Celebrating the impact of women engineers

Lehigh marks 50 years of coeducation
With Fall semester in full swing, autumn’s blue skies, brisk breezes, and blazing colors grace our campus as usual. But this year, it’s not the rustling of leaves overhead or their crunch underfoot that calls our attention. It’s the greetings of our colleagues in passing. The chatter of students as they move between classes. The familiar soundtrack of in-person living and learning at Lehigh that brings a smile and assures us—lehigh’s new president, Joseph Helble ’82, discusses his research and public policy work as an environmental chemical engineer. He also shares his experience as an administrator, including as provost and engineering dean at Dartmouth College. Under his leadership, Dartmouth

Soaring Together—50 Years of Coeducation Celebrating the Impact of Lehigh women engineers

ALTHOUGH MUCH HAS BEEN ACHIEVED OVER THE PAST 50 YEARS, MUCH REMAINS TO BE DONE TO REALIZE GREATER DIVERSITY, EQUITY, AND INCLUSION FOR ALL UNDERREPRESENTED GROUPS IN STEM.

We welcome to a special Fall 2021 issue of Resolve—a magazine dedicated to research and educational innovation in the P.C. Rossin College of Engineering and Applied Science at Lehigh University.

With Fall semester in full swing, autumn’s blue skies, brisk breezes, and blazing colors grace our campus as usual. But this year, it’s not the rustling of leaves overhead or their crunch underfoot that calls our attention. It’s the greetings of our colleagues in passing. The chatter of students as they move between classes. The familiar soundtrack of in-person living and learning at Lehigh that brings a smile and assures us—we’re back!

When asked to put an engineering spin on the Soaring Together logo, Lehigh’s Design Labs team, including Wilbur Powerhouse assistant manager Michelle Rodriguez ‘22, Mechanical Engineering student Kiraan ‘23, and managing director Brian Sciarra, rose to the challenge. To do so, a laser-engraved laser reveals the full path of the ultraviolet laser on a piece of wood (see page 21) with a laser cutter.

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At Lehigh, “we have access to an incredible variety of advanced spectroscopic techniques capable of performing those cutting-edge studies,” Sobchinsky says.

Chemical plants and petroleum refineries make olefins by using a complex, energy-intensive process called steam cracking. Given the current abundance of natural gas, however, industry has shifted to using lighter hydrocarbons from the final product. “That will allow us to determine which surface structures of the catalyst look like during reaction and understanding the synergies between the nickel and sulfate species,” says Sobchinsky. “That will then enable new catalysts with better performance by synthesizing catalysts that contain more of those reaction-enhancing species.” Sobchinsky and her team develop a fundamental understanding of what is happening at the molecular level, they’ll be able to fine-tune the molecular structures toward the goal of designing more active catalysts. The more active a catalyst, the more reactant it can convert, with less energy use and impact on the environment or infrastructure.

“This approach to catalysis, although it at the cutting edge, has been informed by other research groups because of the limited availability of such sophisticated instrumentation,” says Sobchinsky. “Doing these in situ and operando molecular spectroscopy and catalysis research studies is one of the most important ways to move forward in the field.”

Researchers report breakthroughs in study of von Willebrand factor

The protein known as von Willebrand factor (vWF) promotes blood clotting by helping platelets in blood stick to collagen. As a single molecule, vWF remains nonreactive in ultrahigh vacuum conditions—meaning at extremely low pressures with almost no gas present around the catalyst—under ambient conditions, where the catalyst is exposed to a humid atmosphere at room temperature. “But those conditions really aren’t representative of what the catalysts experience during reaction,” she says. “The surfaces of many catalysts can also restructure, which makes characterization during reaction all the more important.”

Sobchinsky and her team are using in situ and operando molecular spectroscopy (conducting experiments under relevant reaction conditions) to characterize their catalyst. Under these conditions, the researchers can better understand what’s happening on the surface of the catalyst, which is where the reactions take place.

“Our current work is focused on determining exactly what the surface structures of the catalyst look like during reaction and understanding the synergies between the nickel and sulfate species,” says Sobchinsky. “That will allow us to determine which surface structures are important for enhancing the reaction. We can then ration-

ally design new catalysts with better performance by synthesizing catalysts that contain more of those reaction-enhancing species.” Sobchinsky and her team develop a fundamental understanding of what is happening at the molecular level, they’ll be able to fine-tune the molecular structures toward the goal of designing more active catalysts. The more active a catalyst, the more reactant it can convert, with less energy use and impact on the environment or infrastructure.

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Novel simulation method

Excessive clotting isn’t the only way the process can go wrong. The most common inherited bleeding disorder, von Willebrand disease (vWD), affects about 1 percent of Americans per 100,000. Symptoms include frequent nosebleeds, easy bruising, and heavy or/and longer bleeding after injury, childbirth, surgery, or dental work, or during menstruation. When vWF approaches an injury site, the increase in blood flow caused by the laceration prompts the global to unrelax. As the protein transitions into a more of a string-like shape, sites that are typically shielded become exposed. Those sites are “sticky” and they bind with platelets and collagen to initiate blood clot formation.

Using a new method of simulation developed at Lehigh, researchers can quantitatively predict, for the first time, blood flow conditions that likely cause pathological unrelaxation of vWF. The predictions can be used to optimize the design of the mechanical pumps known as left ventricular assist devices used in heart failure patients. LVADs have been associated with causing unexpected vWF depletion and associated bleeding disorders, akin to von Willebrand disease. The method also has the potential to improve diagnosis and treatment of vWD.

In an article published in Biophysical Journal, the researchers describe their use of an enhanced sampling method (called Weighted Ensemble), in conjunction with molecular simulations, to identify blood flow conditions that cause pathological behavior of vWF. The method allowed them to compute the global-to-unrelaxed transition rate of the protein on timescales inaccessible to standard simulation methods.

“This method is all about studying the kinetics of vWF using an all-atom computer model,” says lead author Edmund Webb III, an associate professor of mechanical engineering and mechanics. “It is always applied in concert with the physics from Sugar Kania, a PhD student in mechanical engineering and mechanics. Webb and Kania worked with Zhang and professors Alp Ortsek (mechanical engineering and mechanics), W. Rossin College
Floating’ microgrids: Optimizing naval ships’ power systems

A ship’s power system is a special kind of microgrid,” says Wenxin Liu, an associate professor of electrical and computer engineering. “In a typical naval ship, the power system can provide electricity for almost everything on board, so ensuring the reliability of the system is critical.”

The Research Briefs section of RESEARCH BRIEFS is dedicated to highlighting recent advancements and findings in various scientific fields. This issue features a study examining the implementation of microgrids in naval ships to optimize their power systems. The study, led by Dr. Wenxin Liu and supported by the National Science Foundation (NSF), aims to improve the efficiency and reliability of naval power systems by considering microgrid technologies.

Innovating where ‘a river runs through it’

Multi-institutional hydrofoil turbine project could help generate cleaner, more cost-effective energy for cities and rural communities alike

For three years, five sub teams will design individual components that, if successful, will combine to create an economical and environmentally friendly solution. Prof. Moore, director of the U.S. Department of Energy’s SHARKS program, explained, “The research team hopes to minimize disruptions to the river’s ecosystem by creating an oscillating riverine turbine that moves vertically at a slower rate compared with existing rotary river turbines. Sensors in the system will allow it to adapt to natural changes in the river’s depth and maintain steady energy production.”

NSF-funded study to examine college tenure, promotion

The NSF-funded study to examine college tenure, promotion, and the role of research productivity is aiming to examine critical questions regarding merit as the sole driver of tenure and promotion decisions. The team will investigate what drives success, with a particular focus on external review letters and tenure clock extensions (often granted to new parents). They will also look at trends in college tenure rates.

THE ADVANCE TEAM SUPPORTS EQUITY AND INCLUSION TO ENHANCE THE CLIMATE FOR WOMEN IN STEM AT LEHIGH.

The study seeks to understand the role of research productivity and external factors in determining tenure and promotion decisions. By examining these factors, the research aims to contribute to the ongoing conversation on equity and inclusion in STEM fields.


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The long-standing tradition of Rossin College faculty members earning recognition through the National Science Foundation’s Faculty Early Career Development program continued in 2021, with three assistant professors joining this nationally distinguished group of teacher-scholars.

BY CHRISTINE FINNESSY | PHOTOGRAPHY BY DOUGLAS BENEDICT/ACADEMIC IMAGE

SIDDHA PIMPUTKAR
Material Science and Engineering

// CRYSTAL SYNTHESIS
A pathway to next-gen semiconductors

Every researcher has their holy grail. For Siddha Pimputkar, it’s cubic boron nitride.

Nitrides are a broad set of chemical compounds in which a nitrogen atom is bonded to another element such as gallium or boron, or most metals. Some of these nitrides are powerful semiconductors, more efficient than silicon, that ubiquitous presence in just about every device you power on or plug in. Some nitrides rival diamond in their hardness. Some are also capable of working in extreme environments. And some, like cubic boron nitride, can do all those things.

“Compared with silicon, cubic boron nitride has the potential to work under more extreme conditions, including higher voltages and currents,” says Pimputkar. “This allows the elimination or re-calibration of some of the process parameters affecting the mobility of carriers in such materials.”

With RDMA, we’re talking about tens of nanoseconds for two machines to interact. Whereas before, we were talking about tens or hundreds of milliseconds. If you’re processing something on social media, and one interaction takes hundreds of milliseconds, and you need 10 interactions, the user is now waiting nearly a second, and starting to think, ‘Why am I waiting so long?’”

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Desalination tech uses CO₂ to tap into municipal wastewater as alternative freshwater source

The two-year project was recently funded by the U.S. Bureau of Reclamation as part of an $5.8 million investment in 22 laboratory and pilot-scale desalination research projects to enable broader deployment of desalination and recycled water technologies.

The Kline’s Island plant treats nearly 35 million gallons every day, says SenGupta, and investigations show that the salinity of the treated wastewater can be reduced by more than 60 percent by the HIX-Dead process, without requiring any reverse osmosis. If successfully deployed using carbon dioxide from the facility’s anaerobic digester, he explains, the technology could lead to savings of approximately 1 million kWh per day (or about enough energy to power 94 U.S. homes for a year).

“This concept forms the basis of a circular economy, in which waste from one process is a potential resource in another process,” he says. “It’s a great challenge, but one that’s exciting as well.”

Converting wastewater into usable freshwater is an environmental win.

Engineering the system to be more energy efficient makes a good idea even better. Using a greenhouse gas—carbon dioxide—to power the process? It’s an approach that’s potentially transformational, according to Rossin College professor Arup SenGupta, a world-renowned researcher, educator, author, and inventor who has dedicated his career to addressing problems relating to the lack of safe drinking water.

“Municipal wastewater treatment plants in large cities are insulated from the negative effects of climate change, and treated wastewater can serve as a potential water source, provided appropriate sustainable and cost-effective technologies are available,” he says.

In 2019, SenGupta and his Lehigh doctoral students were awarded a U.S. patent for their innovative CO₂-driven ion exchange desalination process, HIX-Dead.

Existing wastewater desalination systems use energy-intensive reverse osmosis (RO) membrane processes that require a separate electrical and/or mechanical energy source. Approximately 1 to 1.5 kWh of energy is required to produce 1000 liters (264 gallons) of treated water, or just over the average amount three Americans use at home each day.

HIX-Dead harnesses the unique chemistry of CO₂ to replace that energy requirement. And, SenGupta says, when paired with existing generators of carbon dioxide, the process can be effectively carbon negative.

“Carbon dioxide, which is safe to handle and nonhazardous, can serve both as a weak acid and a weak base concurrently in a single process for desalination,” he says. “Avoiding the need for energy-intensive RO membrane processes.”

The system also reduces water pre-treatment required to protect the membrane in reverse osmosis setups, resulting in cost savings.

SenGupta’s team will gain insight into the energy advantages and scalability of the technology in a new collaboration with the Lehigh County Authority’s wastewater treatment plant in Allentown, Pennsylvania.

Turning cities’ wastewater into usable freshwater is an environmental win.

“Rocket’ science

It’s the rare engineer who gets to conduct experiments in space. But the Rochester College now has three who will be doing just that. A multidisciplinary trio recently received $400,000 from the National Science Foundation and the Center for the Advancement of Science in Space (CASIS) to fund their project studying thermophoresis in quiescent fluids for bioseparations. The team is led by chemical and biomolecular engineering professor James Gilchrist, and includes Xuanhong Cheng, a professor of bioengineering and materials science and engineering, and Kelly Schultz, an associate professor of chemical and biomolecular engineering. Their experiments will take place aboard the International Space Station (ISS).

The team soon learned what made the problem so intractable: gravity.

“We have very different, and very complex, behaviors in a gravity-free environment,” says Cheng. “It’s much more complex, but we can control them. In space, we can design experiments that allow us to isolate a particular sample.”

Thermophoresis is a natural phenomenon in which a temperature gradient causes particles to migrate. It’s used to separate molecules within a sample, for instance, to detect the presence of disease in bodily fluids or in air. The problem is, no one really understands how it works. It’s an old problem, says Gilchrist, and one he joined forces with Schultz and Cheng to solve.

“I realized that we can track how the particles are moving,” he says. “They can move thermophoretically, but they can also jiggie, and tell us about the microenvironments. That allows us to know what the fluid around the particles is doing while it’s migrating.”

The team soon learned what made the problem so intractable: gravity.

“If you had your run out of a cup, or cup it down, its buoyancy changes and it creates this microcirculation,” says Schultz. “So you wouldn’t get this concentration on one side because the particles are constantly recirculating.”

The team recently proposed experiments to be conducted on the ISS.

The team has designed 12 such experiments that will take place inside a roughly 18-inch cubed “lab in a box,” that they’ll control from the ground.

“It’s safe to say that all three engineers are over the moon about this opportunity. And it’s one they couldn’t have secured working as a standalone. We have very different, and very complex, behaviors in a gravity-free environment,” says Cheng. “It’s much more complex, but we can control them. In space, we can design experiments that allow us to isolate a particular sample.”

“We have very different, and very complex, behaviors in a gravity-free environment,” says Cheng. “It’s much more complex, but we can control them. In space, we can design experiments that allow us to isolate a particular sample.”
With a track record of success in closing the gender gap in engineering education, Joseph J. Helble ’82, Lehigh’s new president, sees strength in diversity

For the second time in the university’s history, a Lehigh engineer is at the helm. Joseph J. Helble ’82 is a chemical engineering alumnus and Lehigh’s 15th president. He returns to South Bethlehem having pursued research related to air pollution, carbon dioxide capture, and other impacts of fossil fuel use. Most recently, Helble served as provost at Dartmouth College, following a 13-year tenure as dean of the Thayer School of Engineering. Under his leadership, Dartmouth became the first comprehensive research university in the nation to have more women graduate with a bachelor’s degree in engineering than men. Diverse communities are stronger and help address important problems, maybe something that provides new opportunities, a world of possibilities,

Q: What got you interested in studying chemical engineering as a way to tackle environmental challenges?

A: I was an undergraduate at Lehigh in the late ’70s and early ’80s, shortly after OPEC imposed an embargo on the supply of petroleum. The oil crisis disrupted everyone’s lives and had us seriously considering energy supply for the first time. The 1979 nuclear accident at Three Mile Island made me—a runner and someone who has always liked the outdoors—think about energy in a more immediate way. Those were the days of limited environmental regulation, and there was sometimes the smell of sulfur on campus and unfiltered diesel buses driving down the roads emitting plumes of black smoke.

I’ve always referred to myself as an environmental chemical engineer. I liked chemistry but was interested in problems in energy and the environment. It was the combination in the application that was important to me. In talking to faculty and doing some reading, it was clear that if I wanted to dedicate my career to working on those problems, chemical engineering was the path to pursue.

Climate change wasn’t much on anyone’s mind back then. So, I was thinking about more visible problems of air pollution: sulfur and nitrogen oxides, soot, and particulate matter. I ended up devoting a large part of my research career to these areas. Over time, I started working on questions related to air pollution, carbon dioxide capture, and other impacts of fossil fuel use. Most recently, Helble served as provost at Dartmouth College, following a 13-year tenure as dean of the Thayer School of Engineering. Under his leadership, Dartmouth became the first comprehensive research university in the nation to have more women graduate with a bachelor’s degree in engineering than men. Diverse communities are stronger and help address important problems, maybe something that provides new opportunities, a world of possibilities.

Q: What was the gender parity milestone Dartmouth achieved so important?

A: It was an important symbol—a way to show that decades-old arguments about differences in interests or aptitude are wrong.

Engineering is about applied problem-solving. It’s about inventing and creating something that provides new opportunities, helps address important problems, maybe even changes the world. It’s about serving society through the application of science.

What we did at Dartmouth, where students aren’t accepted into a college and are free to choose any major, to me, showed that it is possible to graduate a class that looks like the rest of the university—and the rest of society—if you have programs that are engaging and interesting to a broad cross section of students.

With a track record of success in closing the gender gap in engineering education, Joseph J. Helble ’82, Lehigh’s new president, sees strength in diversity.

Q&A INTERVIEW BY KATH KACKENMEISTER

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Q: What is your vision for Lehigh as the university strives toward achieving greater diversity, equity, and inclusion?

A: One of the greatest strengths of Lehigh is the strength of the community. Each and every individual is valued and brings something unique to the community. That means every single individual. Not the majority. Everyone.

We want everyone to have the opportunity to fully engage and be fully valued. To bring their whole selves to the classroom and to work. It’s important the community knows that’s what the administration stands for. It’s who we are as a community. We’re committed to doing everything we can to make sure that there are no barriers that prevent anyone from pursuing their interests.

Q: In what way has Lehigh contributed to closing the gender gap in STEM fields?

A: It’s important that scientists and engineers reflect the community and comprehend the problems at hand. That brings a better understanding of the importance of different weighting factors, which is something we ask engineering students to consider when designing solutions. There are always several different paths you can pursue. What are your objectives and what’s important to the community? How you ascribe weights to each of those different parameters for one community might not be right for another. It’s beneficial if you have professionals who understand the community they’re trying to help. Every argument about diversity applies here. You have different perspectives approaching a problem and a question in different ways with different life experiences that they bring to the table.

Q: How did it take to accomplish this goal?

A: I’m a numbers person. I’m data driven. While I was dean, the national data showed that the percentage of undergraduate engineering degrees received by women was 20 percent. At Dartmouth, it was around 25 percent and moving toward 30 percent. That sparked a series of conversations with the faculty and staff.

We know from the literature that a lot of the challenges are perceptions of barriers to entry. What could we do to lower them? We already had classes designed for nonmajors, and we significantly expanded our offerings. We increased the amount of hands-on group work, even in the earliest project classes. We didn’t change the content but rather our approach to delivering it. We started to think very intentionally about the composition of project review boards for our classes. We made sure there was gender diversity on every single board, and that we were drawing people from the outside. We thought about search committees in the same way. We focused on hiring more women faculty, but we thought about our technical staff instructors as well. We looked at the composition of our advisory board and our seminar speakers. We started to intentionally build more project work into middle- and higher-level classes.

And when we saw success, we talked about it openly. Some of the greatest ambassadors for the effort at Dartmouth were the students. When we reached 40 percent, I would say publicly, we’re at twice the national average—which would mean if we could be the first to get through this imagined glass ceiling! The effort drew the focus of the entire community.

Every university has a distinct structure and different approach. But to effect change requires examining absolutely every process, absolutely every structure that’s in place. Is it inclusive of everyone? And is the program represented that way to the outside world? Because perceptions help drive decisions.

A: One of the greatest strengths of Lehigh is the strength of the community. Each and every individual is valued and brings something unique to the community. They are here because they have something to offer and because they can learn from being part of this community. And that means every single individual. Not the majority. Everyone.

We want everyone to have the opportunity to fully engage and be fully valued. To bring their whole selves to the classroom and to work. It’s important the community knows that’s what the administration stands for. It’s who we are as a community. We’re committed to doing everything we can to make sure that there are no barriers that prevent anyone from pursuing their interests.
I nstinctively knew I couldn’t just sit back and expect things to change,” says Ota.

The same year that Ota unwittingly made history, Lehigh itself was doing the same by opening up undergraduate education to women. This year marks the 50th anniversary of that 1971 milestone. The university is commemorating the occasion through Soaring Together, a multiyear celebration that is recognizing the impact of all women on campus—past, present, and future.

For Lehigh Engineering, that impact began, in many ways, with Ota, and it continues today with 33 women on the faculty of 154.

Representation in the Rossin College’s student body also continues to grow: 32 percent of all undergraduates enrolled in engineering are women, a level that exceeds the national average (in 2019) of 23.8 percent, according to the American Society for Engineering Education.

But to appreciate where we’re at, it’s good to know where we’ve been. And to continue to increase the number of women in engineering—and ensure an equitable future for all engineering students, faculty members, and staff—it helps to understand the challenges, the efforts, and the wins inside our community today.

They’re improving the efficiency of drug delivery, creating faster ways to process data, and building machines to grow films for electronics. They’re authoring papers, launching startups, and mentoring youth. A new generation of women is taking research and scholarship in the Rossin College to greater heights. But the path for women in STEM at Lehigh hasn’t always been smooth—and is still a work in progress. Here, we trace back where we were, where we are, and where we aspire to be.

UNFINISHED BUSINESS

Soaring Together
Celebrating Lehigh Women and 50 Years of Coeducation

It isn’t easy being the first person to do something. In the case of Patti Ota, Lehigh’s first woman engineering faculty member, that fact is an understatement.

In 1971, Ota was finishing up her PhD at the University of Pennsylvania when her dissertation supervisor recommended her for an adjunct position teaching electrical engineering at Lehigh.

As she walked across campus that first day, she wasn’t thinking about how she was about to make history. Having completed her master’s in electrical engineering and her PhD in computer science at Penn, Ota was used to being the only woman in most things she did—and what that meant.

“If you were a woman back then,” she says, “you knew that if you were going to compete in this, let’s call it ‘man’s world,’ you knew that all kinds of things were going to happen, and you just had to grin and bear it.”

For Ota, the grinning and bearing it started before she even made it through the front door of Packard Lab. “I remember walking up the steps to the main entrance, and having two of my male colleagues greet me, and tell me that I shouldn’t have been hired.”

This is odd, she thought to herself. But it wasn’t surprising, and so she kept walking, went through the door, and joined roughly 200 men on the engineering faculty. She would be the only woman for nearly a decade.

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BY CHRISTINE FENNESSY
PHOTOGRAPHY BY DOUGLAS BENEDICT/ACADEMIC IMAGE
I’m looking into a void no one has looked into before

Alexandra Howzen, PhD student, Materials Science and Engineering

Her mom was trying to tell her she had to make a choice in life. She could, for example, be the one who builds the electronics that power a ship. Or, she could be the one who designs the ship itself. “When I said I want it all, she was like, ‘You can’t do that,’” says Alexandra Howzen. “And I said, ‘You’re gonna stop me?’”

It was a rhetorical question. Howzen has never been the type to be stopped by anyone or anything. She loved solving puzzles and pushing boundaries, and the idea that she could take an idea from test to product to market sold her immediately on materials science. She’s stubborn, she says, and that trait has served her well in what she describes as the love-hate relationship with the machine that has designed as part of her research. It’s a 100-plus-pound atomic layer deposition chamber that resembles, in part, an old metal milk jug (her dad thinks so, anyway), and is used to grow films for electronics.

Howzen uses the machine’s specific capabilities to study the surface science of attracting films used for semiconductors, with the ultimate goal of improving the efficiency and reliability of chips used in electronic devices such as computers and phones.

“This chamber is quite unique,” she says, “there’s only one other in existence.” Which means when it doesn’t work or if it breaks, she can’t turn to the literature or her advisor for solutions. And that’s why she likes grad school to boot camp. An experience that tears you down, then builds you back up.

“When the machine failed or didn’t work, I used to think, ‘Wow, what’s wrong with me?’ But I’m looking into a void that no one has looked into before. I’m one gaining the knowledge. Now every time I look at my chamber, I feel immense pride. And also annoyance—because it’s put me through a lot.”

“I’m looking into a void no one has looked into before” because it’s put me through a lot.”

I look at my chamber, I feel immense pride. And also annoyance—wrong with me?

Grad school is boot camp. An experience that tears you down, then builds you back up. She likens grad school to boot camp. An experience that tears you down, then builds you back up.

“When I was stressing out. I should have been doing my homework. I should have been studying. And I couldn’t because I couldn’t charge my laptop,” she says. “They’re going one up on the spot.”

“Looking at how many people were without power and how long they went without it has been eye-opening,” she says. “I realized that experience was definitely changed my perspective.”

FROM DISASTER TO PERSONAL DISCOVERY

Alyssa Arizola ’23, Civil Engineering major

The worst part of the blackout was not being able to get in touch with her professors. When Alyssa Arizola and her family lost power for three days during the deadly winter storm that hit Texas last February, Arizola thought, “They’re going to think I’m skipping class. They’re going to think I’m a bad student.”

“I was stressing out. I should have been doing my homework. I should have been studying. And I couldn’t because I couldn’t charge my laptop,” she says. “I feel lucky that they were so understanding.”

So understanding, in fact, that they asked her to join a research project looking at energy poverty and the failure of the Texas power grid. Specifically, she’s exploring potential connections between socioeconomic status and the length of time communities went without power.

“Looking at how many people were without power and how long they went without it has been eye-opening,” she says. “I realized that experience was a piece of history that we lived through.” The project has been enlightening in other ways, too. Arizola had planned to pursue structural design, particularly of large houses, in part because she’s got a serious creative side, but also because she’s from a large family that’s always lived in too-small homes in not-so-great neighborhoods. But now, she’s increasingly interested in renewable energy and learning how to avert the looming crisis of climate change.

“She’s also discovered that she really likes research. “Before Lehigh, I used to think of research as hard as men.” (To which she says she responded, “All we know that women don’t work as hard as men.”) To which she says she responded, “All we know that women don’t work as hard as men.” (To which she says she responded, “All we know that women don’t work as hard as men.”)
ENTREPRENEURSHIP

SAREENA KARIM ’22, Bioengineering major

If there’s one thing that research has taught her, it is to have an open mind. Karim, whose mother has multiple sclerosis, had long targeted a career in regenerative medicine and tissue engineering. She came to Lehigh as a bioengineering major with an entrepreneurship minor, and as a RARE scholar. The Rapidly Accelerated Research Experience is a four-year program that provides students from backgrounds under-represented in STEM with experimental learning opportunities meant to accelerate their development as scientists.

As a sophomore, she began working with Lesley Chow, an assistant professor of bioengineering and materials science and engineering. Karim was part of the Chow Lab team designing tissue scaffolds that promote tissue growth when she had a lightbulb moment for her haircare startup, Foli-Q.

“ar times, people come to the university department chair in the fall of 2012, she achieved “potty parity” in Whitaker Lab. “It had just always struck me that we had five floors, and the tenure clock stopped for female faculty. And it’s a trivial example, she says, but when. For her, it wasn’t about enduring sexism and discrimination, but lacking the confidence to say no to her colleagues’ many requests.
“If I felt like I had to be loyal here and loyal there, rather than being loyal to myself, she says. “That happens to a lot of young faculty.”

If men can do it, you can do it

YIHAN HU ’22, Chemical and Biomolecular Engineering major

“I grew up in a family that had a strong work ethic. My parents were both engineers. I’ve always had a passion for science since I was young. I’ve always wanted to be an engineer. When I was a child, I would build things and ask my parents how they did it. They would explain the science behind it to me.

When I was in high school, I decided to pursue a career in chemical engineering. I was attracted to the field because it combines chemistry, physics, and mathematics, and it has a wide range of applications in industry. I also like the fact that chemical engineers can work on projects that have a direct impact on solving real-world problems.

Sareena Karim, it’s to have an open mind. If there’s one thing that research has taught her, it is to have an open mind. Karim, whose mother has multiple sclerosis, had long targeted a career in regenerative medicine and tissue engineering.

So Baran started at Lehigh as a finance and accounting major. But during an internship in Prague, she realized that she really didn’t care about the data she was seeing on her dashboard—she wanted to know what was going on inside her brain. So she switched to Computer Science and Business and started her master’s research during her senior year.

Her new leadership role in next-generation distributed synchronization protocols within Lehigh’s Scalable Systems and Software Research Group, together, the team is designing and building faster, more reliable ways to process data so consumers can get the data they want, when they want it.

Baran loves the challenge of improving existing systems. And it’s that determination and drive that carries her through the moments of doubt and obstacle she’s encountered. She’s learned that persistence and resilience are key traits in any field. She has seen the power of hard work and dedication, and she’s determined to push herself even further.

And so that’s what she would say, too, to any young woman struggling to find her way around the expectations of others. “You only live once,” she says. “You’re not living for your family. If you want to prove something, then go for it.”

‘IF YOU WANT TO PROVE SOMETHING, THEN GO FOR IT’

YIHAN HU ’22, Chemical and Biomolecular Engineering major

Bracing your emotions doesn’t come without challenges, which is why inclusiveness is critical in every organization.

Embracing your differences doesn’t come without challenges, which is why inclusiveness is critical in every organization. "You can do it. And so that’s what she would say, too, to any young woman struggling to find her way around the expectations of others. "You only live once," she says. "You’re not living for your family. If you want to prove something, then go for it."
"At the time, it was very hard to bring about this sense of community. If a woman came to civil engineering, she would have felt pretty isolated, bound to her own lab and her own students," says Pamukcu. "We wanted to promote community through interdisciplinary research, through mentorship, meet-
ing, and a variety of programs. Creating that environment would help us not only attract faculty, but retain them, and help them advance in their careers."

Lehigh ADVANCE pursued numerous goals over the five years it was funded by the NSF (it's now supported by the university): increasing women in STEM faculty positions; support-
ing their advancement; studying interdiscip-
line
ty as a strategy for gender equity and leading national dialogue around that approach, and transforming the university's culture through policies and programs.

The program built a Women in Science and Engineering (WIS
ed) community that hosted regular informal and formal gatherings, created a mentoring network, held seminars and workshops focused on research and professional development issues, provided best practices and support to departments for recruiting, and reviewed policies around promotion and tenure to improve retention.

**FINDING FASHION IN ENGINEERING**

**SARAH HORNE ’22, Computer Science and Business major**

"I have a very creative brain," says Sarah Horne. "I do a lot of sewing projects, and to me, computer science goes hand in hand with that mindset. You're creating a program with a specific end goal, and you have to piece together how you'll get there and what tools you'll need."

Horne, a creator of patchwork jackets and hats and T-shirts, quit made from high school and college student spirit wear, always fig-
ured she'd have to give up—some extent, anyway—her love for fashion if she were to pursue computer science. But when she landed a remote internship as a software engineer this summer at Gap, Inc., it changed everything.

"The internship opened my eyes to the fact that computer science can be applied to the retail space. And even though I'm not picking out the fabric or the collections, I still have a hand in a lot of the retail marketing. I love it."

Horne credits her captain's experience at Lehigh with giving her a meaningful edge over some of her fellow interns. That project involves developing a transportation app for a real-world client, and she didn't realize just how realistic the process was until she started the internship. She understood immediately how Gap ran their meetings, what was expected in a stand-up meeting versus a retrospective, and what it meant to be on a sprint timeline.

"I know the goal of every meeting before my manager explained it to me," she says, "so it was just a really comfort-
able transition into the real world."

And a successful one. After she graduates, Horne will join Gap full-time as a software engineer.

**OBSESSED WITH PROBLEM-SOLVING**

**NUSAIBAH ALQASAWAH, PhD student, Environmental Engineering**

When Nusabath Alqasawah was a kid growing up in Jordan, she wanted to know why there was so much pollution around her—in the air, in the water, on the streets—and what she could do about it.

She soon became "obsessed" with the idea that she could solve these pollution problems with environmental engineering. She earned undergraduate and master’s degrees in the field before eventually meeting with her husband at Bethlehem.

At first, he was the Lehigh PhD student, and Alqasawah was the mother of their one-year-old son. It was hard to think about balancing family life with grad school, but, remember, she was obsessed. And so she applied to the civil and environmental engineering graduate program and had her pick of multiple research positions. Today, her son is four, and she’s in her second year as a doctoral student working with professor Kristen Jellison.

It’s been a wild research ride. She started out studying the presence of Cryptop-
pondium in recreational waters. The microscopic parasite causes cryptosporidiosis, which leads to diarrhea and, in some people, serious illness. It can enter rivers, lakes, and streams through fecal matter runoff from nearby pastures. After the pandemic hit, funding for the project dried up, and she was crushed. But then Lehigh funded something similar: detecting COVID-19 RNA in wastewater, specifically in the effluent from the university.

"It’s an opportunity, she says, to contribute in a significantly different way to early detection measures that could guide decision makers trying to control virus outbreaks. It is immensely rewarding work. The kind of work that would make her younger self proud."

"I think this is a very good thing that I can do for my community," she says. "I’m totally satisfied with my life."

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"It takes knowing your strength, knowing what you bring to the table and that you deserve a seat at that table, and networking with others, to succeed."—Ricole (Edwards) Johnson ’89, Engineering Project Leader–Product Development & Innovation, Boeing.
As Jellison knows well, it’s not just about getting more women on campus, but supporting them once they’re here. To that end, they’ve expanded the reach of LE-WISE. There are now versions for undergraduates, graduate students, and faculty. Women faculty from across the university get together once a month for lunch, workshops, and guest speakers (during the pandemic lockdown, there were a lot of Zoom coffee hours). Jellison says she and her co-director Monefield pull the community at the beginning of the academic year for topics of interest and work hard to deliver that content at the monthly sions.

They’ve also instituted a mentoring program, called INC, which stands for Interdisciplinary Network Committees. New professors are paired with a senior faculty member in their department, and with another mentor/mentee pair from another department. “This gives them a network of mentors and support.” They’ve run a couple of grant-funded mid-career mentoring programs and are working on establishing a permanent such program. “We’re starting the conversation around criteria for promotion.”

“The associate professor with tenure rank is where women take longer to get promoted to full professor because they’re doing important, transformative service,” she says. “Can we have a pathway to promotion where we recognize significant leadership in institutional efforts? Because if we don’t promote that, people aren’t going to do it, and what kind of institution would we have if everyone was hunkered down in their labs and no one was mentoring undergraduate students or running graduate programs or professional development programs or leading research centers? You need people who are going to contribute to the mission of the institution.”

ABOVE AND BEYOND

Our pages couldn’t hold all there is to showcase! Head to engineering.lehigh.edu/soaringtogether for more student stories, alumni interviews, and faculty profiles, including a special episode of the Rossin Connection podcast. Learn more about the university-wide celebration of Lehigh women and STEM—and supporting them so they stay and build fulfilling careers—since its launch in 1971 when Pati Ota was met by her male colleagues and told she was unwelcome. The idea that diversity is inherent to our success is no longer just a bullet point awaiting a check mark. Conversations have shifted, and there’s a willingness to try new things. Jellison points specifically toward the college’s creation of its Diversity, Equity, and Inclusion Council (see page 24), and its strategic plan to improve its policies and practices. And to the fact that diversity and inclusion is now a core value ahead of every step of the search process, from job posting to job offer. That value system also now permeates the research groups, says Jellison, and increasingly, she’s been asked to advise them on how to write proposals and form groups in ways that are more inclusive.

“We’re starting to see that attention to diversity and inclusion issues on campus, which we would traditionally lump into service, is starting to trickle into teaching and research, and all that we do as faculty members,” she says. “There’s the recognition that when we talk about this, we’re not just talking about changing the demographics of who is here, but we’re talking about changing the way we do our jobs. Things are moving in the right direction.”

Remember, no matter how much you learn or think you know, every single person in a room knows something that you do not know.”

—J Duury ’74, retired water utility manager

Merging Avenues of Creativity
ANDREA JONES ’23, Arts and Engineering major (Mechanical Engineering and Product Design)
It all started with a sewing machine. Andrea Jones was 12 and she wanted to make pillowcases, but sometimes the needle jammed and the machine would just quit. So she’d take it apart, and after a while, she’d figured out the guts of the thing. Soon, she was making bags, skirts, and shirts. Her interest in solving mechanical mysteries and bringing ideas to life eventually led her to Lehigh’s dual degree program in mechanical engineering and product design and an internship at Air Products. There, she was tasked with conceiving a new way to design heat exchangers for the transport of gas.

“I have to think about the materials I’m going to use, and what the end product will look like,” says Jones. “It’s a good example of how you need to be able to translate your ideas onto paper and present them in a compelling way to your managers.”

She plans to go into industry after graduation, although which industry is another mystery. “With this degree, I have so many opportunities. I could get a job in mechanical engineering or in product design or in both,” she says. “I’m excited about how I can use my knowledge from Lehigh, integrate it into the real world, and make the world better.”

Working Toward Pain-Free Movement
DIANA HAMBSTERONE ’20, graduate student, Materials Science and Engineering
Diana Hammerstone is many things. As a undergraduate in MSE, she is a President’s Scholar and a National Science Foundation Graduate Research Fellow. And, when there’s time, she volunteers as a running coach for the women’s team. Hammerstone is also a published author. She is a co-author on a recently accepted paper on expediting the polyester printing press.
As a member of the Chase Lab, Hammerstone is studying how to regenerate cartilage in the knee using 3D-printed scaffold materials that guide the formation of tissue with the same properties as the native tissue. The ultimate goal is to interfere early in patients with osteoarthritis, before they require a knee replacement.

“It’s a path she didn’t foresee. “I never envisioned myself being so closely tied to biomedical engineering. I didn’t study a lot of biology in high school. But being part of this thrust, and getting to work in an interdisciplinary field is really cool,” she says. “I’m using what I learned in materials engineering to work with bioengineers to basically guide stem cells to do what we want them to do.”

She’s also interested in all the opportunities that go along with being a scientist. She wants to continue working toward drug delivery technology commercialization. “To me, the most exciting thing about this research is that I can see how we can bring science to real treatment,” she says. “Ravel drug delivery technology development is urgent, and can help with a range of serious diseases, and potentially give patients options.”

Developing the Future of Drug Delivery
NAN WU, PhD student, Chemical Engineering
Her dad was an engineer working with an oil company, and when Nan Wu was a kid, he took her to the factory. She learned how the place worked, and that she wanted to be an engineer, too. But she knew she wanted to work with a different material. Today, Wu works with Kelly Schultz, an associate professor of chemical and biomolecular engineering, and focuses on developing novel techniques to understand how hydrogels degrade in response to biologically relevant stimuli.

“Our work is looking at how to design these biomaterials, such as vehicles for controlled, sustained release of drug molecules to the target,” she says. Essentially, ensuring that molecules get delivered to the right place, at the right time, with the right amount of the drug. Such efficient delivery could lower the dosage or frequency of reliefs or injections, she says.

To date, Wu is the author of four papers, one of which was recently featured on the inside front cover of Soft Matter. She plans to go into industry and continue working toward drug delivery technology commercialization. “To me, the most exciting thing about this research is that I can see how we can bring science to real treatment,” she says. “Ravel drug delivery technology development is urgent, and can help with a range of serious diseases, and potentially give patients options.”

Soft Matter
Chemical engineering can be intimidating. But a new student-designed class—open to all majors—serves up key concepts through the study of two everyday essentials: coffee and cosmetics.

She had to take a second before reading the email.

It was May 2020 when Veronica Meyer ‘22 saw the message from chemical and biomolecular engineering (CHBE) professor James Gilchrist. “He wanted to know if there were any students interested in doing something over the summer if their internship had fallen through due to COVID-19,” says Meyer. “He was basically asking us, how can we improve the CHBE program? As a student, you don’t usually get asked that.”

Soliciting that level of feedback was new for Gilchrist, too. But after the pandemic derailed so many internships, Lehigh instituted a virtual research opportunity for undergraduates—and it got him thinking. His work on the fundamentals of particulate systems was too experimental, he says, for students to interact with those things, “so, it’s just expected that they’ll memorize the equations and (eventually) grasp the concepts.” But as a consumer, you don’t interact with those things,” he says. “Historically, not much thought has gone into how to relate those ideas to things students actually use, like refrigerators and coffee makers. Gilchrist had already started addressing this relevance problem with the introductory chemical engineering course, which he co-teaches with associate professor Angela Brown. So it was top of mind after he assembled the student focus group last summer. As a team, they came up with several ways to improve the program. They started mapping out activities they could do with local schools and how to build a stronger social media presence.

When Gilchrist mentioned a coffee course to a colleague he started at the University of California, Davis— one that eventually grew into a research and teaching facility—a group loved the idea of creating a similar class. But they wanted theirs to have a broader scope. “One of the 10 students, seven women,” says Gilchrist, “and they said, ‘You must have cosmetics in here, it’s such an easy way to connect with, well, everyone.’ Sure, the industry is more heavily marketed toward women, but products like deodorant, lotion, toothpaste, and coffee—those are all personal care products.” They came up with the idea of developing a syllabus and pitching it to the department as a new class.

The students split the course into separate sections on coffee and cosmetics, ending each with a project. They designed the class structure and the instruction sheets, homework, quizzes, and final projects. They came up with the grading criteria, too. They wanted the class to be accessible to all students, so all math, physics, and chemistry was high school level, and there were zero requirements to memorize and spell equations on tests.

The group focused on developing modules and hands-on labs that would engage students’ creativity. They also wanted to give them ownership over what they learned. At that end, they came up with using Google Jamboard, an interactive whiteboard, to kick off each section. The tool would allow students to identify and rank what it was that they were learning. Because the focus group had designed the course, and because students in the class were following their own interests within the topics of coffee and cosmetics, Gilchrist found himself in a unique position.

He says he “learned a ton,” especially from the business majors as they presented ideas around the design and marketing of new products like tea bags for coffee, or coffee-infused wine, or cosmetics blended to a customer’s specifications. “Their discussions about products often went beyond chemistry and biology to culture and diversity.

Stirring up discussions
When the students presented their syllabus to the CHBE faculty at the end of last year, “it was definitely nerve-racking,” says Meyer. “I was a junior, so they were my professors.” But their pitch, done over Zoom, was a hit.

“They did a great job of explaining the benefits and why we should do this,” says Brown. “At that point, the program didn’t offer any classes to nonmajors.” She says that people often don’t know what chemical engineers do—“I didn’t know when I chose this as a major,” says a classmate so the class gave students a chance to experience the discipline and see if it resonates.

The first Coffee and Cosmetics cohort included students majoring in finance, business, and chemical engineering, and since it was on Zoom, some high school students as well. “They really liked how the class was focused more on applications as opposed to memorizing calculations and taking exams,” says Walker. They also liked how accessible it was: “It was taught at a level that wasn’t exclusive,” says Meyer. “It was comprehensible to everyone, and they were excited to be learning about something they use every day.”

It wasn’t just the students who were learning. Because the focus group had designed the course, and because students in the class were following their own interests within the topics of coffee and cosmetics, Gilchrist found himself in a unique position.

He says he “learned a ton,” especially from the business majors as they presented ideas around the design and marketing of new products like tea bags for coffee, or coffee-infused wine, or cosmetics blended to a customer’s specifications.

“Their discussions about products often went beyond chemistry and biology to culture and diversity. For example, how the marketing of cosmetics is often centered around those with relatively pale skin. Or how socioeconomic factors can have a real impact on how students interpret some of those foundational engineering concepts, like the Bernoulli equation [the relationship between flow rate and pressure]. I can lecture for two hours on something like that, but if I were to instead start by asking the students, ‘Can you give me examples of where you see fluid moving very slowly or very fast?’ there could be some culturally rich answers to a question like that, he says. “What I’ve learned most is to ask the students what they know, before I tell them what I know.”

Coffee and Cosmetics is now under way in person, and Gilchrist hopes to add a competitive aspect (another of the focus group’s ideas) that will have students vying for who can brew the best coffee and make the best lip balm. For him, the genius of the class and its rollout has been an inspiring, humbling, and eye-opening experience. And it’s changed his perspective on what it means to engage his students, and by default, what it may take to attract more of them to this unique, varied—and yes, tough—discipline.

COFFEE (AND COSMETICS) TALK
Listen to our in-depth conversation with Professor Gilchrist on a new episode of the Rossin Connection podcast. Visit go.lehigh.edu/rossinconnection to download and subscribe.
It was a quintessential “good problem” to have for Svetlana Tatic-Lucic, the Rossin College’s associate dean for faculty development, and the individuals and committees involved in faculty hiring.

The pool of more than 800 applicants represented an unprecedented response to an unconventional approach to recruiting talent in unusual times.

“The pandemic caused most universities, especially large and state-supported institutions, to freeze their typical hiring cycles,” says Tatic-Lucic, who has a joint appointment with the departments of bioengineering and electrical and computer engineering. “We saw this as a moment for Lehigh to follow a different path, an excellent opportunity to open our doors—when so few institutions did—to attract top scholar–educators in areas of critical importance.”

Tatic-Lucic is also a chair of the Rossin College Diversity, Equity, and Inclusion Council. Formed in 2019, the DEI Council includes representatives from each of the eight engineering departments and a staff member. Tatic-Lucic has directed the group in conducting a historical review of the college’s DEI efforts, identifying baseline metrics, and outlining objectives for creating and maintaining an equitable and just environment (the basis of a strategic plan adopted over the summer).

Those activities contributed to a university-level milestone: earning Bronze status from the American Society for Engineering Education’s Diversity Recognition Program. Over the past two years, more than 120 institutions have been recognized by ASEE for making “significant, measurable progress in increasing the diversity, inclusion, and degree attainment outcomes of their programs.”

Numerous DEI Council members have facilitated the college’s recent faculty search, which, Tatic-Lucic says, focused primarily on academic excellence, while also “putting particular emphasis on identifying new professors with passion and leadership experience around initiatives that help to create diverse, equitable, and inclusive learning environments.”

The call for applicants was intentionally broad—not tied to specific disciplines or departments, nor level of experience or seniority. The evaluation process was inherently demanding, requiring multiple rounds of screening and interviews (conducted via Zoom in the midst of the pandemic) to narrow the sea of candidates down to a pool of the most promising. And the result: seven new faculty members (five of whom are either women or members of other historically underrepresented groups) with enthusiasm for DEI work—was unquestionably successful in advancing the college’s strategic priorities.

The disciplines and research directions of these new faculty members range widely, from modeling, optimization, and resilience of interconnected infrastructure systems to novel material design strategies inspired by nature. There’s also commonality in the high degree of interdisciplinarity in their envisioned research. In one case, one of the Rossin College’s joint hires with Lehigh’s College of Health, Soms are making the jump from postdoc to professor. All, says Tatic-Lucic, hold exemplary credentials and extraordinary promise.

And, as prescribed, they share a passion for advancing diversity, equity, and inclusion in the academic setting. In some cases, the new professors have demonstrated their support for increasing representation in STEM by taking on leadership positions in student and young investigator sections of their professional societies. Others have focused on community outreach, tutoring teenge immigrants and motivating them to pursue college degrees, or volunteering with organizations that provide mentoring and other support for children and families in low-resource areas.

“Many of our new hires were innovative in the way they made a difference,” explains Tatic-Lucic, “and, likewise, they have wonderful ideas on how to make an impact here at Lehigh, too.”

She points to a proposed initiative to increase representation of Hispanic and LGBTQ communities, as well as a suggested plan to secure external funding and promotion for research conducted by those who are underrepresented in STEM fields.

“We are inspired by the talent this search has identified and we look forward to significant contributions from this group to our educational and research missions,” says Stephen P. DeWeerth, professor and dean of the Rossin College.

“Our department leadership, working with the DEI Council, seized an opportunity for broader visibility and interest amid a hiring cycle suspended by the pandemic. The result has enhanced the diversity of our community in terms of representation and academic focus.”

RISING STAR

An out-of-the-box faculty recruiting approach opens doors to new professors who combine academic excellence with a commitment to advancing equity and inclusion.
AN INCLUSIVE COMMUNITY

“I’m always asking students questions,” says Lehigh’s new president Joseph J. Helble ’82, a chemical engineering alum and former Dartmouth College provost. “I’m curious about what motivates them and finding common ground.”

See page 10