THE TREND IN ENGINEERING

Spring 2026

STAR POWER

UW researchers are leading development of fusion energy

PAGES 10–11

From the Dean

"Greetings from a busy College of Engineering! 2026 has brought tremendous momentum. Early in the year, I had the pleasure of connecting with engineering alumni through Converge, the UW's signature international alumni event. While in Japan, we joined President Jones and Tohoku University President Hideo Tominaga for a signing ceremony launching Q-DREAM — an expansion of the universities' decades-long partnership dedicated to advancing research, education and innovation in quantum information science and engineering, disaster resilience, engineering and advanced manufacturing and medicine.

Back on campus, the University is finalizing a strategic plan to set a clear vision through 2030. This is a vital opportunity to build on UW's strengths, confront emerging challenges and align around a bold, shared direction that is ambitious, accessible and grounded in the UW's capabilities. Engineering is central to every pillar of this vision, and as we near the conclusion of the College's current five-year plan, we will realign our priorities with the University plan.

Our impact is felt well beyond campus. Since its earliest days, the College has helped power Washington's economy and translate new ideas into real-world solutions — several of which you'll read about in this issue. Yet, like many institutions, we are navigating a complex budget environment. Federal funding remains reduced and uncertain. While the State Legislature avoided major reductions to the UW this session, the University remains focused on using state resources efficiently and this year will undertake a major plan to centralize several internal services.

Finally, I'm thrilled to share that — despite budget constraints — our community rallied to bring back Engineering Discovery Days this spring. It's an inspiring opportunity to welcome young people from across Washington to campus and spark their curiosity about engineering. I encourage you to visit **engr.uw.edu/dd2026** to see some inspiring photos and video.

Nancy Allbritton, M.D., Ph.D.
Frank & Julie Jungers Dean of Engineering

Celebrate the Class of 2026

Help recognize the UW Engineering Class of 2026 by supporting the programs, resources and opportunities graduating students say mattered most in their time at the UW.

Gifts at any level by June 15 help ensure future Huskies benefit from the same experiences and support.

Learn more about giving options
▸ **engr.uw.edu/coe-class-gift**

UW Engineering's ECONOMIC IMPACT

In addition to being a leader in research and innovation, we're also a powerful economic engine for Washington. Our impact ripples far beyond campus, reaching businesses, industries and communities across the state.

$605 MILLION
UW Engineering's annual economic impact on Washington State

82% OF GRADUATES stay in Washington

UW Engineering alumni contribute nearly **$3.9 BILLION** in annual economic activity

50% OF NEW ENGINEERS in Washington are UW graduates

UW Engineering accounted for **58% OF ALL NEW STARTUPS** at the UW

80% OF STUDENTS graduate without debt

Reported by Parker Strategy Group, covering fiscal year 2024. Learn more: engr.uw.edu/eir

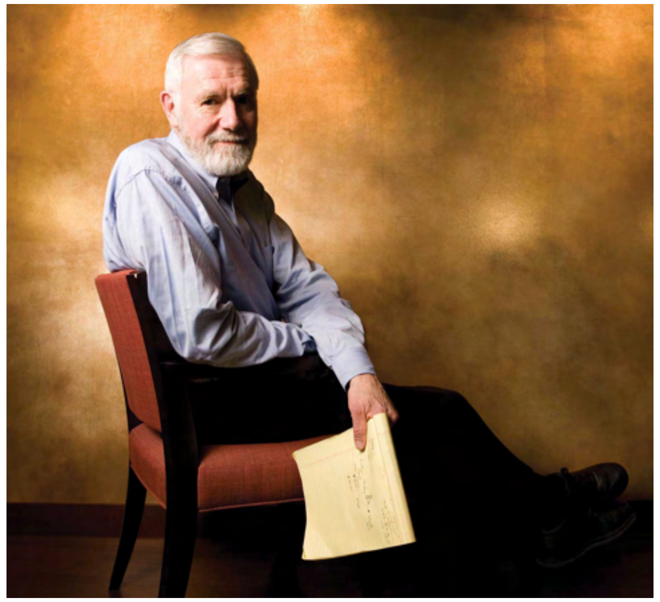
Microsoft partnership expanding into AI

Microsoft Vice Chair Brad Smith (left) and UW President Robert J. Jones (right) announce a sweeping AI partnership. University of Washington

The UW and Microsoft are expanding their longstanding partnership to accelerate AI research, prepare students and workers for an AI-driven economy and help communities understand and use AI responsibly.

This strategic collaboration will increase the UW's access to the most advanced AI computing power, expand internship and applied research opportunities for students, and develop community AI literacy programs, including a foundational AI course for working Washingtonians.

"President Jones has outlined a bold vision for the University of Washington, one that expands access and affordability in higher ed, forges radical partnerships and strengthens civic health," says Microsoft Vice Chair and President Brad Smith. "It's essential that this vision includes broad access to AI technology and the skills to use it, so students, workers and communities across Washington are prepared for this new era of computing and can share fully in its benefits."



Dr. William Foege was a giant of global health. Brian Smale

Remembering William Foege

Dr. William Foege, a 1961 graduate of the UW School of Medicine, died in January at age 89. A physician and epidemiologist, Dr. Foege was best known for developing the surveillance and ring vaccination strategy that eradicated smallpox worldwide by 1980. First tested in Nigeria in 1966, his approach targeted immunization toward those most likely to be infected.

Dr. Foege went on to head the U.S. Centers for Disease Control and Prevention from 1977 to 1983, navigating the early HIV/AIDS crisis and toxic shock syndrome identification. He later advanced global vaccination and child survival through leadership at The Carter Center and the Bill & Melinda Gates Foundation.

In 2006, the UW dedicated the William H. Foege Building, which houses the departments of bioengineering and genome sciences, in his honor. In 2012, he was awarded the Presidential Medal of Freedom.

David Baker elected to National Academy of Engineering

David Baker, recipient of the 2024 Nobel Prize in Chemistry, has been elected to the National Academy of Engineering.

Baker is a professor of biochemistry and adjunct professor of bioengineering, chemical engineering and computer science and engineering.

This latest honor recognizes his development of computational methods to predict the folded structures of proteins and to engineer novel proteins that can perform vital functions in the body. More recently, he has been leading efforts in deep learning and other AI technologies to accelerate protein design.

Baker directs the UW Institute for Protein Design and is co-founder of 21 biotech companies.

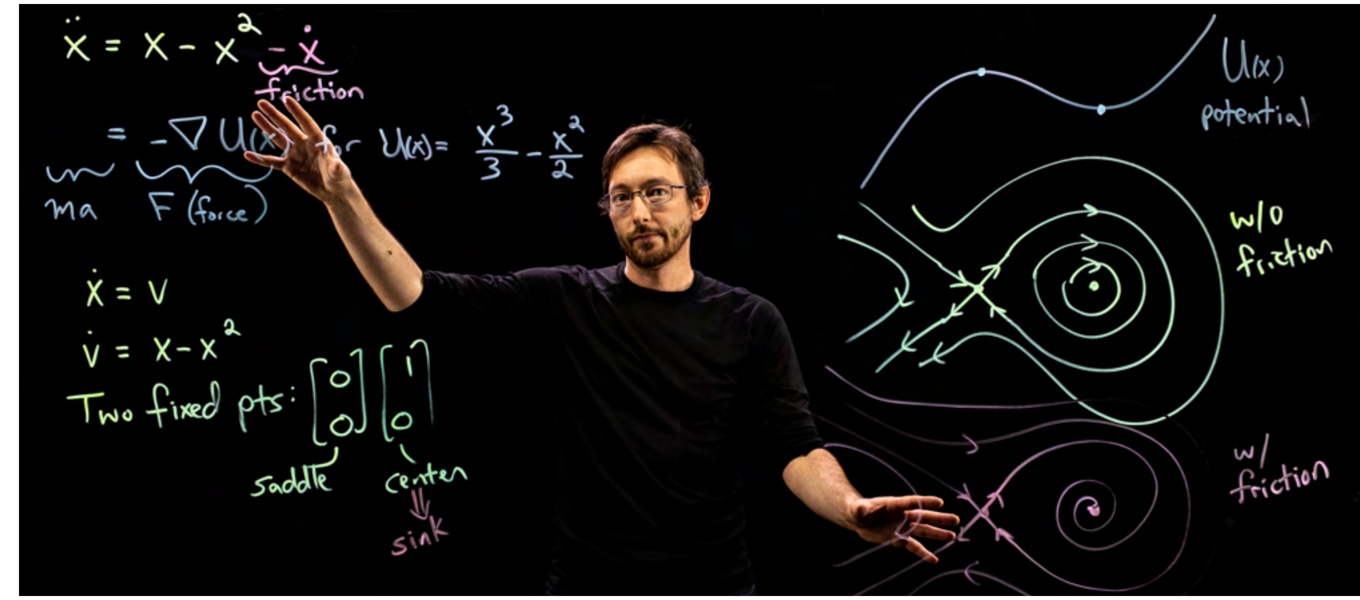
UW converges, Q-DREAM emerges

A panel discussion on global partnerships headlined the College of Engineering reception at UW Converge. University of Washington

At February's Converge, the UW's signature annual event for international alumni and friends, more than 60 UW Engineering alumni attended a reception in Tokyo hosted by Nancy Allbritton, Frank & Julie Jungers Dean of Engineering. Vice Dean Jihui Yang moderated a panel exploring high-impact global partnerships around research and education.

One such partnership is Q-DREAM, a new joint research, education and innovation partnership of the UW and Tohoku University to advance innovation in quantum technologies, disaster resilience, advanced manufacturing and medicine.

"Addressing today's complex challenges requires bold, collaborative solutions," said UW President Robert J. Jones of the Q-DREAM agreement. "When leading research universities align around a shared vision, we amplify our ability to advance discovery, drive innovation and serve the public good."



Steve Brunton, professor of mechanical engineering, directs the College's new professional programs in AI and machine learning for engineering. Dennis Wise / University of Washington

Demystifying AI for engineering

AI tools are reshaping nearly every field — including engineering. To meet the growing demand for engineers who know how to integrate these tools into their practice, the College of Engineering has launched two new professional programs — a graduate certificate and a master's degree — in AI and machine learning (ML) for engineering.

Steve Brunton, a professor of mechanical engineering and the programs' director, explains what makes them unique and why the time for them is now.

Who should consider these professional programs?

They're designed for working engineers who want to add AI and ML to their existing expertise. We see students from a wide range of fields, from early-career engineers looking to expand their technical toolkit to experienced professionals who want to lead teams integrating AI into complex systems. They come from aerospace, chemical manufacturing, healthcare, e-commerce, energy and beyond. What they share is a desire to apply AI smartly and safely to real engineering challenges.

Why were these programs created?

We recognized a gap between what's typically taught in classrooms and the cutting-edge research on applying AI in engineering contexts. General AI tools are not intended for designing airplanes or bridges. Engineers need to learn AI that's built specifically for engineering — because the margin for error in the physical world is essentially zero.

What are students working on?

We have engineers working on safer aircraft — improving control systems, inspection methods and warning systems. Others are using AI to optimize manufacturing processes and improve worker safety. One engineer is developing automated food spoilage detection. Others are applying these techniques to offshore wind energy, fusion, medical physics and advanced imaging.

How do these programs prepare engineers to use AI responsibly and strategically in their careers?

One of the best ways to use AI responsibly is to truly understand it. These programs demystify AI tools for engineers, teaching them to treat AI systems the way they treat any engineering system: understanding how they work and how to evaluate their limitations. That foundation is what allows engineers to certify, deploy and manage AI technologies in ways that prioritize safety and reliability, not just technical performance.

This mirrors what industry is looking for right now. Every sector is investing in AI, and companies need engineers who combine deep domain expertise with a strong understanding of AI systems. Engineers who complete these programs will work smarter, tackle more complex problems and be better positioned to lead. The goal, ultimately, is for AI to be a tool that allows us to do our jobs better and to make the world a better place through engineering.❖

Learn more about our AI and ML for engineering professional programs

▶ **engr.uw.edu/ai-ml-programs**

DECADES OF

ENGINEERING IMPACT

We look back at 26 groundbreaking inventions and discoveries from UW engineers and computer scientists that have transformed the way we live, work and connect.

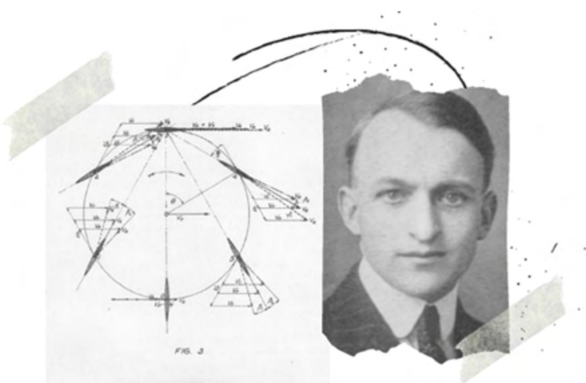
From the beginning, UW engineers and computer scientists have shaped progress in ways that touch everyday life. Here we spotlight 26 inventions and discoveries developed wholly or in part by faculty, alumni and staff — examples of the lasting impact of UW engineering innovation.

This list isn't meant to be definitive, but a snapshot of a much larger legacy — one that includes foundational research and advances in theory and methodology that reshaped engineering practice, making later breakthroughs possible. We acknowledge that most of the names here are men, a reflection of the field's historical gender imbalance. We look forward to highlighting a broader range of contributors and innovations in future features.

Air and space

BOEING JET AIRLINER

If you've flown on a Boeing commercial airliner, you've experienced the work of Maynard Pennell, '31; Jack Steiner, '40; Joe Sutter, '43; John Roundhill, '67; and others — aeronautical engineering graduates who served as chief designers of jet planes that revolutionized air travel.



Prolific inventor Frederick Kirsten. UW Aeronautics & Astronautics

CERAMIC TILES FOR RE-ENTRY

When early space shuttle tiles failed under 2,000-plus-degree re-entry heat, engineering professors James Mueller and John Bollard, along with other UW scientists and students, devised solutions to fix the problem: strengthening tile material and toughening its base, creating stronger load paths between the tiles and the vehicle surface.

CYCLOIDAL PROPELLER

Invented in the early 1920s by engineering professor Frederick Kirsten, the cycloidal propeller used rotating blades with changing pitch to produce thrust in any direction. Tested in the UW's wind tunnel and later developed with William Boeing, the design enabled exceptional maneuverability and influenced modern thrust-vectoring systems still used in marine propulsion.

HARD SPACESUIT

Electrical engineer Siegfried Hansen, '33, developed the early hard-shell "Mark I" spacesuit, featuring a rigid torso and flexible arms that maintained constant volume while allowing the occupant to manipulate their external environment. His design laid the foundation for the spacesuits used in NASA missions today.

Computing and digital technologies

Early personal computers. Kimberly Nguyen / Unsplash

CLOUD COMPUTING INFRASTRUCTURE

As one of Google's first 20 employees, computer science alumnus Jeff Dean, '93, '96, co-designed and co-implemented the revolutionary distributed computing architecture that enabled Google to scale, underpinning the company's rapid rise and spawning the cloud computing era. Dean now leads Google's deep learning and language model efforts.

DESKTOP PUBLISHING

Mathematics and computer science alumnus Jeremy Jaech, '77, '80, co-founded and led engineering at Aldus, which pioneered desktop publishing with PageMaker. When Aldus was acquired by Adobe, Jaech went on to co-found Visio, maker of the first mass-market diagramming and data visualization software, later acquired by Microsoft.

DIGITAL ART AND CGI EFFECTS

After earning his electrical engineering degree, Victor Wong, '89, founded vfxNova, the first digital graphics and visual effects house in Hong Kong, helping advance CGI (computer-generated imagery) technologies for film and gaming. Wong also invented A.I. Gemini, a robot trained to paint in the traditional Chinese *xieyi* style.

EARLY PC OPERATING SYSTEMS

UW alumni helped shape the personal computer revolution. Mathematics and computer science alumnus Gary Kildall, '67, '72, created CP/M, the first practical PC operating system. Computer science alumnus Tim Paterson, '78, later wrote QDOS, which Microsoft acquired, renamed MS-DOS, and licensed to IBM — establishing the industry standard that launched modern personal computing.

FRACTAL GRAPHICS AND DIGITAL ANIMATION

Computer science alumnus Loren Carpenter, '76, revolutionized computer graphics and digital filmmaking. In 1980, he created the world's first fractal movie using algorithms that rendered landscapes faster than hand-drawn animation. His approach shaped iconic movie effects and later informed Pixar's industry standard software for digital animation and visual effects.

GOOGLE GLASS

Building on his invention of bionic contact lenses, electrical and computer engineering faculty member Babak Parviz founded and led development of Google Glass. His team, which included alumna Jean Wang, '04, '07, delivered the first fully integrated head-mounted device, advancing AR/VR hardware, wearable technology and robotic surgery platforms worldwide.

OPEN DATA KIT

Allen School Professor Gaetano Borriello led the development of Open Data Kit (ODK) — software for mobile data collection and reporting in low-resource settings. Driven forward by computer science alumnus Yaw Anokwa, '07, '12, ODK has been used in over 220 countries to collect billions of records in support of public health, conservation and more.

SHAREWARE

PC-WRITE, written by computer science alumnus Bob Wallace, '78, was the first software program distributed for free with a proviso asking for a contribution. If the user sent back the fee, they would receive added features. Wallace dubbed the idea "shareware," a concept that spread worldwide with the birth of the Internet.

DECADES OF
ENGINEERING IMPACT

Health and wellness

CARDIAC TREADMILL
Designed by mechanical engineering alumnus Wayne Quinton, '59, the first medical treadmill transformed cardiac testing. Used in UW cardiologist Robert A. Bruce's landmark stress test, it offered a safer, more precise alternative to step tests and enabled physicians to diagnose heart and lung disease.

DUPLEX ULTRASOUND
Electrical engineer Don Baker, '60, was part of a UW team that integrated pulsed Doppler with ultrasound imaging to measure blood flow. This diagnostic tool — duplex ultrasound — became a foundation for modern ultrasound scanners and is used worldwide in cardiology, obstetrics, cancer detection and surgery.

ENBREL AND OTHER DRUGS
Bioengineer Wayne Gombotz, '85, '88, helped develop Enbrel, transforming treatment for rheumatoid arthritis and psoriasis. Approved in 1998, it became a top-selling drug. Gombotz also contributed to the development of Leukine, Bexxar, Melacine and Thioplex to treat cancer, MPL to boost vaccine response, and Omidria for use during eye surgery.

HELP US EXPAND THE LIST
Know of a life-changing invention developed by UW Engineering faculty, staff, students or alumni that's not listed here? Send us a note at trenduw@uw.edu

Ultrasound scanners have become an essential tool of modern healthcare.

KIDNEY DIALYSIS INNOVATIONS
UW Medicine Professor Belding Scribner envisioned a Teflon shunt which engineer Wayne Quinton, '59, helped bring to life, making kidney dialysis a viable lifelong treatment. Albert Babb, a professor of chemical engineering, advanced kidney care by developing machines for automated and home dialysis, saving countless lives worldwide. Babb was nominated for the Nobel Prize in 1978.

ROTABLATOR
David Auth, a professor of electrical engineering, invented the Rotablator, a device that uses a tiny catheter to clear arterial blockages. Its football-shaped burr spins up to 190,000 rpm, sanding away brittle plaque while preserving healthy tissue, offering a precise and minimally invasive solution for restoring blood flow.

SMARTPHONES FOR HEALTH MONITORING
Professors Shyam Gollakota (Allen School) and Shwetak Patel (Allen School and electrical and computer engineering) transformed smartphones into powerful health-screening tools by repurposing built-in cameras, sensors and microphones to measure vital signs, detect ear infections and more. Their work expanded access to low-cost diagnostics and generated multiple startup companies — including Senosis, later acquired by Google.

SONICARE TOOTHBRUSH
Bioengineering Professor Roy Martin — with David Engel, Joseph Miller and David Giuliani — introduced the first Sonicare toothbrush in 1992. Its bristles moved 100 times faster than manual brushing, and the brush's cleaning action directed fluids between teeth and below the gumline, removing plaque and preventing gum disease.

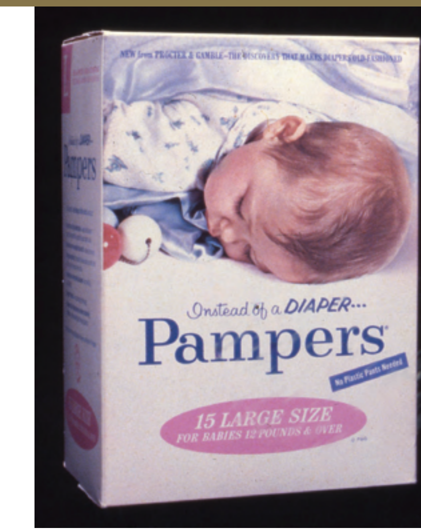
Lifestyle and entertainment

DIGITAL HDTV
Electrical engineer Richard Citta, '71, helped bring entertainment into high definition. At Zenith Electronics, he led development of an over-the-air broadcast system that enabled the transition from analog to digital HDTV. His innovations reduced interference and energy use and freed up spectrum for countless wireless digital services to follow.

DISPOSABLE DIAPERS
During his legendary tenure leading product development at Procter & Gamble, chemical engineer Victor Mills, 1926, had the vision to transform the waste pulp of a newly acquired paper mill into the super-absorbent liner of the first disposable diaper. Pampers changed the game for harried parents — and launched what has become a $100 billion global industry.

MASS-PRODUCED FOODS
At Procter & Gamble, Mills also converted insights from his large-scale refinement of Ivory Soap and Pampers diapers into mass-production of foods ranging from Jif peanut butter to Duncan Hines cake mix to Pringles crisps. Chemical engineer Charles Matthaei, '43, developed the first industrial process to incorporate whole grains into Roman Meal bread, paving the way for healthier packaged foods.

Golf club innovator Karsten Solheim. Courtesy of PING and Golf Digest



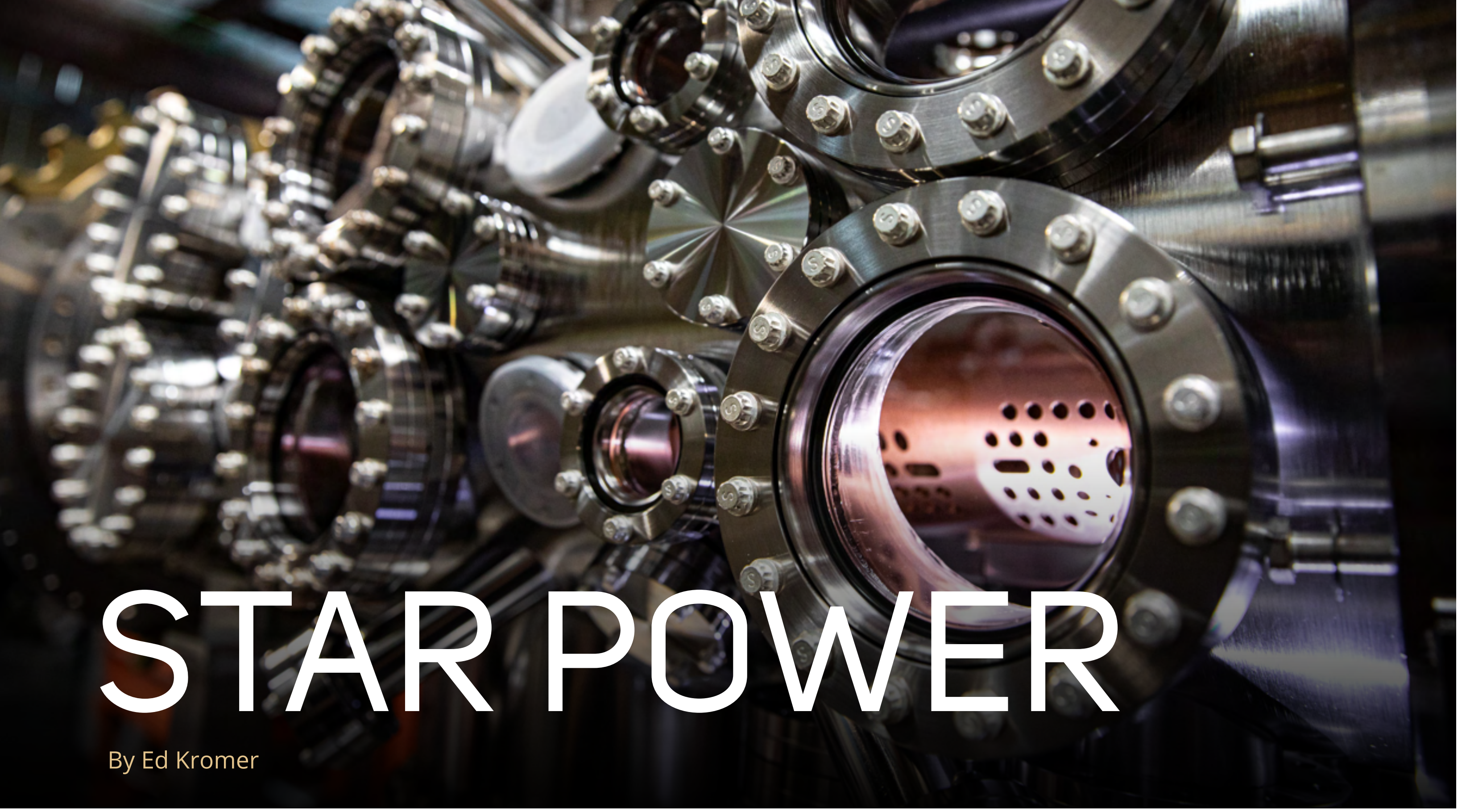
The disposable diaper was a game-changer for babies and their parents. Courtesy of Procter & Gamble

REAL-TIME TRANSIT TRACKING
Before real-time transit data, bus riders relied on schedules and guesswork. The OneBusAway app changed that by providing tracking information for King County Metro buses. Created when graduate students Brian Ferris and Kari Watkins merged their Ph.D. research, the system transformed how people navigated Seattle's public transportation.

SINGLE-HANDLED FAUCET
While studying mechanical engineering at the UW in the late 1930s, Alfred Moen invented the single-handled faucet after scalding his hands under a conventional dual-handled fixture. His humble, hygienic innovation led to the founding of the eponymous company that remains a major player in plumbing.

SWEETER GOLF CLUBS
An avid but frustrated golfer, Karsten Solheim, '33, applied his mechanical engineering expertise to revolutionize club design and manufacture. His precision putters and irons introduced a bigger "sweet spot" and allowed more room for error to pros and duffers alike. The brand he founded, PING, is still one of the bestselling in the sport.

SYNTHETIC RUBBER, VINYL AND BUBBLE GUM
A chemical engineer at B.F. Goodrich during World War II, Waldo Semon, 1920, 1924, developed synthetic rubber essential to the war effort. He later invented a soft, pliable form of PVC now used in thousands of products, from credit cards to garden hoses. But his favorite invention? Synthetic rubber bubble gum, which looked like regular gum but blew giant bubbles. ❖



STAR POWER

By Ed Kromer

UW researchers are leading the development of nuclear fusion, harnessing the power of a manufactured miniature sun to meet the exploding demand for sustainable energy.

Uri Shumlak was just a kid working at a Houston gas station in the mid-1970s when the OPEC oil embargo forced drivers to queue for hours in hopes of filling their tanks.

"I saw the desperation of people begging for gas after we had reached our daily quota," he recalls. "I thought, there *has* to be a better way to produce energy."

Shumlak has devoted his career to finding it. The professor of aeronautics and astronautics is a leader in the development of nuclear fusion, perhaps the best alternative to fossil fuels to meet humanity's exploding demand for energy.

He says fusion energy — extracted from fusing atoms in superheated plasmas — offers a long list of virtues: It emits no greenhouse gases and produces no long-lived radioactive waste. It has the potential to generate vast amounts of power from abundant fuel drawn from seawater. And, unlike existing renewables, it could scale to meet global demand.

Most of all, fusion is forever, according to Bhuvana Srinivasan, Shumlak's former student and current faculty colleague.

"If we can achieve fusion," Srinivasan says, "we can solve the energy problem to perpetuity."

Of course, there are a few details to work out first.

In the superheated soup

As a concept, fusion energy is as awesome as it is audacious.

Shumlak, Srinivasan and researchers around the world are endeavoring, essentially, to create and contain a miniature sun — a "star in a jar" — and harness its energy to power modern life.

The process begins by generating stellar levels of heat. "With the technological innovations that the field is driving, we're now able to create temperatures hotter than the core of the sun in the laboratory," says Srinivasan.

This superheating creates plasma, a state of matter best described as an atomic soup. Extreme temperature and pressure enable positively charged nuclei, such as common hydrogen isotopes, to overcome their physical repulsion. And when two nuclei fuse into one, enormous energy is released in the form of alpha particles and neutrons.

The challenge is in confining plasma and capturing the energetic product of its fusion.

Containment strategy

The sun accomplishes this with its massive gravitational force. On Earth, however, researchers need to finesse physics to confine plasma. Shumlak has long experimented with a magnetic method called a Z-Pinch.

In his Flow Z-Pinch Lab, students tinker with a Frankenstein-ed device of conjoined metal cylinders speckled with welded portals and tethered to capacitors by a tangle of hoses and wires. Its steampunk vibe feels appropriate to this effort to turn science fiction into reality.

Inside the ZaP-HD's fusion chamber, an electric current runs through an accelerated flowing plasma, enveloping it in a stable magnetic force field. The stronger the current, the tighter the compression — until it reaches sufficient heat and pressure to fuse nuclei.

More advanced equipment has been developed at Zap Energy, the spinoff company that Shumlak co-founded with longtime collaborator Brian Nelson, an emeritus professor of electrical and computer engineering, and inventor Benjamin Conway.

With nearly $350 million in private and public investment, Zap is enhancing the production and frequency of plasma flows and using liquid lithium to convert the hailstorm of neutrons from a fusion reaction into steam that can produce grid-ready power. The company plans to deliver this via compact, modular reactors, each capable of generating 50 megawatts of electricity — enough to power a small city.

Ecumenical support

While Zap pursues a particular path to fusion, Srinivasan supports a wide range of efforts and approaches.

Her PLASMAWISE Lab creates computational models and measurements for concepts being developed at the UW, Princeton and several national labs. She says the "high-fidelity physics" behind their simulations guides experimentation and diagnostics — often with superior efficiency and precision.

"If you run a whole series of experiments, you may not have the ability to construct the full picture. If you run a whole series of simulations, you may never capture the real world," Srinivasan says. "But a combination of the two validates what's really happening."

The race to fusion

When it comes to fusion energy, the trillion-dollar question remains: When will this technology deliver?

"When I was a grad student, the joke in my field was that fusion is always 30 years away," Srinivasan says. "Now the joke is that fusion is always 10 years away."

What may finally kill this joke, she says, is the extraordinary research and development underway at massive international projects such as ITER and a constellation of national labs and universities — and in the clusters of startups forming around them. Washington's robust fusion ecosystem represents a large chunk of the nation's nascent industry, led by Zap and Helion Energy, which was co-founded

Professors Uri Shumlak (left) and Bhuvana Srinivasan (right). Zap Energy and University of Washington

by aeronautics and astronautics Ph.D. alumnus George Votroubek.

Though many scientific and engineering problems remain to be solved, researchers are producing regular breakthroughs, most notably the first fusion "ignition" at Lawrence Livermore National Lab in 2022, when more energy was extracted from fusion than it took to produce it.

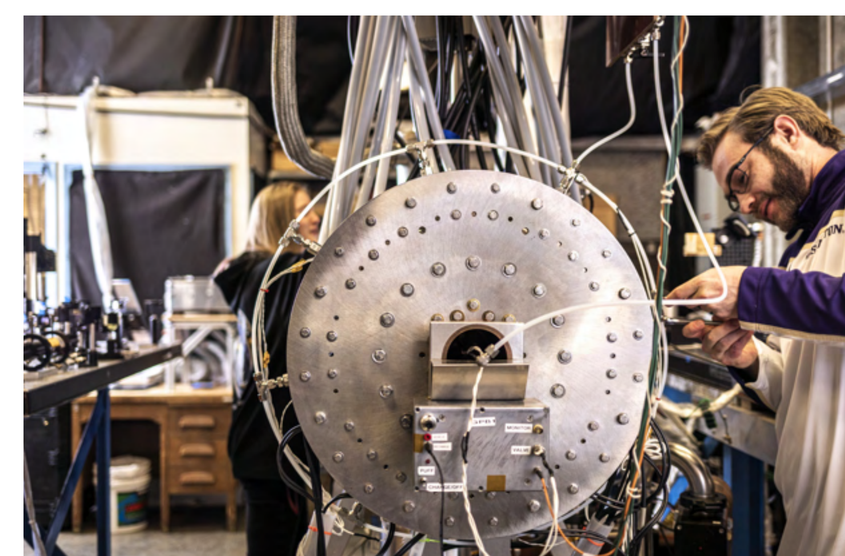
Fusion's timeline depends on science, engineering and funding by government, universities and conscientious (or opportunistic) investors. And on the commitment of researchers like Srinivasan and Shumlak and generations of their students — who are all in.

"I don't know when it's going to happen," Shumlak says. "But I believe that fusion energy is going to be necessary for us to move forward as a civilization. That's a cause worth devoting my career to."

It's why the race to this technology may be more collaborative than most.

"We *need* fusion energy," Srinivasan says. "Whoever gets there first, it will be a huge win for humanity." ❖

Top left and cover: Zap Energy is developing advanced fusion energy reactors. Zap Energy. *Bottom: Graduate student Jared Smith (right) and undergraduate Kirsten Alderson (left) work on the UW's ZaP-HD fusion energy development device.* Mark Stone / University of Washington



Forest thinning supports snowpack and wildfire resilience

Researcher Andrew Lyda pilots a drone equipped with sensors to measure snow depth and forest density. Mark Stone / University of Washington

As rising temperatures nudge weather in Washington's eastern Cascades in extreme and volatile directions, forest managers have a lot to juggle. Hotter, drier summers are contributing to bigger and more frequent wildfires, while warmer winters may cause the mountainous region to lose 50% of its annual snowpack over the next 70 years — a critical concern, as mountain snow supplies the Yakima River Basin with 75% of its water supply.

To encourage fire resilience, forest managers use tools like controlled burning and selective felling to thin out the forest. But less is known about their impact on snowpack. To address this knowledge gap, researchers at the UW and The Nature Conservancy embarked on a multiyear study along Cle Elum Ridge. The team experimentally thinned a roughly 150-acre area, then measured snowpack and compared it to a previous winter before treatment.

The results were encouraging: forest thinning increased snowpack by 30% on north-facing slopes and 16% on south-facing slopes, with gaps of 4-16 meters in diameter emerging as the "sweet spot" for snow retention.

"At its core, this research shows that reducing wildfire risk and protecting water resources don't have to be competing goals," says Cassie Lumbrazo, who completed this work as a doctoral student in civil and environmental engineering. "So much of the climate conversation focuses on loss, which makes findings like this especially meaningful."

- William Poor

App turns smartphone into fetal heart rate monitor

DopFone mimics Doppler ultrasound on a smartphone to estimate fetal heart rate.

Heart rate is an important sign of fetal health, yet few technologies exist to easily and inexpensively track fetal heart rates outside of doctors' offices.

A team led by UW researchers has created DopFone, a system that uses a smartphone's existing speaker and microphone to accurately estimate fetal heart rate. The phone mimics a Doppler ultrasound, emitting a tone and listening for the subtle variations in its echo caused by fetal heart beats. A machine learning model then estimates the heart rate.

In a clinical test with 23 pregnant women, DopFone estimated heart rate with an average error of 2 beats per minute, or bpm. The accepted clinical range is within 8 bpm.

"Eventually DopFone could let people test fetal heart rate regularly, rather than relying on the intermittent tests at a doctor's office, or not getting tested at all," says Poojita Garg, a doctoral student in the Paul G. Allen School of Computer Science & Engineering and DopFone's lead developer.

- Stefan Milne

Smart glove has its own sense of touch

The Wearable Intelligence Lab in electrical and computer engineering (ECE) is full of machinery that's oddly cozy. Soft and pliable sensors are sewn, knit and glued directly into clothing to give everyday garments new capabilities.

One of the lab's newest curiosities is a nondescript gray work glove embedded with sensors that enable it to "feel" on its own. An array of small wires hidden inside the glove report the location and degree of pressure anywhere along its surface. When in use, the signals from the glove inform a real-time "heat map" of pressure that could one day help physical therapy patients track their progress, teach robots to grasp objects and more.

The OpenTouch Glove project is led by ECE doctoral student Devin Murphy in collaboration with the Computational Design and Fabrication Group and Multisensory Intelligence Lab at MIT.

Inside the OpenTouch Glove (right) is a grid of wires (left) that allows the glove to sense the location and degree of any pressure applied to it. University of Washington

Murphy and his colleagues have released the glove's design files to allow others to develop their own iterations. And they plan to open source the data collected with the glove.

"I'm excited about developing new wearable technologies that allow people to record less popular sensing modalities like touch," he says. "I want to figure out how we can capture the nuances of touch-based interactions, so that ultimately we can get better insights into our daily lives."

Watch a demonstration: **engr.uw.edu/smart-glove**

- William Poor

Ph.D. candidate Nicole Gunderson and Dr. Waleed Abuzeid of UW Medical Center conduct an endoscopic survey of a 3D-printed sinus model. Photo courtesy of Gunderson

3D vision for surgical precision

Mechanical engineering and UW Medicine researchers have developed a solution to help surgeons perform safer, more complete and more precise endoscopic procedures in the sinus and skull.

This could serve the one in eight adults who suffer from chronic rhinosinusitis, an inflammation of the honeycombed bone between the eyes and behind the nose bridge that can be removed with the aid of an endoscope — a surgical device with a light, small camera at the end of a long, flexible tube. To avoid hitting critical structures near the cavities, however, surgeons often leave behind tissue, and 30% of the surgeries need to be repeated.

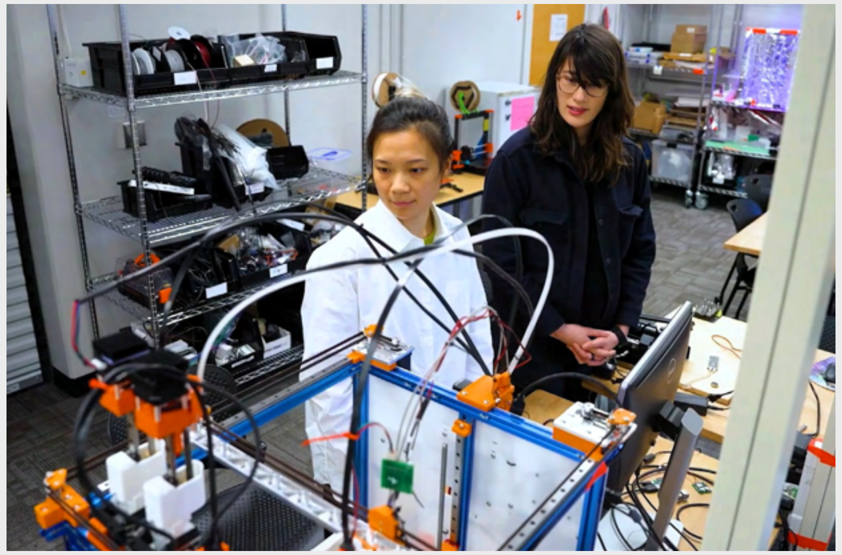
To reduce the rate of repeat surgeries, the research team developed VISTA (vision-integrated surgical tracking assistance), a system that provides accurate guidance by creating 3D models of the surgical field as tissue is being taken out.

The models are then used to update medical imaging taken before surgeries to show surgeons how much tissue has been removed and to quantify how close their medical tools are to critical structures such as the eye and brain.

"VISTA could create a huge impact for patients and the people paying for image-guided surgery, including sinus and skull-based procedures," says Ph.D. student Nicole Gunderson, who leads engineering development under the guidance of Eric Seibel, a research professor in mechanical engineering.

- Lyra Fontaine

Human-centered automation for the lab



Ph.D. student Danli Luo (right) works with Nadya Peek in the Machine Agency Lab. University of Washington

In the Machine Agency Lab, Nadya Peek, an associate professor of human centered design and engineering, is leading the design of open, adaptable automation systems that scientists can customize to fit their own research — making experimentation more reproducible and creative, and broadening who can participate in scientific discovery.

Peek's flagship platform, Science Jubilee, is an open-source hardware and software system for laboratory automation developed with Lilo Pozzo, the Boeing Roundhill Professor in chemical engineering. The Pozzo Research Group has used it for high-capacity sample preparation — mixing, measuring and photographing large numbers of samples at once. Peek also collaborates on projects that cross disciplines at the UW, from battery design to sustainable polymers.

"Every scientific field works differently," Peek says. "One setup can't serve everyone, so our goal is to develop toolkits that scientists can customize and adapt for their own spaces."

Through NSF-supported workshops, Peek has built a growing global network of scientists and engineers who co-design lab tools, share automation strategies, and contribute improvements to the community.

Looking ahead, Peek is exploring self-driving laboratories — environments where automation acts as a collaborator in discovery. "Invention can come from anywhere," she says. "The more people who have access to the tools and infrastructure to make scientific discoveries, the better equipped we are to tackle the hardest challenges."

- Leah Pistorius

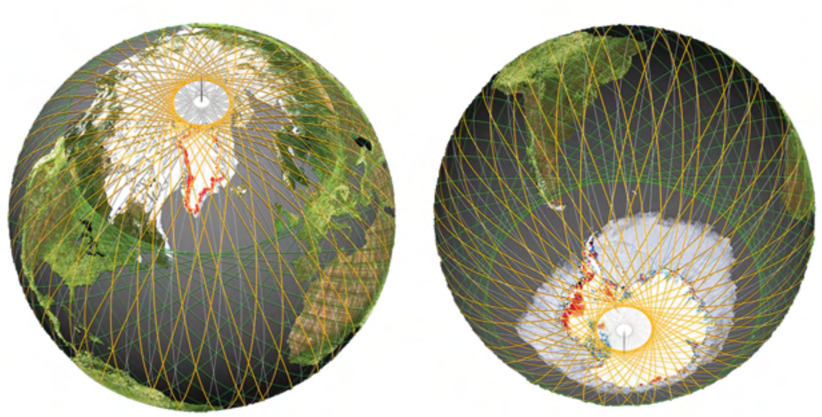
A sharper view of a changing planet

NASA has green-lit the Earth Dynamics Geodetic Explorer (EDGE) satellite mission, whose science team is co-led by David Shean, an associate professor of civil and environmental engineering.

The multidisciplinary and cross-institutional EDGE team will use laser measurements of satellite images to create high-resolution, 3D maps of the Earth's surface — the density of forests, the topography of ice sheets and glaciers — and track how it changes over time.

"We're going to be able to see things in new detail with remarkable precision and accuracy," Shean says. "And that means we can measure very subtle changes in the Earth's surface due to processes like ice melt, snow accumulation, landslide motion and volcanic deformation — all of these things that are happening around the world every day."

- Julia Davis



The EDGE orbit, depicted by the orange tracks, enables dense mapping around the edges of ice sheets and sea ice. Photo courtesy of EDGE

Eliane Nirere at a KUDURA Power solar mini-grid system in Kenya. Photo courtesy of Nirere

Bringing electricity to remote African communities

Electrical and computer engineering (ECE) doctoral student Eliane Nirere is developing data-driven approaches to expand reliable, renewable electricity access in remote communities across Sub-Saharan Africa. Drawing on fieldwork in Rwanda, Kenya, Tanzania and Nigeria, Nirere focuses on a persistent challenge in rural electrification: designing systems that match what communities actually need and will use.

"These systems, which we optimize or develop as engineers, need to be usable and benefit the communities they serve," she says. "To achieve that, we need to include the community perspective in our planning."

Nirere's research centers on decentralized, solar-powered mini-grids that operate independently from larger national grids. Mini-grids can deliver affordable power to rural areas and, in many places, provide more consistent service than outage-prone urban grids. But success depends on accurate demand estimates and community buy-in.

To address this, Nirere works directly with residents to gather input about daily energy use, priorities and expectations, then uses machine learning to convert that feedback into quantitative planning data. The resulting tools can help developers estimate demand, avoid over- or under-building, and reduce installation costs — supporting systems that are technically sound, functional, affordable and sustainable.

Advised by ECE Assistant Professor June Lukuyu, Nirere is also working toward a practical planning tool to help energy developers incorporate community perspectives into mini-grid design and broader electrification strategies.

- Wayne Gillam

Lab notes

Smart headphones clarify conversations

Conversations in a crowded room can be challenging to comprehend — especially for those with hearing impairment. But Allen School researchers have developed smart headphones that proactively isolate the voices of conversation partners amid a noisy soundscape. The headphones are powered by one AI model that detects the cadence of a conversation and another that mutes any voices or background noises that don't follow the pattern.

- William Poor

AI can learn cultural values

Artificial intelligence systems absorb values from their training data — but values differ across cultures. A new study led by UW researchers suggests that AI agents, when trained using inverse reinforcement learning, could learn cultural values by observing human behavior, much the way children do. This could enable AI models to be fine-tuned to a specific culture's values.

- Stefan Milne

Marine energy tech put to the test

Marine energy — power harvested from tides, waves and currents — has enormous potential as a clean, renewable resource. But underwater turbines or power-generating buoys can harm marine wildlife. Researchers at the UW's Harris Hydraulics Lab are modeling underwater turbine collisions with marine wildlife and submerged debris through a small sensor that detects impacts and plots interactions. The goal is a system that detects, and potentially avoids, collisions in real time.

Watch this research in action: **engr.uw.edu/marine-energy-tech**

- William Poor

BECOMING A PUBLIC SCIENTIST

By Ed Kromer

Immunology innovator Elizabeth Wayne pairs rigorous research with accessible outreach, bringing her work to the people it's meant to serve.

Elizabeth Wayne knows the power of "sticky balls." The BBC coined that evocative term to describe the immunology breakthrough revealed in Wayne's first published paper, co-authored while she was a doctoral student at Cornell University.

The 2014 study was a big deal scientifically, introducing a drug delivery system that sends bundles of adhesive and cancer-killing proteins into the bloodstream, where the proteins hitch a ride onto circulating immune cells — effectively arming them to destroy the traveling cancer cells they naturally seek.

It was a big deal culturally, too. Though scholarly publications rarely travel outside academic circles, this one ignited a global frenzy in the popular media. Hundreds of articles unpacked the paper for audiences far beyond the discipline of bioengineering.

But the BBC's pithy distillation of the study's complex biological operation — "'Sticky balls' may stop cancer spreading" — made the biggest impression on a grad student just getting started.

"It was my introduction to the power of science communication," says Wayne, now an assistant professor of bioengineering at the UW.

She has pursued that power throughout an early career equally focused on conducting rigorous research and conveying its value to the public it serves — through relatable podcasts, accessible advocacy and even an entertaining TED Talk on, well, sticky balls.

Immune system hacks

An unabashed science nerd since elementary school, Wayne's academic career took off at Cornell, where she applied insights from physics to design more perceptive biological imaging technology.

A colleague named Michael King (now a professor at Rice University) approached her to help develop a novel way to mitigate metastatic cancer, which causes 90% of cancer deaths.

King envisioned attaching a tumor-reducing protein called TRAIL to the body's macrophages — immune cells that hunt but can't harm cancer cells. "If we can kill circulating tumor cells," Wayne says, "then we can stop them from traveling to different parts of the body."

Her experiments demonstrated just that: bundling TRAIL with an adhesive protein called e-selectin was remarkably effective at binding with macrophages in the bloodstream. These "sticky balls" adhered to cancer cells and killed them on contact. This became the blockbuster 2014 paper in the Proceedings of the National Academy of Sciences, attracting attention from the biomedical community and general public alike.

Wayne followed up with a study confirming that this technique significantly reduced the population of cancer cells *throughout* the body — in the original tumor, the bloodstream and remote organs.

Taking science to the masses

The success of these studies emboldened her to apply for a TED Fellowship. She had already begun engaging outside the lab at Cornell, organizing conferences and hosting a podcast called "PhDivas."

But when Wayne earned a coveted slot presenting at the 2017 TED Conference, an exponentially bigger audience awaited. After an intensive and surreal week of coaching and presentation prep in the presence of Elon Musk, Al Gore, Serena Williams and other celebrities, Wayne delivered a TED Talk on hacking immune cells to combat cancer. The video has been viewed more than 1.5 million times.

The experience generated a level of celebrity she'd never imagined. There were speaking invitations, a book proposal and hopeful letters from cancer patients. But also criticisms from scholars in some corners of academia, who believe that time and energy spent on podcasts and TED Talks diminishes the serious business of research.

It was overwhelming. But after Wayne took some time to reflect on her future, she emerged with clarity and a renewed sense of mission: to operate with a dual focus on research *and* outreach.

"The tension is real, and understandable," she says. "But I think about how to merge research and outreach into one common vision. It has become imperative to reinforce why scientists are needed and what is our value."

America's nerds

The value in Wayne's lab is obvious. Her work has evolved from hacking immune cells for drug delivery to converting them into diagnostic — and even prognostic — tools. With long-term funding from the National Institutes of Health, she's currently exploring whether bioluminescent molecules from fish and fireflies can be used to make macrophages "light up" in response to the earliest signs of disease.

And not just cancer. The promise of Wayne's bioengineering is an organic system of surveillance and treatment for virtually any of the body's myriad potential disorders. "We started with cancer cells," she says. "But inflammation is everywhere."

Wayne stays busy outside the lab, too, advocating for inclusion of women in STEM, engaging with cancer patients and survivors to inform her work and inspire her students, and translating research for the public. She has co-produced a TED-Ed explainer video on COVID-19 vaccines. And she's once again behind the microphone, this time shining a light on the contributions of fellow researchers through her "Office Hours" podcast, a partnership with the American Biomedical Engineering Society.

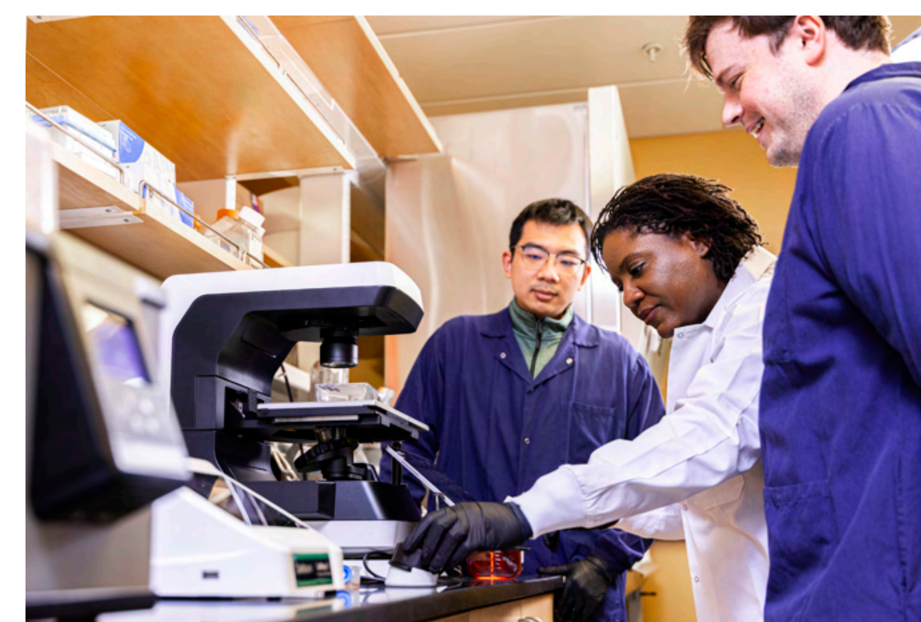
"I feel like I'm inventing a new way to be a public scientist," she says.

She increasingly views research and outreach as her yin and yang — complementary and interdependent forces that create human connection, provide purpose, ensure relevance and generate visibility that is essential to funding her work and supporting her students' development.

It's also a constant reminder that the heart of bioengineering is human.

"I believe that engineers and scientists serve the public," says Wayne. "We ask probing questions to solve important problems and train students who will make our communities better. We're America's nerds. I'm *your* nerd." ❖

Top left: Elizabeth Wayne delivers a TED Talk in 2017. Ryan Lash / TED
Bottom: Wayne backs her outreach with probing research and student development in her UW lab. Mark Stone / University of Washington



ACTIVE STRAKES, LESS DRAG

By Amy Sprague

An undergrad team advances a system that could save dramatically on flight fuel.

For decades, aircraft designers have managed a built-in compromise at the intersection of engines and wing airflow: strakes. These small fins, mounted on the sides of engine housings, generate vortices that help boost lift and reduce the risk of stall during takeoff and landing. The trade-off is that the same strakes add drag during cruise — when aircraft spend most of their time — forcing planes to burn extra fuel to carry a safety feature needed mainly during takeoff and landing.

A team of aeronautics and astronautics (A&A) undergraduates advanced a way to improve that trade-off. The students validated an “active strake” concept that uses controlled air injection to dynamically shape the vortex flow based on angle of ascent or descent. In limited tested conditions, the approach reduced cruise drag by as much as 33% while preserving the strake’s safety benefits during takeoff and landing.

Less drag means less fuel burned and fewer carbon emissions. The team estimates that its optimized 33% drag reduction could save about 650 kilograms of fuel on a typical flight from Seattle to Los Angeles.

“This project demonstrates the power of combining rapid prototyping with rigorous testing,” says Giovanni Nino, an A&A affiliate associate professor who mentored the team. “In just one academic quarter, these students went from paper mockup to wind-tunnel validation, producing results that challenge decades of accepted aircraft design.”

The research isn’t finished. The team made the strake larger than usual so the wind tunnel could clearly measure its effects, and future designs will scale it further. Students — a few of whom are continuing their graduate studies in A&A — have also been testing other setups, including different flap positions, air-injection methods and strake angles.

As the aviation industry works to cut costs and emissions, the active strake concept could offer a way to keep takeoff-and-landing safety without adding as much drag during cruise.

“The industry has accepted passive strakes as a necessary compromise for 50 years,” Nino says. “These students demonstrated a solution that eliminates that compromise while maintaining all the safety benefits at stall.” ❖

Top: Strakes are the small fins mounted to the sides of engine housings. Bottom: Students Cade Homfeldt, Hugh Carbrey and Alexander Maldonado model an expensive aerodynamic problem. Photos provided by UW Aeronautics & Astronautics

Entrepreneurial leadership + environmental action

Victoria Tchervenski turns engineering into action and activism. Photo courtesy of Denitza Deltcheva

Industrial and systems engineering (ISE) blends technical problem-solving with people- and process-focused leadership — skills that can help drive change across complex global systems. For sophomore Victoria Tchervenski, it offers a practical route to climate-change mitigation and environmental protection.

Tchervenski arrived at the UW with leadership and project-management experience and a clear commitment to environmental action. In high school, she founded the Climate Action Club, organizing events that promoted climate education, community awareness and environmental stewardship across the greater Seattle area. She also served as a field intern with the local sustainability nonprofit Whale Scout, leading habitat restoration projects that supported recovery efforts for threatened salmon ecosystems.

On campus, she jumped into engineering and entrepreneurship communities, including Engineers in Action and the Lavin Entrepreneurship Program. Her initial goal was to explore how different engineering paths can contribute to environmental impact and identify the direction that fit her strengths.

“I quickly learned that there are so many ways, across every single engineering discipline, that people can work to support environmental efforts,” Tchervenski says. She sought out coffee chats and networking events, asking students and faculty how they chose their majors and how they knew they’d found the right one. “I thought I had to choose between the hands-on impact of environmental field work, and the strategic planning and organization of business.”

At first, the word “industrial” gave her pause, conjuring images of overconsumption and manufacturing pollution. Conversations with ISE students reframed the discipline as a way to address those very challenges — by improving systems, reducing waste and helping organizations adopt cleaner, more efficient practices. The field’s emphasis on optimizing workflows, managing projects and connecting technical solutions to real-world constraints made ISE feel like a direct path toward her long-term goals.

“I love everything about project management and about making things happen,” says Tchervenski. “I want to help people solve technical problems and remove barriers to create cleaner, more efficient systems and workflows.”

- Ro Stastny

Enterprising engineers shine at health innovation challenge

UW Engineering students swept the top prizes at this year’s Hollomon Health Innovation Challenge.

The annual competition, hosted by the Buerk Center for Entrepreneurship in the UW Foster School of Business, challenges students to devise tech-driven solutions to healthcare conundrums.

CPRight — an interdisciplinary team powered by students in medicine, computer science and engineering and electrical and computer engineering — won the grand prize for its inexpensive CPR sensor that provides real-time feedback to ensure optimal frequency and force of chest compressions.

The second-place winner was TheraT, a collaboration of MBA and civil and environmental engineering students who developed a drinkable therapy that removes toxins before they reach the bloodstream of chronic kidney disease patients.

And third place went to LegUp Prosthetics, a team featuring molecular engineering, bioengineering and mechanical engineering students who created a smartphone-enabled 3D scanning technology that produces precision-fit and inexpensive prosthetics that can be ordered from home.

The winning CPRight team, from left: Shubham Bansal (neuroscience), Deeya Sharma (medicine), Prisha Hemani (computer science and engineering) and Atharv Dixit (electrical and computer engineering). Matt Hagen / Buerk Center for Entrepreneurship

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371 Loew Hall, Box 352180
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Days of discovery

This year's UW Engineering Discovery Days welcomed more than 10,000 elementary and middle school students to campus from schools across the state. Over two unforgettable days, our young guests experienced every facet of engineering through more than 130 hands-on exhibits, experiments and activities, led by hundreds of students and faculty.

Discover more

▶ engr.uw.edu/dd2026