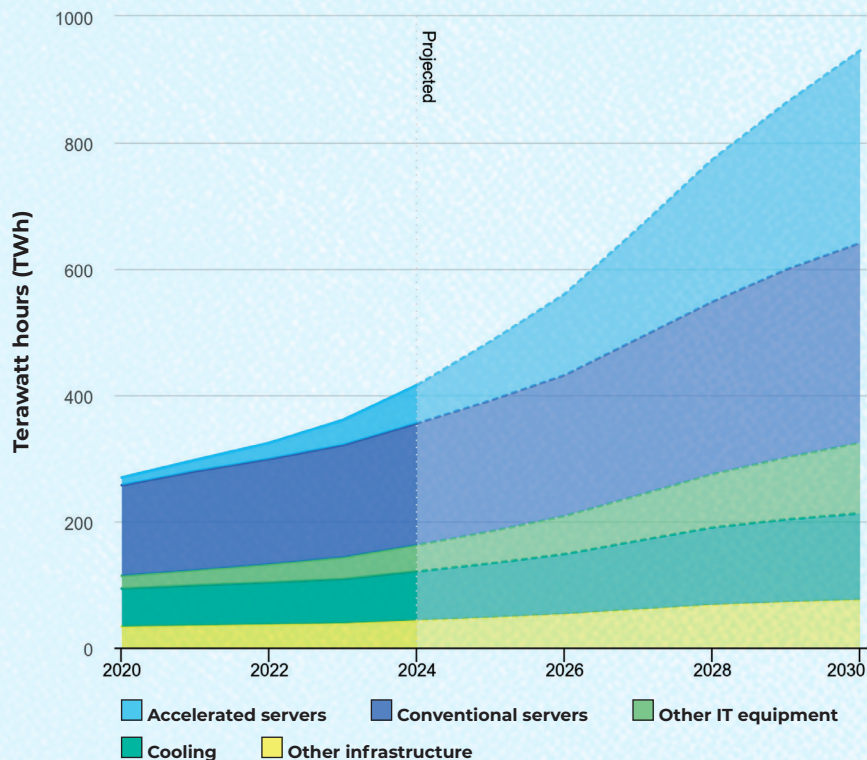
Data centers can save additional power by limiting the amount of data they crunch to what they actually need. Masanet notes that AI has been around for decades without consuming massive amounts of energy. The big energy hog is generative AI, he explains, "the LLMs, ChatGPT, Gemini, and so forth." That's because "they're trained on all human knowledge on the internet." But, he continues, "we don't need those humongous models for most things. The models that are going to help us cure cancer or optimize logistics in a shipping company—they don't need to be trained on every piece of data, like Taylor Swift's 1989 album sales. They just need the right data." And those models can be much smaller and more energy efficient.

Speed Versus Cost

Beyond refining energy and data needs, engineers are also looking at overall streamlining of data centers. "The way we are doing AI today ... the techniques throughout the entire stack—hardware, software, applications, algorithms—many of them have a lot of inefficiency because of the focus on very quick growth," Chowdhury says. Tech entrepreneurs tend to want to get things up and running quickly and figure out later how to cut costs, he says. Eventually, costs become an issue if investors want to see a return on their money. So research is underway to design more efficient applications.

"This is where AI—all types of AI, not just large language models—comes into play. Essentially, it's in some ways a search problem," Chowdhury explains. "AI allows us to do many, many things in parallel, so we can explore and discard [possible solutions], then pick up very good candidates" that researchers can focus on

Global Data Center Electricity Consumption (Base Case)



The International Energy Agency projects that accelerated server electricity consumption, mainly driven by AI, will grow 30% annually in the base case. License: CC BY 4.0

without performing searches themselves, one by one. This is how researchers use AI to search for new drug therapies or novel materials. AI can also be put to work to find new and better ways to design chips, develop new heuristics for software and configure algorithms, and work out better ways to run models and schedule techniques for applications and user requests, Chowdhury says. Coskun agrees: "AI can help with a lot of things, because AI essentially can learn patterns, it can help with forecasting, and it can help with complex, data-driven optimization." Her own flexibility technology makes use of AI's pattern-learning, forecasting, and optimization abilities.

Data centers can derive additional savings from liquid cooling, a method that uses much less energy than air conditioning and controls heat emissions from stacks of computers, Masanet says. The method involves circulating a heat-absorbing coolant through a closed-loop system that needs very little water and then ejecting the heat into the atmosphere.

Like Kandemir, Masanet sees the impact of AI on energy distribution and use as an example of the technology's transformative potential. "We've never seen this before," he says. "Before the AI boom, data centers were just consumers of energy, right? Now they're... actively shaping the future of the grid. I don't know any industry that has done that."

Masanet tempers his optimism with an acknowledgment that the AI sector of the tech industry is moving too rapidly for researchers and policymakers to make sense of it. But eventually there will be better data-transparency requirements and models, as well as more thorough studies of the industry. And that, he says, should provide "enough intelligence where we can kind of know how to measure and monitor it, and prevent it from going off the rails." And, one hopes, keep the lights on, too.

Thomas K. Grose, Prism's chief correspondent, is based in the United Kingdom.

The Deep Web

A new curriculum takes students below the surface of global connectivity.

By Tom Gibson, PE



3D illustration of an armored submarine fiber optic cable structure
By Bet_Noire/Getty Images

WHEN WE THINK OF digital communications, we tend to imagine data speeding invisibly through the air. But even in this era of ubiquitous wireless technology, our networks still rely heavily on physical connections: fiber optic wires traverse oceans and tie together continents.

The number of these undersea cables is increasing, and they play an important role in our high-tech society. Yet the undersea cable industry is largely unknown and suffers from a chronic labor shortage. Opportunities abound for engineers in many disciplines, but most don't know about the possibilities or where to get training.

A new curriculum at the University of California, Berkeley, is attempting to address both challenges. Housed in the Berkeley Center for New Media, the

certificate program takes an interdisciplinary approach to global internet infrastructure, including the “technical, economic, legal, environmental, and social dimensions.”

Nicole Starosielski, a UC Berkeley film and media professor, developed the program. She teaches classes and supervises projects on digital infrastructures in addition to conducting research on elements such as data centers and undersea cables. Over her decade in the industry, she has heard repeatedly about the labor challenges. “We need additional people,” she says. “We need engineers in the industry. And there aren't any training programs at universities. So that motivated me to address the workforce gap.”

Slim but Mighty

TeleGeography, a Washington, DC-based company specializing in telecommunications data and analysis, estimates that submarine

cables account for about 99 percent of intercontinental data traffic. According to research analyst Lane Burdette, “these long, thin cables transmit data more cheaply and efficiently than satellites.”

Submarine cables are a “critical but often forgotten part of global communications,” Burdette says. As digital infrastructure becomes increasingly important to the world, UC Berkeley's webpage stresses, that invisibility places continuity of service at risk.

The history of subsea telecommunication cables stretches back to the early days of the telegraph. Since the installation of the world's first submarine cable in 1850, connecting France and England across the Dover Strait, these cables have been essential to the world's communications infrastructure.

Whereas cables once connected cities, they now link data centers. Today, some 900,000 miles of cables crisscross the earth's oceans as part of nearly 600 different systems, according to TeleGeography. Enabling millions of phone calls and terabits of video and internet

data per second, they're now owned by tech giants such as Google and Amazon instead of former telecommunication greats such as Bell and AT&T.

An undersea cable is surprisingly thin, only about the diameter of a garden hose. Yet one cable consists of many fiber optic strands, made of glass, packaged in ribbons. For example, an 864-count package consists of 36 ribbons each containing 24 strands of fiber as thin as a human hair. A jacket made of plastic protects the bundles.

One such system, Anjana, is a 7,121-km (4,425-mile) transatlantic fiber optic submarine cable connecting Myrtle Beach, South Carolina, and Santander, Spain. It is privately owned and operated by Meta through multiple subsidiaries. The system consists of 24 fiber pairs (48 individual fibers), each with a design capacity of approximately 20 terabits per second.

Help Wanted

The proliferation of subsea cables has largely followed growth in the tech and electronic industries. Cable installation flourished from around 1980 to 2002, particularly during the dot-com boom, says Peter Jamieson, vice chairman of the European Subsea Cables Association, a trade group of cable owners.

After that, the industry “went dormant for about 10 or 12 years,” Jamieson continues. Then, around 2015, with the rise of social media and companies like Meta, Google, Amazon, and Microsoft, it took off again.

Nexans Subsea Operations is a 120-year-old company focused on cabling and electrification. US sales director Pete Kohnstam assesses the cable workforce: “It’s been a small niche area for a long time. The skill sets are not typically widely available on the market. It doesn’t get the headlines some of the other industries do.” That makes hiring a challenge, he says, and “engineering is one of the bottlenecks.”

What disciplines are needed? “You name it,” Kohnstam says. The industry needs “telecommunication engineers, civil engineers, and mechanical engineers. I’m a civil engineer originally, but I cross-pollinated into a telecommunications engineer.”

Burdette explains that “optical engineers are always working on new technologies to keep up with global bandwidth demand and transmit data faster, further, and cheaper.” As she puts it, young people often don’t know about internet infrastructure, but they “become very interested in the topic after learning about it.”

A Broad View

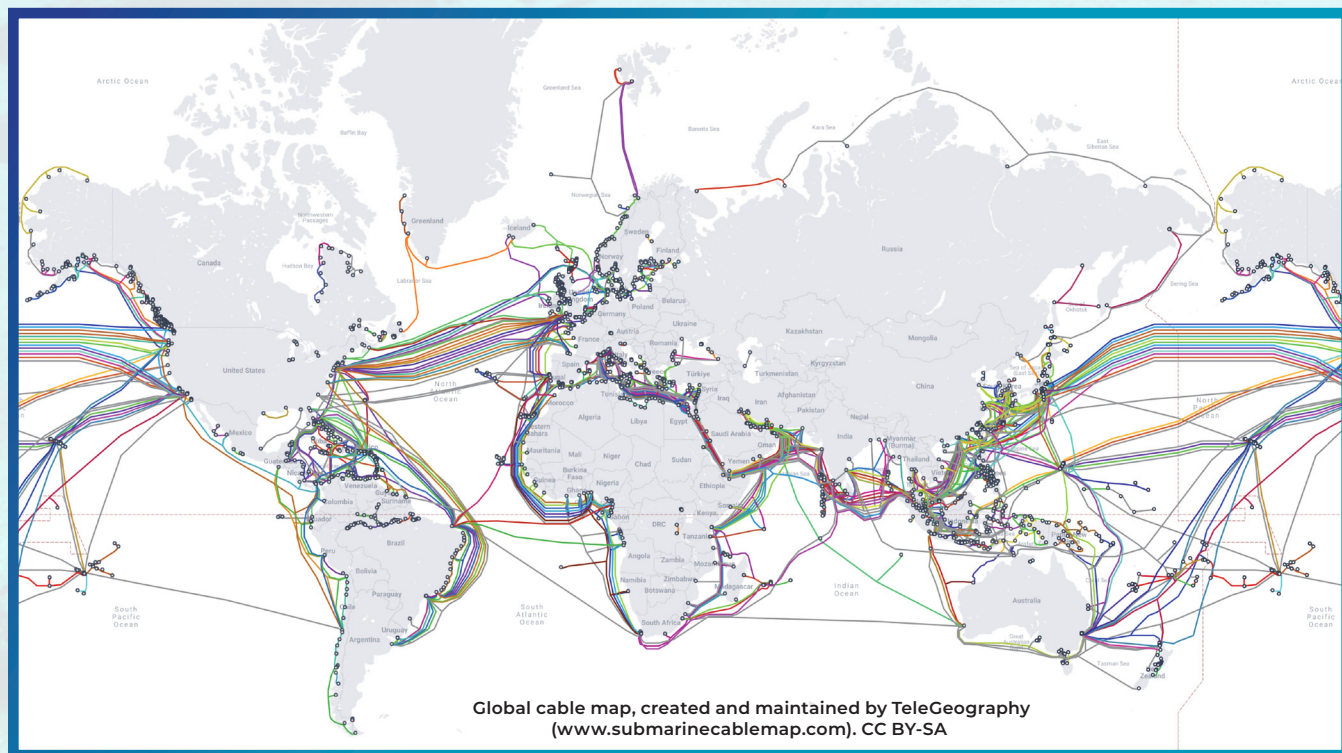
Enter the Berkeley certificate program, launched this past summer. The program on global digital infrastructure focuses on subsea cables and data centers. It is supported by partnerships with industry organizations and other Berkeley entities such as the College of Engineering, School of Information, and Graduate School of Journalism. The University of Oregon’s School of Computer and Data Sciences is also a collaborator.

The holistic curriculum, the program’s website explains, includes “components, business models, design/build, operations, and maintenance, alongside the impacts of/on economies, geopolitics, artificial intelligence, and the environment.”

The undergraduate classes are open to anyone from any field. Starosielski says the first cohort included working professionals from the tech sector and graduate students. Cal Berkeley attendance is not required—nor is prior digital infrastructure, engineering, or computer science experience. The program organizers believe that since everyone uses the internet, everyone should be able to grasp what makes it work.

The certificate requires three six-week courses, but participants can also take the classes individually. Digital Infrastructure 101 explores the fundamentals, such as the historical development of cables and data centers and the role of those infrastructures in emergent internet technologies. How to Build a Global Internet examines the steps and challenges in executing these megaprojects. Tech Wars focuses on the security and geopolitical aspects of digital infrastructure.

This past summer, about 200 people enrolled in the courses. The format was heavily influenced by the industry’s need for engineers. Starosielski explains that, because engineering curricula are so



TODAY, SOME **900,000** MILES OF CABLES CRISSCROSS
THE EARTH'S OCEANS AS PART OF NEARLY **600** DIFFERENT SYSTEMS.

chock-full, the organizers created the program “as a kind of ‘summer minor,’ which students could take to specialize in an area beyond their engineering focus and expand their career opportunities.”

The classes are held online, with lectures and discussion content scheduled synchronously so students can ask questions, contribute ideas, and hear from guest lecturers. But they are also recorded and made available for any student that needs to take the course asynchronously.

Diving Deep

How to Build a Global Internet is the most technical class of the set. As Starosielski explains, the project development course centers on how to “build, design, and implement subsea cable and data center projects at scale.” Six modules make up the class, including Subsea Cable Design and Development and Manufacturing and Cable Installation.

The course is taught by Erick Contag, president of the board of trustees of the SubOptic Foundation, which offers educational programs to grow the future subsea workforce. Contag has a degree in electrical engineering from the University of Tulsa and an executive engineering management certification from Instituto de Estudios Superiores de Administración (IESA) in Venezuela.

To create the curriculum, Contag worked with three undergraduate students. He shared his experience in developing large-scale projects, and the students researched and developed slide decks for the class pairing his insights with peer-reviewed academic content. “The students learned from him and then helped him translate [his knowledge] into student-friendly terms and relate it to existing academic literature,” Starosielski says.

How to Build a Global Internet covers financial considerations, project management, and hurdles on the ground, from permitting to weather. Case studies focus on digital infrastructure in locations around the world. Contag uses a service level agreement as a framework to dive into designing, building, operating, and maintaining various components.

Artificial intelligence, sustainability, and energy are also key topics in the course. As a culminating project, students work in teams to design a new digital infrastructure, considering aspects such as architecture and regulation.

From Academia to Industry

Originally from Douala, Cameroon, Ngandjon Landry works in Paris as a telecommunications engineer for mobile operator SFR. He holds an engineering degree from the Catholic University of Central Africa and is enrolled at Télécom Paris for a master’s degree in digital architecture.

In addition, Landry, 35, completed the Cal Berkeley certificate program this summer to build his expertise in subsea cables and digital infrastructure. The program enabled him to combine academic learning with real-world challenges, Landry explains.

Amina Ibrahim, 30, also completed all three courses. She graduated from Dar es Salaam Institute of Technology (Tanzania) in 2022 and now works as an electronics and telecommunications engineer contractor for Vodacom Tanzania PLC.

“During my degree work, I didn’t have much exposure to subsea cable technology,” she says. “I took the class to fill that gap and understand how digital infrastructure supports global connectivity, especially the role of subsea systems in enabling internet and data services.”

Greater Understanding

Like Landry, Ibrahim highlights how the certificate program complemented her academic foundation by adding “real-world, practical knowledge that connected directly to the telecommunications field.” Calling it “rewarding and eye-opening,” she says “the class gave me a new perspective on how deeply interconnected our world is through physical infrastructure that most people never think about.”

Ibrahim says she now understands the huge role that undersea cables play in global communication, as well as their engineering, planning, and maintenance challenges. “It gave me a deep appreciation for the systems behind the services we often take for granted,” she adds.

Currently working as a customer support network engineer, Ibrahim says that the certificate program has helped her understand the origin and infrastructure of the services her company provides. She explains, “It has made my work more meaningful and has strengthened my interest in pursuing a career in global infrastructure and sustainable digital systems.”

Landry says he learned not just about the technical aspects of undersea cables but also “their strategic importance for global connectivity and digital sovereignty.” He continues, “I came to appreciate how subsea cables are not only an engineering challenge but also a geopolitical and economic issue, since they enable the vast majority of international data traffic.”

This education influenced Landry’s career goals, broadening his perspective beyond his contributions as a technical presales engineer and allowing him to imagine himself in roles such as a bid manager in the subsea cable industry.

Next Steps

Starosielski reports good results for the program’s inaugural run, with around 90 percent of participants rating it “extremely effective” in course evaluations. “So it was very well received by the students who took it,” she says. Industry showed interest as well. Not only did digital infrastructure professionals take the courses to broaden their knowledge, but industry members also expressed interest in hiring graduates. UC Berkeley plans to offer the courses again next summer.

Starosielski’s most recent project focuses on increasing the sustainability of digital infrastructures. The project team has developed a catalog of best practices for sustainability in the subsea cable industry as well as a carbon footprint of a cable.

Across the industry, getting more young people involved in and educated about subsea cables will remain a high priority. As Kohnstam puts it, “it’s an interesting world to be in.”

Based in Sugar Grove, Virginia, Tom Gibson, PE, is a consulting mechanical engineer and freelance writer.

Learn more about the Certificate in Global Digital Infrastructure at <https://bcnm.berkeley.edu/digital-infrastructures>.

LET'S TALK ABOUT IT

Abstract ethical principles turn into shared moments of reflection, dialogue, and real-world learning.

The Online Ethics Center, based at the University of Virginia's School of Engineering and Applied Science, provides resources to students, faculty, researchers, and professionals around the world. I host the center's webinar series, moderating discussions with speakers who have shared not only their expertise but also their authenticity and vulnerability. This openness has made each session a meaningful shared exploration.

Some of the most powerful moments have come from audience interaction—a student sharing an experience or asking a question, or a faculty member connecting the discussion to one of their classroom lessons. For example, at the end of one session, a student posed a difficult question about accountability in AI decision-making. The speaker recounted multiple perspectives, and a spontaneous conversation arose in the Q&A box among students, faculty, and practitioners.

Key Lessons

Several important themes have arisen out of the sessions:

Ethics starts with leadership. A session on corporate ethics reminded us that culture begins at the top. Roy Davis, formerly Johnson & Johnson's corporate vice president of business development and president of the company's venture capital group, pointed to J&J's 1982 Tylenol recall as an example of leadership grounded in principle rather than profit. The decision cost the company \$100 million. Johnson & Johnson's credo, created in 1943, identifies consumers as the company's top responsibility. The recall showed that those aren't just words on a wall but a living guide for action.

Takeaway: Ethics can't just be a statement in an annual report. It must be modeled, practiced, and prioritized by leadership, especially when the stakes are high.

Ethics is a process, not a product. In sessions on operationalizing AI ethics and responsible AI, IBM's Francesca Rossi, global leader for responsible AI and AI governance, and Olivia Gambelin, founder of the company Ethical Intelligence, emphasized

the importance of integrating ethics into every stage of innovation. Rossi described how IBM's AI ethics governance framework embeds learned values into data practices, technical tools, and decision-making processes. The approach makes ethics part of a proactive, continuous feedback loop, with thinking shifting from, "Did we meet the requirements?" to "Are we living our values?"

YOU DON'T NEED TO BE AN EXPERT TO ENGAGE IN ETHICAL REFLECTION.

Takeaway: Ethics isn't a onetime checklist. It's an ongoing, iterative process that evolves alongside technology.

Empowering voices builds trust. In his session on whistleblowing, American Chemistry Council senior director Paul DeLeo stressed that dissent is not a liability; it's a safeguard. He described how steps such as documenting differing opinions and establishing clear processes for resolving scientific disagreements help protect integrity and trust. DeLeo pointed to cases in which systems for recording dissent enabled accountability, such as when scientists at the US Environmental Protection Agency challenged revisions to risk assessments. The lesson: Organizations that provide safe, structured ways to raise concerns not only prevent crises but also strengthen credibility.

Takeaway: When people feel it's safe to speak, organizations become healthier, more resilient, and better able to respond to crises.

Humility creates space for growth. The sessions were particularly compelling when speakers admitted they didn't have all the answers. Whether discussing the risks of gene editing or the politics of public health, our guests frequently demonstrated curiosity and humility. They didn't preach; they invited us to think together.

Takeaway: You don't need to be an expert to engage in ethical reflection. You just need to be willing to ask hard questions and listen.



Better Questions

One of the most rewarding outcomes of hosting these webinars has been hearing how educators use them as case studies and discussion prompts, with students carrying those insights into projects, internships, and job interviews. Seeing ethics move from the screen to real-life decisions is inspiring.

Across sessions, a common motif has emerged: The pace of innovation often outstrips the pace of ethical reflection. In areas such as AI, CRISPR, climate resilience, and social media, technology advances faster than our ability to decide not just whether we *can* use it, but whether we *should*.

We need people in every area to keep thinking about these issues. Ethics isn't about perfect answers; it's about better questions. It's about learning together, staying curious, and embracing complexity. Let's keep the dialogue going.

Azita Hirs is a senior lecturer in Rensselaer Polytechnic Institute's Industrial and Systems Engineering Department, where her courses bridge technical decision-making with ethical and leadership frameworks. A past chair of the ASEE Ethics Division, she hosts the Online Ethics Center Webinar Series, bringing real-world dialogue on ethics into the classroom and beyond.

Explore past and upcoming webinars at <https://onlineethics.org>.

HALLWAY HELP

Funding assistance may be closer than you think.

Early-career STEM educators face a daunting challenge: securing external funding while juggling heavy teaching loads, service commitments, and research responsibilities. At non-R1 institutions, which don't have the robust support infrastructure of major research universities, this challenge intensifies.

But what if the solution is just down the hall? Our research with STEM educators at three institutions revealed a powerful framework, which we've deemed "collabo-gleaning," in which faculty intentionally collaborate with experienced researchers to systematically build their own capacity.

Understanding the Barriers

In our study of 40 STEM educators, 90% cited one or more of these impediments to pursuing external funding: lack of time due to other responsibilities, lack of university resources and support, and lack of experience or knowledge. These obstacles feel insurmountable when tackled alone, but collabo-gleaning addresses all three simultaneously.

Grasping the Differences

Unlike traditional mentoring, collabo-gleaning shifts power to *you* as the early-career educator. *You* identify the skills you want to build. *You* seek out an experienced researcher who has those skills. *You* actively

participate in grant projects together (either yours or theirs).

By working with someone with experience, you receive:

- **Mentoring.** Your collaborator demonstrates successful practices in real time, showing how experienced researchers navigate proposal development.
- **Consulting.** Your collaborator provides targeted support on challenges—for instance, assistance with budgeting or technical writing.
- **Peer exchange.** Your collaborator contributes access to networks and institutional knowledge that takes years to accumulate.
- **Resource sharing.** Your collaborator provides templates, facilities, administrative support, and connections that enhance your competitiveness.

Through collabo-gleaning relationships, you systematically develop five critical capacities:

- Increased awareness of grant opportunities and fundable research ideas
- Enhanced skills in time management, writing, and budgeting
- Leveraged relationships that provide access to internal or external resources and administrative support
- Action and persistence through proposal submission (Among our study's tenured participants, the majority had submitted 20+ proposals. Persistence pays off!)
- Collaborative networks that extend beyond the initial relationship, creating ongoing opportunities for partnership and support

Changing the Definitions

The collabo-gleaning framework helps early-career STEM educators reframe success as capacity built, not just grants won. Too many early-career faculty label a "no" as failure. We count the wins you can control: building relationships, sharpening skills, and taking deliberate steps toward funding with each submission.

Starting the Process

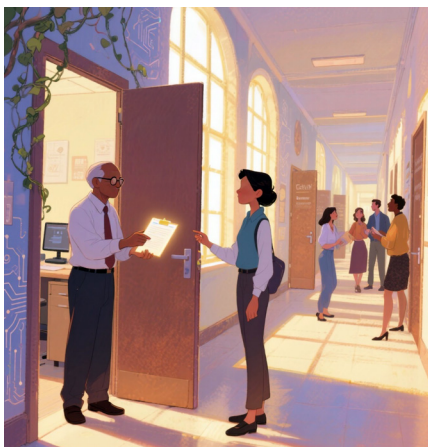
The funding landscape may seem mysterious, but it becomes more navigable with strategic relationships. Initiate your collabo-gleaning experience by following the steps below. Committing one to three hours per week can produce great results without overwhelming your schedule.

First, use our self-assessment to identify your specific needs. Based on your results, identify three potential collabo-gleaning partners. Keep in mind that different collaborators offer different strengths, and experienced faculty often welcome eager collaborators who offer fresh perspectives. Reach out with a specific, time-limited request—for example, to observe a research meeting or discuss insights from their recent funding success.

The path to external funding does not require waiting for institutional change. It starts with relationships you build and intentional steps you take to develop your capacity. Your research ideas deserve funding. Applying the collabo-gleaning framework can help make that vision a reality. This is your opportunity, your career, your chance to contribute to the world with your research ideas!

Allie DeLeo-Allen, an engineer with over a decade of experience in higher education, is owner of DKB Solutions, a proposal development small business. Alicia Kiremire, PE, is the owner of FlowStream Management, a small business focused on grant consulting. Beginning in grant writing and then moving to project management, FlowStream now plays a training, consulting, and evaluation role. Katie Evans is dean of science and engineering and a professor of mathematics at Houston Christian University. She is also a professor emerita of mathematics at Louisiana Tech University. Anne Case Hanks is the associate vice president for academic affairs at the University of Louisiana at Monroe. Krystal Corbett Cruse is an assistant professor of mechanical engineering at Louisiana Tech University who leverages her roles as first-year programs coordinator and director of the Office for Women in Science and Engineering to advance her research in engineering education.

This article was based on "Unveiling the mystery: A capacity development framework for early-career STEM educators pursuing external funding," presented at the 2025 ASEE Annual Conference in Montreal, Quebec. For the full paper, self-assessment, and collabo-gleaning future work interest survey, visit collabo-gleaning.com.



SEATS AT THE TABLE

The Art of Gathering: How We Meet and Why It Matters

By Priya Parker

Riverhead Books, 2018

In *The Art of Gathering*, Priya Parker challenges the way we think about meetings, classes, and academic events, [defining them] as opportunities to create meaning and connection. Moreover, she offers insights on how to design more intentional and impactful gatherings, from lectures to department retreats.

Parker argues that gatherings should have a clear purpose that is specific, unique, and disputable. For example, instead of defaulting to “faculty meeting,” she suggests asking: What is the need this gathering exists to meet? Perhaps it is to decide whether replacing classes A and B with class C will better prepare students for success as entrepreneurs.

One particularly relevant topic is her critique of “chill” hosting. In academia, we often avoid structure to seem open or democratic. But Parker shows how thoughtful structure like setting ground rules or curating who speaks when can foster deeper engagement by creating a temporary alternative world where people are free to be themselves.

She also emphasizes the power of meaningful openings and closings, [such as] starting a class with a provocative question instead of logistics or ending the semester by helping your students “find a thread to connect the world of the gathering to the world outside.”

If nothing else, Parker’s [list of] 15 Ways to Make a Conference—Or Any Kind of Gathering—Suck Less is a must-read.

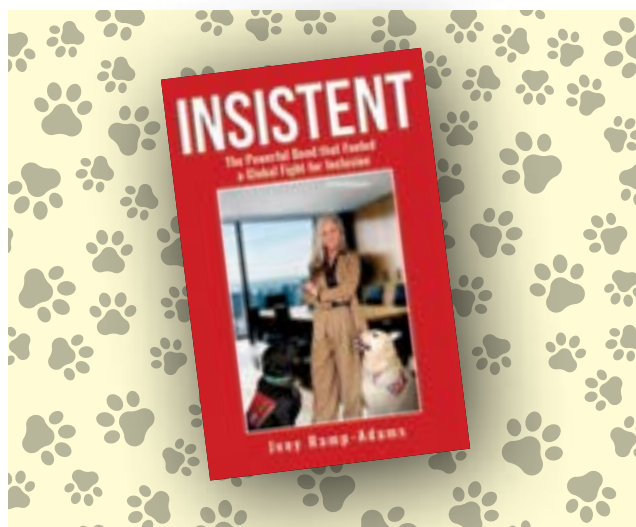
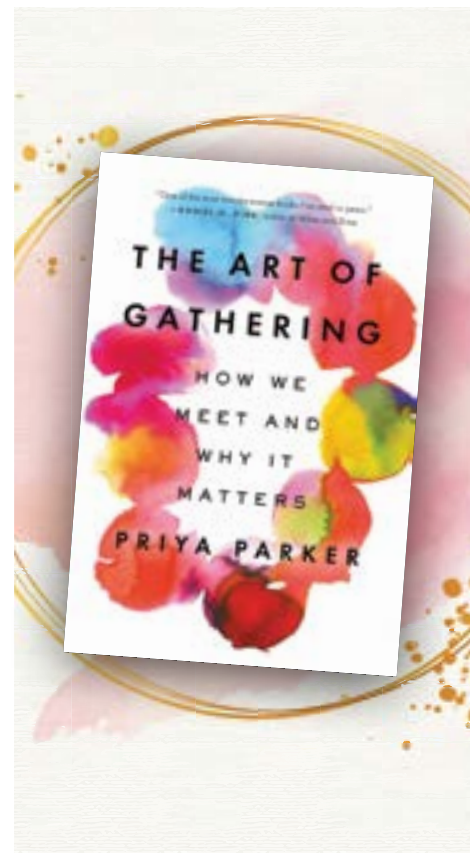
For faculty seeking to build stronger communities, foster inclusive classrooms, or simply make meetings less painful, *The Art of Gathering* is a compelling, practical read.

Jamie Canino

Associate Professor of Engineering Practice

School of Aeronautics and Astronautics

Purdue University



Have a good book to recommend? Email prism@asee.org with a brief writeup of a mainstream read (not textbook) that would be useful, interesting, or enlightening to fellow engineering educators. Please include why you recommend it. Wildcard submissions are also welcome (a non-job-related book that you think others should read, such as a poetry compilation, humor collection, or novel). We will run a selection of submissions in Prism. Writeups may be edited for length and clarity. Looking forward to your recommendations!

Insistent: The Powerful Bond That Fueled a Global Fight for Inclusion

By Joey Ramp-Adams

Morgan James Publishing, 2025

I absolutely loved *Insistent*. First, ... [Ramp-Adams] has an incredible story—severely disabled due to an accident, but instead of giving up or hoping others would fix things, she studied neuroscience and was successful in situations where the deck was stacked against her. Second, ... her descriptions of what it’s like to have her disabilities were so powerful that I feel like I can better empathize with people who are in similar situations. And, finally, ... she makes a compelling case for why we need to change the world to be more inclusive, and shows how to go about doing it. (And, of course, there are pictures of her service dogs, and dog pictures automatically make everything just a bit better!)

Diane Peters

Professor, Mechanical Engineering

Kettering University



FORWARD MARCH

ASEE's new CEO will help the Society advance into a new era of progress.

By Dr. Ashok Agrawal

On January 1, ASEE will begin a new chapter under the leadership of our incoming CEO, Dr. Brian J. Novoselich. I am confident that Brian will usher in a period of excitement, growth, and renewed commitment to member engagement and services for our almost-135-year-old organization. ASEE President Christi Patton Luks and I have worked closely with Brian to facilitate his transition into the role since his appointment was announced at the Annual Conference in Montreal this past June. We are both thrilled to get him on the team in his new capacity.

Brian will contribute a unique skill set built through an extraordinary career pathway. He joins us after completing more than 30 years of service in the US Army, culminating as a colonel, professor of engineering education, and director of strategic plans and assessment at West Point. Brian earned bachelor's and master's degrees in mechanical engineering from West Point and the University of Texas at Austin, respectively. He earned his PhD in engineering education from Virginia Tech in 2016 and currently serves as chair of that department's advisory board. Brian spent nearly 16 years as an engineering faculty member at West Point. He has been a long-time volunteer and leader within ASEE as an author and member of the executive committees for the Military and Veterans, Engineering Leadership Development, and Mechanical Engineering Divisions. He has most recently served on the Finance Committee. His exceptional set of career experiences will serve him well in this new role.

As I approach the conclusion of my interim term on December 31, and as Brian takes on the leadership of this great organization, I am pleased to report that ASEE's health remains strong, and we've made significant leaps in stabilizing our finances. Although there is still a long way to go, I look forward to seeing Brian lead us to new heights in the coming years.

I AM PLEASED TO REPORT THAT ASEE'S HEALTH REMAINS STRONG, AND WE'VE MADE SIGNIFICANT LEAPS IN STABILIZING OUR FINANCES. I LOOK FORWARD TO SEEING BRIAN LEAD US TO NEW HEIGHTS IN THE COMING YEARS.

I am honored to have been entrusted with the leadership of the Society since February 2025. As many of you are aware, I inherited an organization still rebuilding from the financial challenges that we endured beginning in 2022. I am pleased to report that we have made incredible progress toward financial stability while we continue to create efficiencies in the organization. We have completed our financial audits through FY2023 and are on track to complete FY2024 soon. This will put us back on schedule for our annual financial audits to be completed on time in the future. Thanks to incredible work by our Board and staff, we have made tremendous strides in cost savings to deliver a balanced budget and remain fiscally accountable. We were excited to begin replenishing our BASS accounts this fall and hope to continue doing so in the future.

I am cautiously optimistic that the worst is behind us. However, we recognize that our recent internal focus and staff cuts to alleviate financial pressure may have degraded the member experience. Our return to some semblance of financial stability is giving the staff the ability to shift focus toward enhancing the member experience and aiding our volunteer leaders who are the lifeblood of the Society. Despite all the challenges, ASEE has maintained strong support from its dedicated members and their institutions, engineering and engineering technology deans, federal agencies such as the National Science Foundation, and industry and private partners. I truly appreciate everyone's commitment to the long-term health of ASEE, and I can't wait to watch Brian move the Society forward into a dynamic and re-energized future.

Dr. Ashok Agrawal is ASEE's interim CEO and Executive Director. An ASEE Fellow, he served from 2013 to 2019 as the Society's managing director for professional services and director of external affairs.

ASEE 2024-25 ANNUAL REPORT

New CEO



ASEE leaders announced the selection of the Society’s incoming CEO, Brian J. Novoselich, at the 2025 Annual Conference in Montreal. Novoselich is a professor of engineering education and director of strategic plans and assessment at the United States Military Academy at West Point. He is also an active duty colonel in the US Army. Novoselich has been a Society member for more than 15 years, serving in various Committee and Division leadership roles.

Learn more at <https://bit.ly/43opgqg>.



Learning in Action

This year, ASEE Learning empowered over 1,000 engineering educators to reach their professional goals through nine fee-based programs and eight free webinars. ASEE launched two new offerings this year: Essentials of Effective Manuscript Preparation and a workshop series on using generative AI to optimize research, teaching, and learning. In the five years since its launch, ASEE Learning has provided career development programming to more than 3,800 participants.

Visit learning.asee.org.



Advancing Sustainability

The ASEE Engineering for One Planet Mini-Grant Program (EOP-MGP), funded by The Lemelson Foundation, launched its fourth cohort in April 2025 and awarded 24 new faculty teams financial and professional support to integrate sustainability into engineering curricula. Since its inception, EOP-MGP has engaged faculty from over 70 institutions, supported the creation or modification of more than 300 courses using the EOP Framework, and reached over 16,000 students, plus hundreds of faculty, nationwide. Applications for the fifth cohort are open now, with program activities beginning in spring 2026.

Go to <https://eop-mgp.asee.org>.



A New Blueprint

Building on the 2024 *Engineering Mindset Report* with NSF support, ASEE developed the *Blueprint for Change* via a national task force. The *Blueprint* translated the *Mindset* report into actionable guidance for colleges, accreditors, and policymakers. One or both have been presented at ASEE’s Annual Conference (Montreal, Quebec), the Global Polytechnic Summit (Menomonie, Wisconsin), Engineering Deans Institute (Tucson, Arizona), and the Engineering Change Laboratory Summit (Austin, Texas).

For more info, contact mindset@asee.org.

Engineering Educators Bringing the World Together
2025 ASEE Annual Conference
 June 22 - 25 | Montreal, Quebec, Canada

ATTENDANCE	PAPERS SUBMITTED	PAPERS PUBLISHED
4,053	2,710	2,466
Previous record: 4,049	Previous record: 2,439	Previous record: 2,192
AUTHORS	TECHNICAL SESSIONS	
1,945	461	
Previous record: 1,735	Previous record: 419	

Prism Honors

Prism won all four Communicator Awards for which we submitted materials in 2025:

- **“Magic Touch”**
Profile Writing, Summer 2024
Award of Excellence
 - **“Twitch and Shout”**
Profile Writing, Fall 2024
Award of Excellence
 - **“Tooth and Nail”**
Cover Design, Fall 2024
Award of Excellence
 - **“Pecking Order”**
Cover Design, Spring 2024
Award of Distinction
- This year’s Communicator Awards received more than 3,000 entries.

See the Prism issues at <https://bit.ly/3P253im>.



The Communicator Awards





Lyle D. Feisel

Former ASEE President (1997–98) and Interim Executive Director (2011–2012)

Engineering education pioneer Lyle D. Feisel, who served in leadership roles within ASEE and as founding dean of the engineering school at Binghamton University, passed away November 5, 2025. He was 90.

Feisel spent his early years on a farm in Iowa and attended a one-room country schoolhouse for elementary school. After three years at sea in the US Navy, he earned his BS, MS, and PhD degrees in electrical engineering from Iowa State University. His distinguished career in engineering education began in 1964 at the South Dakota School of Mines & Technology, as professor and then department head of electrical engineering. In 1983, Feisel was named the first dean of the Thomas J. Watson School of Engineering and Applied Science at Binghamton University, part of the State University of New York system. He led the school's formation and expansion until his retirement in 2001.

Feisel's long academic tenure spanned teaching, research, and administration. In a 1997 *Prism* article, "Teaching Doesn't Matter," he explained one of the core tenets of his educational philosophy: "[I]n the end, our job is not to teach. Our job is to help our students to learn."

Feisel said that ASEE had "an enormous impact" on him. He took on various local and national leadership roles, including chairing the *Prism* Editorial Advisory Board. He also helped launch and chaired the New Engineering Educators Division and served as PIC I Chair and VP of Finance. Later he became President and then Interim Executive Director of the Society. He was an ASEE Fellow.

"I always reminded people that they were faculty members, not just researchers or engineering practitioners, and ASEE was the place where they needed to be involved and form connections," he told an interviewer.

ASEE Chief Operating Officer Patti Greenawalt knew Feisel for many years. "Lyle was a wonderful, warm, and generous soul," she says. "He always had time for you, always had a smile, was always thoughtful and supportive."

Feisel was also very involved with the Institute of Electrical and Electronics Engineers (IEEE) and served as president of the Association of Engineering Colleges of New York State. In 2013, columns he wrote for *The Bent*, the Tau Beta Pi engineering honor society's magazine, became his book *Lyle's Laws: Reflections on Ethics, Engineering, and Everything Else* (Brooklyn River Press).

A Few of Lyle's Laws

- See what is there, not what you wish for.
- If you do things for the right reasons, you will probably do the right things.
- Who you are is revealed by what you do when you are absolutely certain that no one will ever know you have done it.

ASEE's DELTA (Δ) Institutes empower engineering faculty at every career stage to lead with excellence. [Sign up now to lock in our last-chance pricing.](#) Learn more at www.learning.asee.org.

NEW FACULTY INSTITUTE

January 5 - 8, 2026 | 11AM - 1PM, ET

This course equips new faculty with knowledge and tools to establish teaching practices; balance research, service, and scholarship responsibilities; and navigate the expectations of their institution and discipline.

Last Chance Rate: \$550 (member); \$650 (non-member)



REGISTER NOW!

NEW DEPARTMENT LEADERS INSTITUTE

January 12 - 14, 2026 | 1PM - 5PM, ET

This course equips new department chairs with insights and strategies to effectively manage resources, support faculty and staff, foster student success, and lead a thriving department.

Last Chance Rate: \$700 (member); \$800 (non-member)



REGISTER NOW!



Can you decipher the clues and discover the words from this issue?

K	P	Z	P	V	B	U	R	Y	Y	R	Y	T	M	N	U	W	Y	Z	P
E	D	Z	B	V	V	D	X	K	U	L	Y	U	D	V	U	N	V	H	O
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F	A	M	J	A	R	W	W	L	N	F	W	D	C	S	I	C	Q	D	T
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Clues:

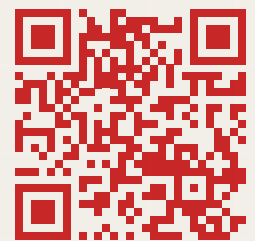
1. Montana State University professor Brock LaMeres missed the first few days of the semester because he was watching his _____ computer get launched to the moon.
2. _____ cooling is a technology that may help address heat emissions from AI.
3. One lesson from the Online Ethics Webinar Series is that organizations that provide ways for employees to raise concerns strengthen their _____.
4. ANSEP COO Michele Yatchmeneff is the only _____ Native in the world with an engineering education PhD.
5. In *The Art of Gathering*, Priya Parker offers 15 ways to make a _____ “suck less.”
6. As noted in the Email from Readers, almost 9 in 10 engineering doctorates now build their careers outside _____.
7. The 2025 ASEE Annual Conference broke records for attendance, papers published, authors, and _____ sessions.
8. According to a TeleGeography analyst, subsea telecommunication cables transmit data “more cheaply and efficiently than _____.”
9. A way to intentionally collaborate with experienced researchers has been deemed “Collabo-_____.”
10. According to Georgetown University’s Center on Education and the Workforce, the US will need an additional 5 million workers with _____ education by 2032.

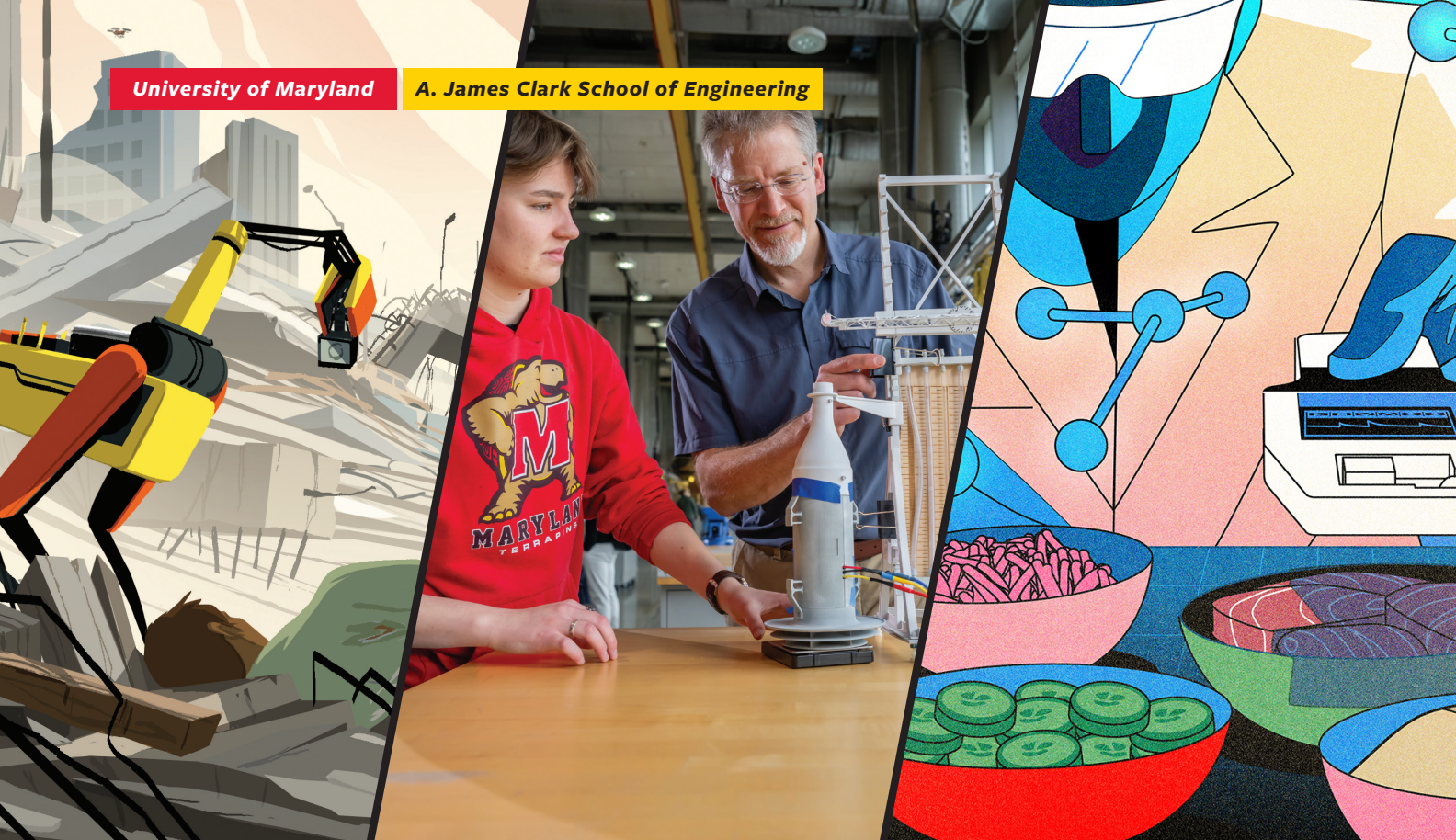
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