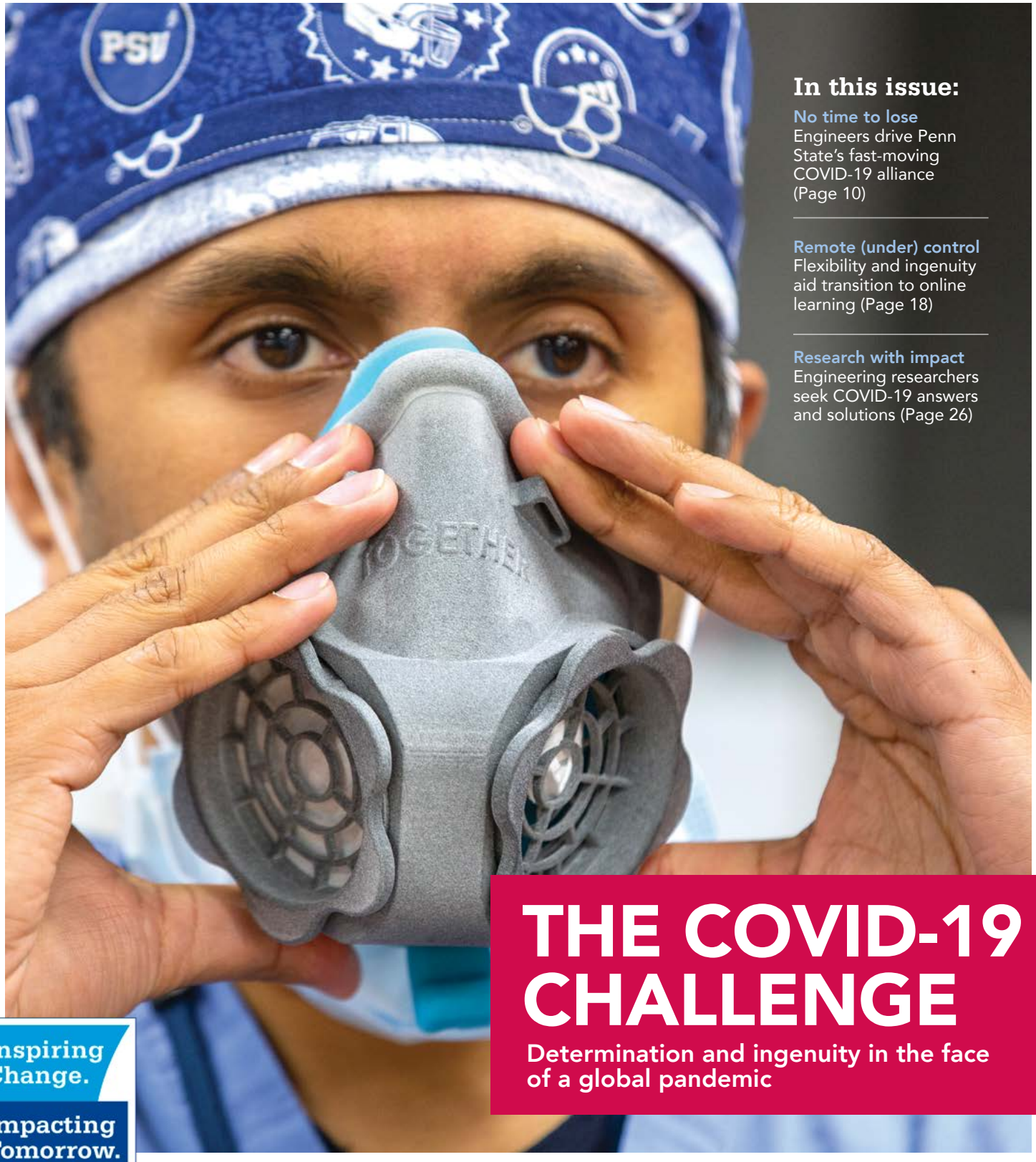
Engineering

The Magazine of the Penn State College of Engineering

PENN STATE

Spring/Summer 2020



In this issue:

THE COVID-19 CHALLENGE

Determination and ingenuity in the face of a global pandemic

Inspiring Change.
Impacting Tomorrow.

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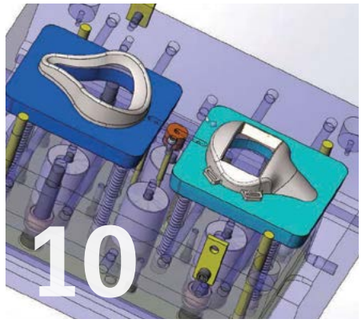

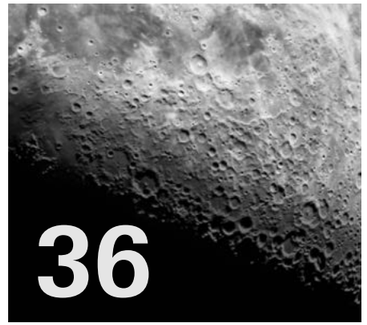

On the cover:
Dr. Neerav Goyal, a physician at the Milton S. Hershey Medical Center, tests out a 3D-printed filtration mask prototype.

Photo credit: Jason Plotkin

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The Dean's Message

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Standing tall:

Transforming in the face of a pandemic

"In the midst of all of this, our engineering community of students, faculty, staff, and administrators adjusted, persevered, and responded with inspiration and innovation."

On February 28, an email to the entire Penn State community outlined steps being taken across the University to respond to the evolving COVID-19 pandemic. We did not yet realize the full scope of what was coming: a historic transition to largely remote operations that would eventually extend through the remainder of the semester and beyond.

In the Penn State College of Engineering—as was the case across the University—the ways in which we learned, taught, researched, delivered support services, conducted meetings, built community, solved problems, and simply connected with each other were transformed in ways both big and small.

We weren't alone. All of society changed course in what seemed like a matter of days, and the lives of millions across the U.S. and in nations around the world were reordered and socially distanced. Daily life took on additional layers of complexity in the face of a grave health threat.

In the midst of all of this, our engineering community of students, faculty, staff, and administrators adjusted, persevered, and responded with inspiration and innovation even as circumstances changed, uncertainties continued, guidance evolved, and the weeks turned into months.

In this issue of *Engineering Penn State*, we are proud to take you inside the spring 2020 semester, as we share a few of the many ways that our college stood tall—and continues to stand tall—in the face of a historically unique challenge.

Our coverage begins on page 10 with the University-spanning Manufacturing and Sterilization for COVID-19 (MASC) Initiative, which nimbly harnessed the intellectual power and enthusiasm of more than 350 researchers for the good of health care providers across Pennsylvania. MASC is a prime example of the importance of engineering-driven research enterprises like ours to ensuring societal health and well-being.

Also in our COVID-19 coverage, learn how our faculty and students shifted focus and adapted during the transition to remote teaching and learning (page 18), how the college adjusted to support the career needs of students during a time of immense economic uncertainty (page 24), and how emerging research from across the college is investigating COVID-19 on multiple fronts (page 26). And there's much more, too!

On every day since March 13, I had been reaching out to students, faculty, and staff with an email intended to be part update, part inspiration and motivation, and part community building during a time we could not be together physically. My final email of the spring semester, which provided a chance to reflect on our collective experience over the previous months, concluded with this:

> *I've heard many people say recently, "we're all in the same boat," but I think that's fundamentally untrue. We're all in the same storm, but in a wide variety of boats. But we all need to keep moving forward, and to do so must remember that it's okay to ask for a tow-cable if your boat needs help, and we should all be on the lookout for those who may need such a rope. We don't know what's next in the battle against COVID-19 and for the world's economy, but we will keep going.*

In terms of this pandemic, we still do not fully know what's on the horizon, but by working together we are a powerful fleet, and we will continue to do what we have been doing: plan, prepare, and react. What I do know is that the College of Engineering community is ready to face whatever challenges that await. We've done it once and we'll do it again.

For the Glory,

Justin Schwartz
Harold and Inge Marcus Dean of Engineering
dean@engr.psu.edu

$15.5 million investment creates engineering scholars program at Penn State

The A. James & Alice B. Clark Foundation has committed $15.5 million to create the A. James Clark Scholars Program in the Penn State College of Engineering to support high-achieving engineering students with significant financial need. Penn State President Eric J. Barron (above) announced the milestone commitment on Feb. 10 at an event with Clark Foundation representatives at the Hintz Family Alumni Center.

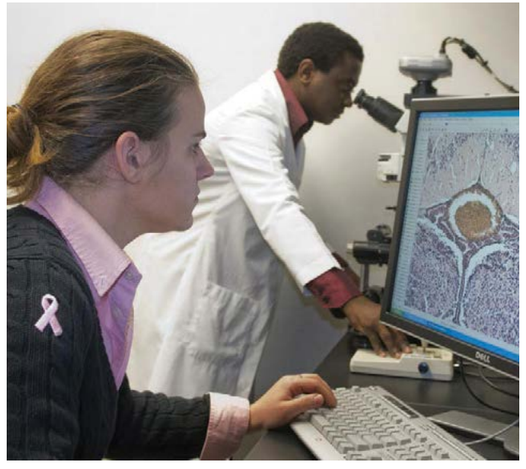
The foundation's investment will be combined with $10 million from Penn State to create an endowment for the new program. This is the largest University match to a private philanthropic gift in Penn State's history.

The college will select 10 Clark Scholars each year, for a total cohort of 40. The scholars, whose primary barrier to higher education is funding, will be selected on academic merit, extracurricular leadership, and demonstrated commitment to civic improvement.

New department head joins industrial engineering

Steven Landry, professor of industrial engineering and associate department head of the School of Industrial Engineering at Purdue University, has been named department head of the Penn State Harold and Inge Marcus Department of Industrial and Manufacturing Engineering. He began on July 1, 2020.

As department head, Landry succeeds **Ling Rothrock**, who has served in the role in an interim capacity since July 2019. Rothrock will rejoin the faculty as a professor in the department.



Penn State tops NSF rankings for breadth of research expertise

The breadth of Penn State's research expertise surpasses that of any university in the country, according to the latest National Science Foundation rankings of Higher Education Research and Development (HERD) research expenditures by key fields and subfields, released in late 2019.

Penn State engineering overall and five College of Engineering subfields rank among the top 10: engineering overall is ranked number 4; mechanical engineering is ranked number 2; electrical engineering is ranked number 4; industrial and manufacturing engineering is ranked number 5; and both chemical engineering and computer science are ranked number 8.

Researchers in the Center for Neural Engineering examine brain samples from cerebral malaria on a computational microscopy screen. Credit: Patrick Mansell

Twelve engineering faculty members receive NSF CAREER Awards

This past fiscal year, 12 engineering faculty members were recognized as part of the National Science Foundation's (NSF) prestigious Early Career Development (CAREER) Program, more than the two previous years combined. According to the NSF, the CAREER Program is one of its most prestigious awards in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization.

Enhancing fracture simulation

Michael Hillman, L. Robert and Mary L. Kimball Assistant Professor of Civil and Environmental Engineering, will develop new computational methods to simulate how materials and structures fracture. He will also develop an open-source software made freely available to academics, scientists, and engineers to facilitate reproducible research and to help them learn the fundamentals of computational fracture mechanics.

Developing a highly sensitive, tunable sensor

Shengxi Huang, assistant professor of electrical engineering and biomedical engineering, will develop a highly sensitive, tunable sensor that will have a strong and highly reproducible signal and be able to detect multiple molecules or components simultaneously. She aims to identify the vibrational modes of molecules and combine that information with 2D materials in order to overcome some of the current method's weaknesses to create better sensors.

Recording and modulating neurons in the brain

Mehdi Kiani, associate professor of electrical engineering, will work to develop an improved, minimally invasive method for recording and modulating neurons in the brain. If successful, according to Kiani, this method has the potential to map brain functions, restore lost sensory and motor functions, and enhance perceptual, motor, and cognitive capabilities.

Improving software security

Danfeng Zhang, assistant professor of computer science and engineering, will focus on improving software security with dynamic security policies. He will explore novel techniques for finding vulnerabilities in existing software, as well as for building, debugging, and verifying that software satisfies the intended dynamic security policies.

Validating airborne nanoparticles in indoor environments

Donghyun Rim, associate professor of architectural engineering, will study modeling and experimental validation of airborne nanoparticles in indoor environments. He will develop a computational fluid dynamics model to predict nanoparticle concentrations that vary with indoor environmental conditions. Once validated, the research will be open source.

Transforming metal casting for the 21st century

Guha Manogharan, assistant professor of mechanical engineering, plans to bridge the fundamental knowledge gap between sand casting and additive manufacturing (AM) and 3D sand printing by seamlessly integrating AM by reimagining 3D-mold geometries to reduce defects that are common in the traditional sand-casting process. He plans to share both research and educational outcomes with foundry educators in order to integrate the new knowledge from this project into classrooms and foundries.

News & Notes

Identifying the sources of salt pollution

Nathaniel Warner, assistant professor of civil and environmental engineering, will research new methods of collecting water-quality data, including the development of homemade sensors built with open-source hardware and software that citizen scientists will use to collect their own water-quality data. Once the data is collected, the citizen scientists will plot their results onto a map of their local watershed, highlighting locations with higher salt concentrations. Warner can then target those "hot spots" for further analysis.

Understanding, optimizing walking for stroke patients

Anne Martin, assistant professor of mechanical engineering, will study how both healthy and post-stroke individuals walk to design better assistive exoskeletons. Specifically, she will develop a novel, physics-based, predictive computational model and apply the framework to test human subjects' movements to determine if the goal of walking remains consistent for different situations.

Examining the influences, interconnections between food, energy, and water systems

Caitlin Grady, assistant professor of civil and environmental engineering and research associate in the Rock Ethics Institute, will examine the influences and interconnections between food, energy, and water (FEW) systems. She will bring together data from a variety of government agencies to model the relationships found within FEW systems in the mid-Atlantic region.

Developing new method of generating therapeutic cells for medical treatment

Xiaojun "Lance" Lian, assistant professor of biomedical engineering, will develop an improved method of generating large quantities of therapeutic blood cells and pancreatic beta cells from stem cells. Among potential uses of these new cells is new type 1 diabetes treatments, engineering of new blood vessels, and cardiac and circulatory medical treatments.

Developing diagnostic and therapeutic ultrasound

Julianna Simon, assistant professor of acoustics and biomedical engineering, will further advance the mission of her research lab—Biomedical Acoustics Simon Lab (BASiL)—which focuses on developing diagnostic and therapeutic ultrasound to improve human health. Specifically, she will work to improve the understanding of where bubbles form in healthy and diseased tissues in order to develop safer and more effective ultrasound diagnostics and therapeutics.

Creating sustainable windows

Julian Wang, associate professor of architectural engineering, will continue his work, conducted while at the University of Cincinnati, in which he created a window glazing material that could be used to produce dynamic windows that adapt to climate conditions in real-time. He will test the window glazing material and will work to take the material from the nanoscale and apply it to commercial window buildings.

Jacqueline O'Connor, Mary Frecker, and Zoubeida Ounaies will assume directorships in newly announced centers at Penn State.

Trio of female mechanical engineering professors to lead new research centers

Three professors from the Penn State Department of Mechanical Engineering have been selected as the directors of newly announced research centers at the University, where they will continue to make tangible impacts in research and grow the representation of women in STEM leadership.

Mary Frecker, professor of mechanical engineering and biomedical engineering, **Jacqueline O'Connor**, associate professor of mechanical engineering, and **Zoubeida Ounaies**, professor of mechanical engineering, have all been tapped to lead the multidisciplinary units.

The centers were established to elevate the University's visibility in critical areas, facilitate interdisciplinary connections, and spur new avenues of cutting-edge research.

Enhancing human health through science and engineering

Frecker will lead the Center for Biodevices, a collaborative unit aimed at initiating and supporting research in the area and facilitating impactful collaborations among Penn State's College of Engineering, College of Medicine, Eberly College of Science, College of Agricultural Sciences, and College of Earth and Mineral Sciences.

In the Center for Biodevices, Frecker plans to expedite research discoveries that could improve human and animal health, such as implantable, surgical, and wearable devices. These kinds of devices are already under development, including a flexible surgical probe that can help treat pancreatic cancer developed by Brad Hanks, a graduate student in Frecker's research group.

Read more

Fueling the future of energy

O'Connor will lead the Center for Gas Turbine Research, Education, and Outreach.

The creation of the Center for Gas Turbine Research, Education, and Outreach provides an enhanced pathway for visibility and collaboration. These cumulative efforts will also help position Penn State as a prominent thought leader in energy sectors by providing technical expertise to inform industry and government stakeholders on the importance of gas turbine technologies.

Read more

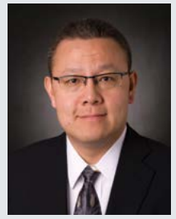
Imagining and building new materials

Ounaies has been named the inaugural director of the Convergence Center for Living Multifunctional Material Systems.

Established in July 2019, this strategic research and education partnership between Penn State and the University of Freiburg in Germany will advance the development of a new class of engineered living materials with potential applications in sustainable infrastructure, new robotics technologies, electronics, medical care, and more.

Read more

Mechanical engineering professor receives Faculty Scholar Medal



Donghai Wang, professor of mechanical engineering and chemical engineering, has received a 2020 Faculty Scholar Medal for Outstanding Achievement for his efforts in enhancing lithium battery technology. As a key researcher in the Battery and Energy Storage Technology (BEST) Center, Wang has helped craft the highly impactful and world-class research program housed at the University.

In the past decade, his research has focused on the discovery and development of novel chemistry, materials, and systems for electrochemical energy storage. Approaching his research as inherently interdisciplinary, Wang has worked with a broad range of students and faculty from colleges and units across Penn State to successfully pioneer new impacts in the field.

Engineering names interim senior director of corporate and industry engagement

In an ongoing effort to strengthen and expand connections with industry partners, **Priya Baboo**—director of industry, innovation, and development in the College of Engineering—has been named interim senior director of corporate and industry engagement in the college.

Baboo will lead collaborative efforts across the college to streamline and enhance industry engagement in areas related to advisory boards, research, philanthropy, and activities directly connected to students.

Online graduate engineering programs rank in top 10 in U.S. News

U.S. News and World Report's 2020 Best Online Programs, released on Jan. 14, 2020, ranked Penn State World Campus online graduate engineering at No. 6 for Best Online Programs and No. 5 for Best Online Programs for Veterans.

Each year, U.S. News develops the rankings based on statistical surveys submitted by colleges and universities as well as data collected in a separate, peer-reputation survey.

Maughmer flies a D-KVXX glider, outfitted with the vertical wing tips he designed to improve lift while reducing drag.

Aerospace engineer recognized with lifetime achievement award

Mark Maughmer, professor of aerospace engineering, has been recognized for his lifetime of contributions to the field of aerospace for the third time by the American Institute of Aeronautics and Astronautics (AIAA) with the 2020 AIAA Aerodynamics Award.

The award recognizes one person a year for their contributions to the development, application, and evaluation of aerodynamics concepts and methods. Maughmer was specifically chosen for his "foundational developments in airfoil and wing design, advancement of novel airfoil configurations, and contributions to rotorcraft aeromechanics," according the AIAA website.

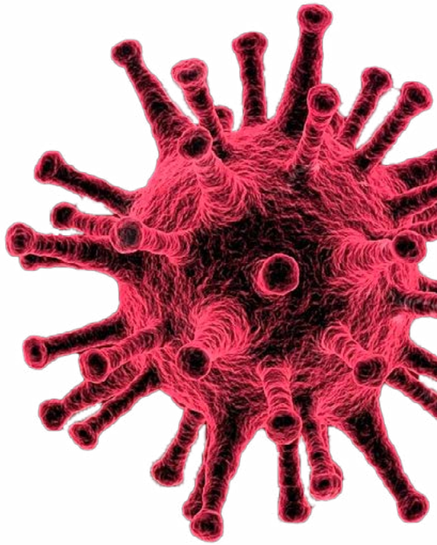
"I'm grateful that doing what I love has contributed to the field. Often … I don't know if I'm playing or working. It's hard to separate my research and teaching from what I do on the weekend."

ASSESSMENT: Physicians at the Milton S. Hershey Medical Center try on 3D-printed filtration mask prototypes. Photo credit: Jason Plotkin

NO TIME TO LOSE

Engineers drive Penn State's fast-moving COVID-19 alliance

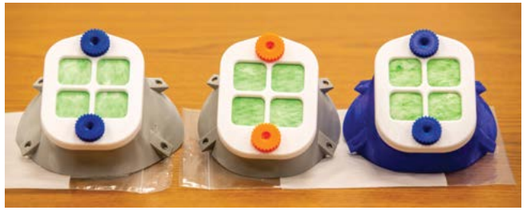
by Erin Cassidy Hendrick



As Pennsylvania prepared for COVID-19 in early spring, Penn State engineers worked quickly to harness the University's broad research enterprise and the dedication of a community interested in helping during a time of dire need. To that end, the Manufacturing and Sterilization for COVID-19 Initiative (MASC) was launched in March. The coalition's unwavering focus was to deliver rapidly scalable solutions and generate tangible impact, particularly within the Commonwealth.

"It speaks volumes about the Penn State family—faculty, students, alumni, industry partners—who are willing and able to do whatever they can to help," said **Tim Simpson**, professor of mechanical engineering and industrial and manufacturing engineering.

Quickly growing to more than 350 participants through Simpson's leadership, the College of Engineering became the thriving nucleus of the University's response.



PROTOTYPING: Filtration inserts designed for the MASC filtration masks.

Through a collaborative relationship with Penn State Health and the Center for Medical Innovation at Penn State College of Medicine, MASC became a grassroots rallying force for researchers to receive calls to action, connect with multidisciplinary experts, and draw resources from every corner of the University—such as recruiting costumers in the theatre department to sew gowns and masks, co-opting University Park's Breazeale Nuclear Reactor to sterilize surgical gowns using gamma rays, and engaging plastics engineers to construct face shields.

"The many ventures MASC has spearheaded are an incredible example of how Penn State researchers can join together for the common good," said **Justin Schwartz**, Harold and Inge Marcus Dean of Engineering. "I'm extremely proud it began in the College of Engineering and reflects the spirit I see every day in their work."

And the work has continued into the summer.

"We now span 21 Commonwealth Campuses and multiple colleges, all with intending to have a direct and immediate impact on our local health care providers and communities," Simpson said. "We are leveraging our Penn State connections across the entire state."

MASC has rapidly evolved in its short tenure by finding new avenues for impact. The three MASC case studies that follow represent only a handful of its undertakings since March, with hundreds of professors, students, and staff members devoting personal time and juggling existing work commitments to contribute to the initiative.

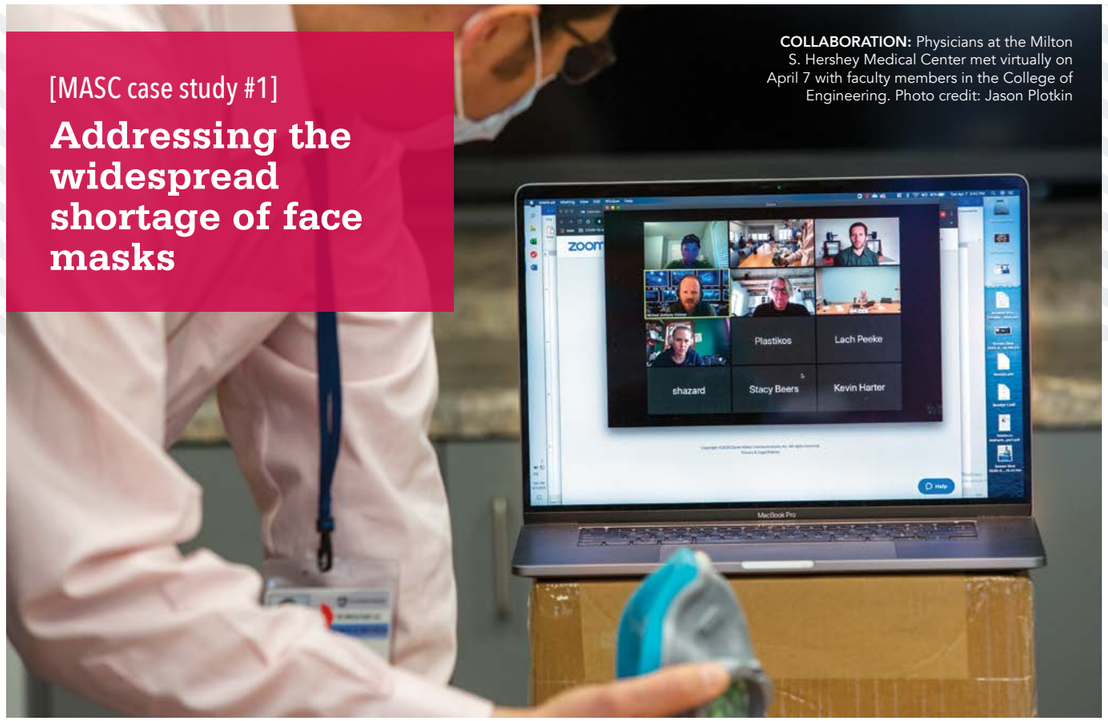
"This is all volunteer work from our team, which shows the commitment," Simpson said. "This has become a way for Penn Staters to channel their existing energy and passion into something that can directly help those affected by the current pandemic. That is what keeps us working overtime, which everyone seems to be willing to put in."

We are responding together

As Penn State navigates the unprecedented challenge of the coronavirus (COVID-19), we are drawing on the strength of our entire community. To learn more or give to the MASC initiative, please visit: bit.ly/masc2020.

[MASC case study #1]

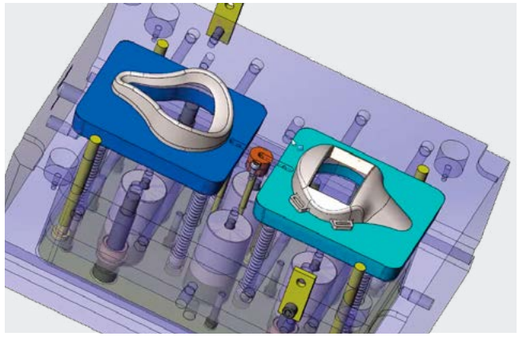
Addressing the widespread shortage of face masks



COLLABORATION: Physicians at the Milton S. Hershey Medical Center met virtually on April 7 with faculty members in the College of Engineering. Photo credit: Jason Plotkin

With its infrastructure and mission in place, a major priority for MASC was to meet the urgent demand for personal protective equipment (PPE). Along with many health care facilities across the nation, increased supplies of protective masks, such as N95s, were needed at Penn State Health to limit the spread of COVID-19.

In response, MASC contributors from the College of Engineering and the College of Medicine have collaborated to design and develop novel 3D-printed mask prototypes.



PRODUCTION: A computer aided design (CAD) model of the plastic injection molding tooling was created to scale the production of the filtration mask.

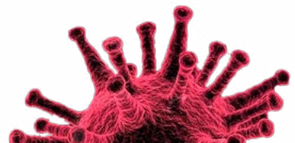
A few weeks after MASC's inception, a group of physicians gathered at Penn State Health Milton S. Hershey Medical Center and were presented with several mask designs to test. Participating faculty members in the College of Engineering, attending the session virtually, received direct feedback on fit, size, and comfort.

"It has been exciting to speak with engineers who can think outside of clinical constraints and current practices," said Dr. Neerav Goyal, an associate professor and otolaryngology surgeon at Hershey Medical Center. "It also allows us to bounce ideas off of experts in manufacturing and prototype very quickly and effectively."

Simpson added, "This was a great example of the energy and commitment we all have to this effort. Engineers and physicians were willing to come together and finalize a design."

While the initial prototypes were 3D printed, to scale manufacturing to meet the current demand, several traditional manufacturing companies, with existing U.S. Food and Drug Administration (FDA) compliance, were recruited to create the shell.

With all the components in place, Simpson said production will be able to create thousands of masks per day to meet demand. ■



[MASC case study #2]

Proactively preparing nursing homes

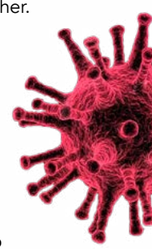
"If we can visualize the spread better, we can let nursing homes know, 'get ready, this is at your doorstep' and then provide them with a surge pack, maybe 1,000 gowns, 500 masks sent out at a moment's notice."

DELIVERY: The final design of the MASC-designed filtration mask shell.

Nursing homes and assisted care facilities have been particularly susceptible to the spread of COVID-19, largely due to the nature of community living of high-risk populations. As MASC was beginning to take shape, Penn State was recruited by the Pennsylvania Department of Health and Human Services to assess the basic needs of local facilities and determine if their staffs had the appropriate supplies and knowledge to respond to an outbreak.

"This is an unprecedented situation, particularly for nursing homes," Dr. Nicole Osevala, an assistant professor and interim chief of geriatric medicine at Hershey Medical Center, said. "Most nursing home aides don't have time to read the 1,000-page documents or hour-long webinars. What we are doing is providing that information in real-time and how to apply it directly to their work."

While solving these immediate problems were critical, Osevala, Sue Purdum, instructor of supply chain and information systems in the Smeal College of Business, and a team of medical students, were encouraged to take things one step further.



By sourcing information from the 221 nursing homes and long-term care facilities in central Pennsylvania, they developed a PPE demand model in conjunction with the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering.

"We are applying predictive analytics to figure out where we think the infection is spreading and get those facilities geared up before it happens," Purdum explained. "If we can visualize the spread better, we can let nursing homes know, 'get ready, this is at your doorstep' and then provide them with a surge pack, maybe 1,000 gowns, 500 masks sent out at a moment's notice."

The team is hopeful the new framework will help well into the future, to predict future surges and better prepare facilities for what they'll face. ■

[MASC case study #3]

Disposable stethoscopes show heartbeat of MASC

Jessica Menold, assistant professor of engineering design and mechanical engineering, carefully pours silicone to create earbuds for an early single-patient stethoscope prototype. Photo credit: Christian Baum

Stethoscopes, which are routinely needed for medical examinations, presented an unexpected, new challenge for the MASC team. Because of additional COVID-19 precautions, physicians at Penn State Health indicated a need for a single-patient stethoscope to ensure each person was treated with a sanitized device.

Within hours, **Jessica Menold**, assistant professor of engineering design and mechanical engineering, got to work.

"Not only did Jessica and the graduate students in the THRED Lab develop the first design for the 3D-printed stethoscope over a weekend, but she recruited several of her faculty colleagues in engineering, and they all rolled up their sleeves and started making parts in the Bernard M. Gordon Learning Factory," Simpson said. "I was blown away by what Jessica and her team accomplished in such a short period of time."

The professors worked in the evenings and on the weekends to produce 100 stethoscopes that were delivered to Hershey Medical Center for testing.

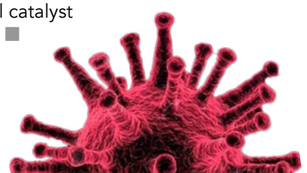
For the initial design, Menold and **Sarah Ritter**, associate director of engineering design and associate teaching professor of engineering design, **Andrea Arguelles**, assistant professor of engineering science and mechanics, and **Meg Handley**, associate director of engineering leadership outreach and assistant teaching professor of engineering leadership, created a new stethoscope with silicone food-grade tubing, typically used to make beer; hand-made silicone earpieces made via a 3D printed mold; and a 3D-printed cover and diaphragm that is held to the patient's chest to hear a patient's heartbeat.

With rapid feedback from the physicians and medical students at Hershey, the design evolved significantly over the next two weeks to improve acoustic quality while reducing the number of parts and assembly time.

Several dozen prototypes were sent to Hershey to address the urgent need, and the team is now moving forward with mass production of their final stethoscope design, in collaboration with an FDA-registered industry partner, similar to the filtration masks.

With their goal of providing Penn State Health with these critical pieces of equipment on the horizon, Menold said she is inspired by the collaborative spirit she has witnessed in both the College of Engineering and at Penn State Health and the Center for Medical Innovation.

"As someone who studies engineering design, I'm fascinated with how fast the design process is going for the medical products we need in this crisis," she said. "The near-constant communication between MASC and Hershey Medical Center is a real catalyst for engineering design innovation." ■



Engineering professor at the helm of COVID-19 innovation

by Erin Cassidy Hendrick

As a faculty member positioned on the forefront of advanced manufacturing, **Tim Simpson** felt compelled to take action when the pandemic began.

"At first, I thought this would be a standalone project, figuring out what we can 3D print to help health care workers," Simpson said. "It grew way beyond what I originally expected."

Simpson's swift actions led to the creation of MASC and his leadership allowed the efforts to grow throughout the University and make a significant impact to prepare and equip health care workers and the citizens of Pennsylvania.

For much of the spring of 2020, Simpson worked in the basement of his family home, his eyes glued to three computer screens monitoring the constant barrage of email. In addition to his regular teaching load, he has facilitated hundreds of connections, ranging from frontline clinicians at the Hershey Medical Center, to relevant researchers, and University administrators, usually beginning in the early hours of the morning and continuing until late in the evening.

"I'm seeing tons of design ideas and questions come to me, non-stop every day," he said. Tim Simpson discusses his work with the Manufacturing and Sterilization for COVID-19 Initiative. "It's both exhilarating and exhausting at the same time!"

During the interview for this profile, Simpson's computer continued to chime with incoming emails. He was alerted to the latest developments in sourcing a wearable sensor to monitor the oxygen levels of COVID-19 patients. Earlier that day, MASC had been contacted by the Air Force Institutes of Technology about a shortage of these devices. Within the hour, Simpson had already brainstormed with four researchers, who exchanged ideas to build upon existing designs for the devices and to find sources for the materials.

While the pressing needs MASC is addressing through their work vary, these lightning-quick responses and actions became the stalwart of the initiative, led by Simpson's example.

"MASC has been and continues to be an impressive and extraordinary undertaking to rapidly move ideas from research to health care solutions," said Lora Weiss, senior vice president for research.

Tim Simpson sorts through an inventory of filtration masks being evaluated by MASC in his home.

At first, Simpson didn't conceive of his efforts as the large-scale, vast consortium that it soon became. His first thoughts were to use his expertise in 3D printing to help create personal protective equipment for health care workers.

"I thought I'd spend a few days tackling the challenges of that," he said. "But I quickly realized that there were so many other critical needs that the team at Hershey was facing and saw more and more opportunities where Penn State's research depth and expertise could help."

His efforts have paid off, with hundreds of projects initiated to address both short-term and long-term issues that have emerged from the pandemic.

"Knowing the time that you're donating is helping people on the front line is huge," Simpson said. "That is what keeps us going, working crazy hours and weekends that myself and everyone involved seems to be willing to put in for free." ■

Tim Simpson discusses his work on the Manufacturing and Sterilization for the COVID-19 (MASC) Project.

BRIDGING THE DIGITAL DIVIDE

by Samantha Chavanic

Students devise a low-cost internet solution for rural communities, a necessity during the pandemic-driven shift to remote learning

IN RURAL COMMUNITIES across the United States, delivering reliable broadband internet to customers remains problematic for service providers. Financial, geographic, and technical components each present unique challenges to overcome. As part of a semester-long project in their EDSGN 558: Systems Design course this spring, Penn State engineering graduate students worked to define a low-cost rural internet solution for Georges Valley, a rural area about 10 miles east of State College.

Course instructor **Sven Bilén**, head of the School of Engineering Design, Technology, and Professional Programs, and professor of engineering design, electrical engineering, and aerospace engineering, challenged his students to design a system to provide reliable broadband access in rural areas. Centre County, which includes the Allegheny Plateau, Allegheny Front, Ridge, and Valley regions, and several wide valleys with rolling terrain, serves as an excellent example of the geographic challenges found in rural regions. With large ridges on either side and a deeply furrowed valley floor, Georges Valley and its approximately 400 residents appropriately represent the small-town American community without access to fast, reliable broadband. Currently, Georges Valley residents rely on satellite or mobile networks.

"Federal, regional, and local governments have recognized this 'digital divide' and are looking for cost-effective ways to address it," Bilén said. "This need became even more apparent and urgent with the rapid shift to remote learning and remote work as a response to the global pandemic. While many people in cities are finding adequate internet access to make this possible, most rural communities remain disconnected, or are underserved at best."

As part of one large systems design team, the students in the class worked all semester on this challenge, led by a project leadership team comprised of project manager **Todd Spurgeon**, additive manufacturing and design graduate student; systems lead **Nate Watson**, additive manufacturing and design graduate student; business team lead **Leen Abubaker**, engineering leadership and innovation management graduate student; and technical team lead **Daniel Henneh**, engineering design graduate student.

Their proposed solution leverages "TV white space" to create a reliable broadband system. It uses idle TV channels within the VHF and UHF radio spectrum, or TV white space, to provide broadband internet to rural areas. The switch from analog to digital TV has freed up portions of the broadcast spectrum, allowing it to be used for other purposes. The benefits of using TV white space include minimal new infrastructure, transmission distance and capabilities, and modest capital investment.

"This approach was chosen because, compared to other methods of providing internet to rural areas, it is more affordable, less susceptible to land topography and obstacles, yet is capable of providing reliable data speeds to the clients," Henneh said.

Currently, use of TV white space is limited because of federal regulations. Spurgeon explained that TV white space is traditionally owned by broadcasting companies and the Federal Communications Commission (FCC) has been reluctant to open up this part of the spectrum for internet use.

"This spectrum is underutilized in these rural communities, and the population density does not lend it to commercial viability," he said. "An opportunity presents itself for a minor change to legislation or FCC rules to permit the use of TV white space for rural broadband exclusively for populations where other solutions are not commercially viable."

Watson explained that TV white space's transmission capabilities—distance and through obstacles—allow for non-line-of-sight transmission, something extremely important in Georges Valley, an area with challenging terrain.

> **"The TV white space transmitters and receivers would be able to be placed on existing towers with existing connections to fiber optic cables with access to the internet."**

"If line-of-sight access is required, then many more towers are needed, which then need to be built and serviced, increasing the cost above what rural, low-density populations can afford," he said. "The TV white space transmitters and receivers would be able to be placed on existing towers with existing connections to fiber optic cables with access to the internet."

When the team first began working on the project at the beginning of the semester, members had no idea just how relevant their project would become. Months ago, lacking a reliable internet connection may have meant not having a stable video chat or issues with watching a movie on a streaming service. Now, during the COVID-19 pandemic, rural areas have limited access to the tool that lets children attend class and submit homework and adults work from home.

"The lack of reliable, high-speed, and affordable internet services limits the success of rural communities because it directly affects their access to educational and economic resources," Abubaker said. "People living in rural areas have the right to have the same service quality that enables them to complete their daily tasks and guarantees receiving an income [and] their continuous personal and professional development." ■

Remote (Under) Control

Flexibility, ingenuity, and humor power successful transition to online learning

A few of the many students and faculty from across the College of Engineering community who adjusted quickly to the March shift to remote teaching and learning. Top row: Sabrina Carrozzi, Sarah Root, Dan Russell; Middle row: Jessica Menold, Martin Pietrucha, Caitlyn Grady; Bottom row: Christopher McComb, Sarah Ritter, Matt Parkinson

When remote learning began, members of the College of Engineering community were invited to submit notes of appreciation for the actions of their peers. Here are just a few...

"**Kellie Scofield** is an incredible asset! She takes time to check on our whole team as we work so hard to take care of each student with fairness and empathy."

Midway through spring break in early March, a message from Penn State President Eric J. Barron dramatically altered the direction of the remainder of the spring semester to come: The University would move to remote learning for all classes beginning on Monday, March 16.

That monumental decision, made in response to the evolving COVID-19 outbreak in the United States and around the globe, immediately transformed the educational experience for engineering students and faculty alike.

"Things simply aren't the same as they would be in a face-to-face environment," said **Sarah Root**, associate teaching professor in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering. "What used to be a 50-minute lecture on a Wednesday morning is now a Zoom meeting and Canvas modules.

"Engineers are problem-solvers though, and we can't just throw our hands up. My logic is this: confined spaces often produce the most creative solutions."

The stories that follow—from across the College of Engineering—highlight just a few of the countless inspirational responses to the shift to remote teaching and learning in the spring 2020 semester.

Zooming through a thesis defense

by Jamie Oberdick

A master's degree thesis defense is difficult enough under normal circumstances: in a room in front of a thesis committee. For **Sabrina Carrozzi**, an integrated undergraduate/graduate student in biomedical engineering, COVID-19 added another level of difficulty by mandating social distancing guidelines.

"We had two options—to do the defense over Zoom or gather the committee and myself in a room where we could each be six feet apart," Carrozzi said. "We chose the first option so that others could also attend my defense via Zoom."

Zoom offered one nice advantage for Carrozzi, as she was able to record her defense to share with friends and family. But a remote thesis defense is highly unusual and comes with its own challenges.

"The biggest challenge was not being able to read the committee's body language," Carrozzi said. "I rely a lot on body language as a teaching assistant to determine the level of student understanding. So, it was difficult to judge the appropriate speed of my talk or if I should have clarified certain topics a bit more. I just had to use my best judgment."

Carrozzi's defense focused on anterior cruciate ligament (ACL) reconstructive surgeries, which are common among active individuals and those who play sports. After surgery, there is a chance the newly repaired ACL can fail and tear again. Carrozzi's thesis focused on examining the failure rates between two commonly used repair techniques using ligaments. These techniques are an autograft, when a ligament is taken from another part of the patient's body, or an allograft, when a ligament comes from a cadaver.

"The goal of my thesis project was to develop a protocol to examine the differences between the two, with an ultimate aim to improve surgical outcomes post-op for those who receive an ACL reconstructive surgery," Carrozzi said.

As for defending over Zoom being different than in-person, Carrozzi said she was actually more relaxed. And it paid off—she passed.

"While it was not ideal to do it virtually, I'm glad I was able to successfully defend my thesis and pass," Carrozzi said. "A thesis defense is a huge milestone, and thanks to Zoom, I will always have a recording of it." ■

"As faculty marshal for Penn State, **Robert Melton** was instrumental in finding a path forward during commencement planning that balanced the justice of maintaining Penn State standards with the mercy of alternate grading to recognize the struggles faced by many students."

"Shout out to the **Office for Digital Learning** for all they have done to guide faculty throughout the change to remote teaching."

Digital learning detectives

by Erin Cassidy Hendrick

The unexpected transition to online classes prompted many changes for undergraduate students and their instructors. To understand the magnitude of these impacts and potentially improve digital learning, researchers in the School of Engineering Design, Technology, and Professional Programs (SEDTAPP) received $196,136 from the National Science Foundation (NSF).

WIth a particular focus on women and traditionally underrepresented groups, the one-year project is gathering data from students enrolled in a first-year design course offered in the College of Engineering.

"When we suddenly changed our undergraduates' fundamental experience by transitioning to a digital environment, we were motivated to understand how this shift might affect the formation of engineering identities," said **Jessica Menold**, assistant professor of engineering design and mechanical engineering and the principal investigator of the project. "Prior work suggests that online learning environments promote individualistic learning attitudes and fundamentally change the way peers and instructors interact."

Menold and co-principal investigators **Christopher McComb**, assistant professor of engineering design and mechanical engineering, and **Sarah Ritter**, associate director of engineering design and associate teaching professor of engineering design, are examining the student experiences of those enrolled in the spring 2020 sections of EDSGN 100.

The class, a cornerstone of the Penn State engineering curriculum, was being taught to more than 500 students and administered by 12 instructors during the spring semester. Its purpose is to impart hands-on skills with engineering design tools and techniques, such as sketching, 3D computer-aided design (CAD) software, physical modeling, and communications processes.

"Because of the nature of EDSGN 100, we have the unique opportunity to explore a 'natural experiment.' Each individual instructor's approach to setting up their virtual classroom will vary, so we can see how those differences affect both student and instructor experiences," Menold said.

McComb added, "This work will address an immediate need—understanding and repairing the disruption caused to our first-year students' educations. However, this work may also fundamentally change how we deliver these hands-on design courses by helping us better understand how to effectively deliver them virtually."

The funding was possible through the NSF's Rapid Response Research (RAPID) Program, which supports projects that present an urgency in light of unanticipated events, such as the COVID-19 pandemic. ■

"This work will address an immediate need—understanding and repairing the disruption caused to our first-year students' educations."

Dressed for success

by Tessa M. Woodring

When it comes to teaching from a distance, **Daniel Russell**, teaching professor and distance education coordinator in the Graduate Program in Acoustics, recognizes the need for positivity. This spring, he set out on a mission to bring creativity and a few laughs to his students and colleagues.

"After my third lecture from home, I discovered that Zoom had the option of using virtual backgrounds, and I immediately recognized that this might be a way to have some fun and bring some humor to my class," Russell said.

Russell found a cabinet in his basement that was filled with old dress-up clothes and Halloween costumes from when his children were younger and decided they would be perfect for his lecture openings and faculty and staff meetings.

He dressed up as numerous characters with backgrounds to match, including Princess Leia and "Dan" Solo from "Star Wars" (Han Solo's brother, according to Russell), and a ghost with a "floating head" at Hogwarts, from "Harry Potter."

"I started digging through the collection of dress-up clothes looking for wigs and hats, and ideas for things I could wear, and then I went hunting online for background images to match the costumes I was finding," Russell said.

Russell said his first week teaching remotely was especially challenging.

"For the first several days after the 'stay-at-home' order came down, I was preparing to teach my class from my home, and I had a terrible time focusing on course-related schoolwork," Russell said. "I was spending way too much time reading news reports, trying to read up about the coronavirus, and how to stay safe and protect myself and my family."

Russell noted that he decided to be honest with his students about his mental and emotional state and encouraged them to let him know if they were struggling with anything—course-related or life-related.

"The responses from students were extremely encouraging both to me and other students in the class," Russell said. "When faculty show that they care about their students, it goes a long way—and when faculty reveal that they too are struggling with making the adjustment to these unprecedented circumstances, it helps to show we are human." ■

Meme mastery

by Miranda Buckheit

Sarah Root, associate teaching professor in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering, like all University faculty, students, and staff, had her schedule upended when Penn State shifted to the remote learning ecosystem.

Throughout the transition to remote learning, Root worked hard to keep a state of routine for the sake of the students, but she also tried to instill some joy and laughter.

Due to the cancelation of the annual March Madness basketball tournament, Root implemented a "March Meme Madness."

Working in a bracket structure, similar to the traditional March Madness, students submitted a funny image that they made, which was related to the class, material, deadlines, or interesting things that have happened. The voting process dwindled down to the top "meme."

The students also took initiative by building a sense of community. In Root's industrial engineering (IE) class, IE 302, **Mackenzie Dominick**, a second-year IE student, suggested that the class sing Happy Birthday to their peer, **Andrea Castaneda**, a fellow student.

"It was a really funny, beautiful moment," Root said.

The experience of using online tools provided Root with inspiration for ways she can work in the future. She plans to implement more use of the Microsoft Office suite and Zoom video conferencing.

"You have to make active learning work in this online environment, and I'm an investigator," Root said. "I'm really looking at how I can shake things up, and I think this experience will help me do that." ■

- "**Kevin Waltz** graciously offered to deliver a check to donor and member services saving me a 40 mile trip to campus! This was an act of kindness that shows his true caring and supportive spirit."
- "**Youyou Cheng** ordered masks from her home in China and gave them to the hospital, school district, CoE, and ARL. When offered reimbursement, she said 'No, we are all in this together.'"
- "Facilities Rep and Safety Officer **JR Watson** has been so supportive to our facilities to make sure we are safe. He walks the buildings, checks labs and hallways, and even waters plants and scans items to our staff to keep them from having to go to their offices."
- "As IT point person, **Scott Heckman**'s initiative and ability to streamline operations allows IME to rely on our automation capabilities as we telework."

The showcase must go on

by Tessa M. Woodring

Each semester, senior engineering students present their capstone design projects at the College of Engineering Learning Factory Capstone Design Showcase. For the spring, to coordinate with the shift to remote teaching and learning, the showcase took place entirely online.

To make this shift to an all virtual format, the faculty and staff of the Bernard M. Gordon Learning Factory collaborated with numerous units across the College of Engineering to create an innovative and easy-to-navigate website. Participating students used the website to upload their completed projects. The projects were displayed for public viewing and evaluated by a panel of industry experts for numerous awards.

According to **Matt Parkinson**, director of the Learning Factory and professor of engineering design and mechanical engineering, students who participated in the virtual showcase gave positive feedback through the transition to a virtual format.

"Students responded to this shift in format as they have to every other challenge that has come during this COVID-19 adventure: with a delightful combination of patience, enthusiasm, and ingenuity," Parkinson said. "I would expect nothing less; our students are great."

The shift to a virtual format created the opportunity for students to share their projects with a much broader audience. During the one-week virtual event, the website logged more than 10,000 visitors from 95 different countries.

Another advantage to this virtual format is that the students' projects are continuing to receive page views on the website long after the showcase ended.

"I think one of the interesting things about this format is that the work lives on beyond the showcase," said **Casey Fenton**, multimedia specialist in the Office for Digital Learning. "Students can continue to share it on resumes and social media."

1
week-long virtual event

10K
visitors

95
countries

"**Lori Miraldi** has continued seeking ways that the Engineering Ambassadors can continue our mission of outreach through social media and member videos."

"**Cheryl Knobloch** is going above and beyond to support those involved in the Women in Engineering Program during this time of crisis. She is tirelessly working to make sure we all have the resources and support we need."

Adapting quickly with empathy

by Tim Schley

The task ahead was daunting: how do you plan and upload an online curriculum worthy of Penn State engineering students in a matter of days?

"When confronted by a crisis, engineers look at it and say, 'Let's define the problem, let's come up with a solution, and let's get to work,'" said **Martin Pietrucha**, professor of civil and environmental engineering. "That's just how this place rolls."

Thus, the flurry of emails began as faculty and staff traded ideas. Should you upload full lectures or just clips? What do you do if an online quiz is not working? How do you demonstrate your lab? Are you available to be a guest lecturer? How are you talking to your students about all of this?

"I have enjoyed watching and interacting with my colleagues who are all trying really hard to adapt quickly," said **Caitlin Grady** in March. She is an assistant professor of civil and environmental engineering and research associate in the Rock Ethics Institute at Penn State. "We're all sharing best practices, asking questions, and figuring out what to do as a collective."

During the spring semester, Grady was teaching an undergraduate course, CE 360: Fluid Mechanics, and a graduate course, CE 597: Ethics, Engineering, and Environmental Management. For her undergraduates, she adopted the flipped classroom model of teaching, where she provided them with pre-recorded lectures they could watch on their own prior to class.

At the regularly scheduled lecture time, Grady organized a video conference with everyone to discuss the material together in more detail. This discussion, she noted, could be used to assess how everyone in the class was handling the complex transition to remote learning.

"Their entire environment has been shifted," Grady said. "My approach has been to acknowledge that and talk openly about it with all my students and discuss what their needs are."

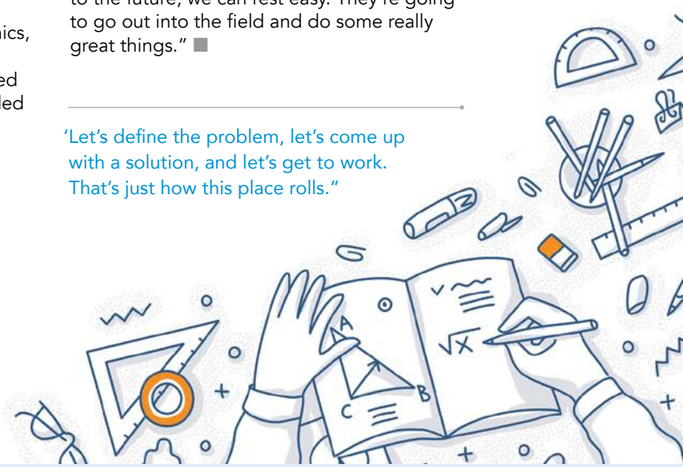
Grady was hardly the only faculty member with this empathetic attitude. Pietrucha serves as the undergraduate adviser for the department and understood the pressure that the transition was adding to many of his students.

"Be as forgiving as you can," Pietrucha said. "We don't need to throw away standards but be as kind as you possibly can because everyone is struggling with something."

Still, Pietrucha was proud of the resilience shown by everyone in the department, especially the students.

"I've been working with students here for 30 years, and I've seen that they have this incredible inner strength," Pietrucha said. "As we look to the future, we can rest easy. They're going to go out into the field and do some really great things." ■

'Let's define the problem, let's come up with a solution, and let's get to work. That's just how this place rolls."



"**Puneet Singla** quickly became the aerospace faculty member who best-identified which students were struggling—even the confidant of students who were infected or were worrying about family who were infected. His just-announced promotion to full professor is well deserved!"

"**Paige Vernon** has been helping out her community in Mechanicsburg by sewing masks for home health care workers."

Student growth opportunities continue ... even during a pandemic

by Tessa Woodring

COVID-19 has negatively impacted the career, research, and internship opportunities of many students. However, the faculty and staff in the Penn State College of Engineering have spent countless hours since March working to ensure that these students are nonetheless provided with the professional growth opportunities they need to further their academic and professional careers.

Units across the college recognized the immediate need for the restructuring of their professional growth programs to accommodate affected students.

"I think the first step was seeing the importance of what the research and professional experience meant to students and understanding that the increasing impact of COVID-19 would change that urgency and significance to students," said **Erin Hostetler,** director of student research and engagement in the Center for Engineering Outreach and Inclusion (CEOI).

Numerous engineering units—including CEOI, the Bernard M. Gordon Learning Factory, and Engineering Career Resources and Employer Relations—made their services broadly accessible to students and showed the capabilities of connecting even when apart.

For these units, that meant shifting to a virtual format and completely reorganizing their programs and their student support services.

For Research Experience for Undergraduates (REU), faculty were asked to re-frame the program's research projects to ensure students would have positive experiences in the virtual setting. Hostetler said there was tremendous support from faculty to help make this transition.

"The response has been overwhelmingly positive from all stakeholders," Hostetler said. "Students are immensely grateful for these opportunities and recognize the significance the growth from the experience will provide."

With an increase in outreach from students for REU opportunities, CEOI increased donor-funded scholarships for students interested in research and received additional funding from the college's Leonhard Center for the Enhancement of Engineering Education for REU opportunities. This allowed CEOI to expand their capacity and support even more students in need.

For students who lost internships due to COVID-19, the Learning Factory created a virtual summer internship program that pairs students with sponsors to work on projects remotely. The internship program also provided students with supplemental training in areas such as financial literacy, ethics, professional communications, leadership, and report writing.

"Internships are a vital part of undergraduate education," said **Matt Parkinson,** director of the Learning Factory and professor of engineering design and mechanical engineering. "Obviously an on-site internship is ideal. The multi-sensory learning that occurs in a physical environment is fundamental to internships—and to the Learning Factory—and it can't be replicated through our remote internships. But we can provide many of the critical elements: mentorship, accountability, and a chance to work on really cool open-ended problems."

Working closely with CEOI, the Office for Digital Learning, and Career Resources and Employer Relations, the Learning Factory provided 95 students from eight departments with summer internship opportunities.

"My internship was canceled because the company did not want to bring in new personnel during the pandemic," said **Jane Pham,** rising junior in industrial engineering. "I immediately continued my internship search, but the process was made even more difficult due to many hiring freezes."

Pham also mentioned that the internships she was finding were shortened programs that did not provide her with the learning experience she was seeking.

"I am lucky to have been partnered through the Learning Factory program for a 10-week internship program," Pham said. "This opportunity is unique in that I am meeting interns within my own college program, so I am hopeful these connections can prosper into the school year as well."

At the foundation of this professional development student support system, Career Resources and Employer Relations has provided essential collaboration for many units on how to shift programs to accommodate students.

"Career Resources and Employer Relations helped us connect our corporate partners with students," Hostetler said. "With their guidance, we were able to plan virtual professional development sessions—presented by sponsors—that discussed topics like ethics of remote work and the value of research on a resume."

According to **Rick McClintic,** director of Career Resources and Employer Relations, the shift to an all virtual format was something the unit was well prepared for.

"With such a broad and diverse base of College of Engineering programs, campus locations, government and industry recruiters, and students and alumni, over the past 10 years our team had already transitioned nearly all of our student internship, cooperative education, and full-time employment platforms to a web-based format," McClintic said. "The abrupt shift to a totally virtual environment was relatively smooth for us and our student and employer customers."

Continuing to provide career advising for more than 10,000 undergraduate and graduate engineering students, Career Resources and Employer Relations has held ongoing informational sessions and trainings for students, provided advising meeting resources via Zoom and Microsoft Teams, and developed and disseminated professional growth information to students.

"We have seen some students lose internship and full-time employment opportunities due to COVID-19," McClintic said. "Our staff has worked tirelessly to identify and add over 1,000 additional co-op, internship, and entry-level job opportunities to Nittany Lion Careers with expanded advertisement to appropriate student populations. Now we are seeing some of our students lose a job offer one day and find another the very next day or by the end of the week."

In the midst of the shift to a virtual format, the unit created a resource webpage for students and employers. Here they provide students and employers with updates on the services they are offering and also links to resources related to career searching during COVID-19.

"Our staff has worked tirelessly to identify and add over 1,000 additional co-op, internship, and entry-level job opportunities to Nittany Lion Careers with expanded advertisement to appropriate student populations.

"The types of experiences and opportunities that we provide for our engineering students are a vital component of their education and to ultimately becoming an engineer," McClintic said. "The Career Resources and Employer Relations team takes a great deal of pride in being an innovative and collaborative career office within Penn State and a primary driver of government and industry employers to Penn State."

As the faculty and staff of the college continue to work through the many obstacles that COVID-19 has caused, the positive feedback expressed by students has shown how well engineering faculty, staff, and students adapt during a challenging time.

"I am lucky to belong to the Penn State College of Engineering, which evidently cares deeply for its students," Pham wrote in a LinkedIn post. "When the world seemed to come to a complete halt in March, the engineering department continued to work tirelessly in search of alternative opportunities for students to utilize their summer to gain career experiences. The department's leaders kept their momentum and helped students like myself maintain motivation for growth in unprecedented times. That is who #WeAre!" ■

Exploring quantum computing for drug discovery

by Sarah Small

QUANTUM MACHINE LEARNING, an emerging field that combines machine learning and quantum physics, is the focus of research to discover possible treatments for COVID-19, according to Penn State researchers led by **Swaroop Ghosh,** the Joseph R. and Janice M. Monkowski Career Development Assistant Professor of Electrical Engineering and Computer Science and Engineering. The researchers believe that this method could be faster and more economical than the current methods used for drug discovery.

According to Ghosh, using the existing drug-discovery pipeline can take five to ten years from initial idea to market approval, and cost billions of dollars.

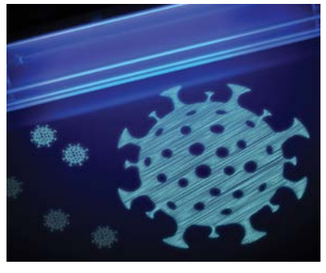
"High-performance computing such as supercomputers and artificial intelligence can help accelerate this process by screening billions of chemical compounds quickly to find relevant drug candidates," he said. "This approach works when enough chemical compounds are available in the pipeline, but unfortunately this is not true for COVID-19. This project will explore quantum machine learning to unlock new capabilities in drug discovery by generating complex compounds quickly."

Read more

Battling disease with ultraviolet light

by Mariah Chuprinski

William Bahnfleth, co-principal investigator and professor of architectural engineering, is joining co-PI Suresh Kuchipudi, clinical professor of veterinary and biomedical sciences in the College of Agricultural Sciences, to study the ability of optical radiation to disinfect surfaces and reduce transmission of viruses like SARS-CoV-2, which causes COVID-19.



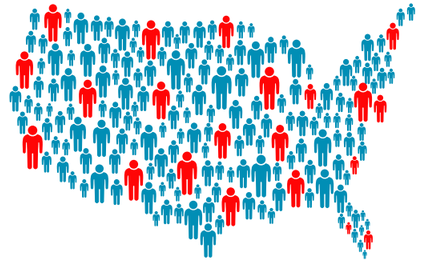
Inside a cabinet-like reactor, Bahnfleth, Kuchipudi, and collaborator **Jim Freihaut**, professor of architectural engineering, will measure the degree of disinfection of coronavirus samples exposed to ultraviolet light of 254- or 365-nanometer wavelengths for different time periods of exposure.

"When best-practice ultraviolet levels and exposure times are determined, ultraviolet-based disinfection devices can then be designed to deactivate airborne viruses in building air supply systems, room or equipment surfaces, facial masks, and virus sampling equipment," Freihaut said.

Next, **Donghyun Rim**, assistant professor of architectural engineering, and **Richard Mistrick**, associate professor of architectural engineering, will work with Bahnfleth to apply the findings of the experimental part of the study to computational fluid dynamics modeling and lighting simulations to predict the effect of the germicidal irradiation system combined with ventilation and filtration efforts on the viability of coronavirus samples.

Merging the test data from the reactor system and the simulations, the researchers will then compare the ultraviolet sensitivity factors to those that have been reported in the literature for other virus types. ■

Read more



Modeling coronavirus for spread mitigation

by Miranda Buckheit

In an effort to help mitigate the disruptive effects of the COVID-19 virus, a team of Penn State researchers from the College of Engineering, College of Health and Human Development (HHD), and Penn State Health Milton S. Hershey Medical Center are developing a novel methodology to analyze its spread and the impacts on policy with a goal of creating better-prepared and more-resilient health care systems.

Hui Yang, associate professor in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering and director of the Penn State Center for Health Organization Transformation, will leverage data analytics and simulation models to gain a better understanding of how human movement spreads the virus across geographic locations. This understanding has implications for three types of crisis strategies: regional health care infrastructure, regulatory measures, and transparent information distribution.

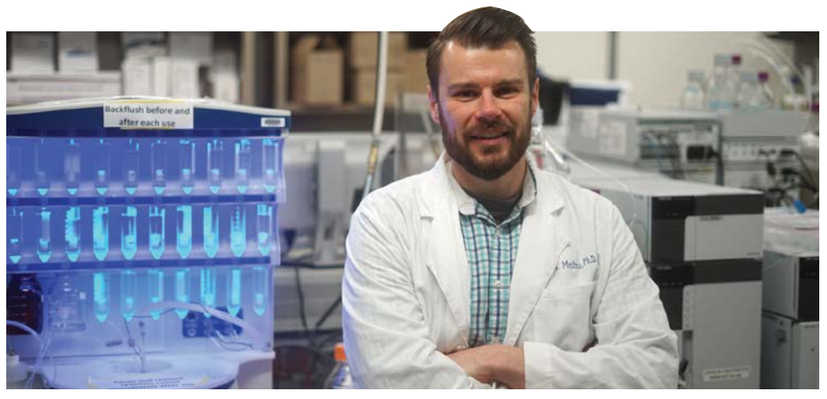
Using machine learning and artificial intelligence, Yang will simulate transmission rates of COVID-19 in local, state, and federal capacities.

Health policy experts in HHD will weigh in on strategic decision making and public interventions based on this data. The HHD team will use the data and simulation models to investigate how various policies and infectious disease control can help health care systems become more resilient and respond more efficiently to disruptive events like the COVID-19 pandemic. ■

Read more

Rethinking traditional vaccine delivery

by Jamie Oberdick



Scott Medina, assistant professor of biomedical engineering, is working on a DNA-based, nanoparticle aerosol vaccine for SARS-CoV-2, the virus that causes COVID-19 illnesses.

However, DNA-based vaccines have not been widely used as of yet due to multiple issues, such as rapid degradation of the vaccines by tissue enzymes and limited uptake into cells.

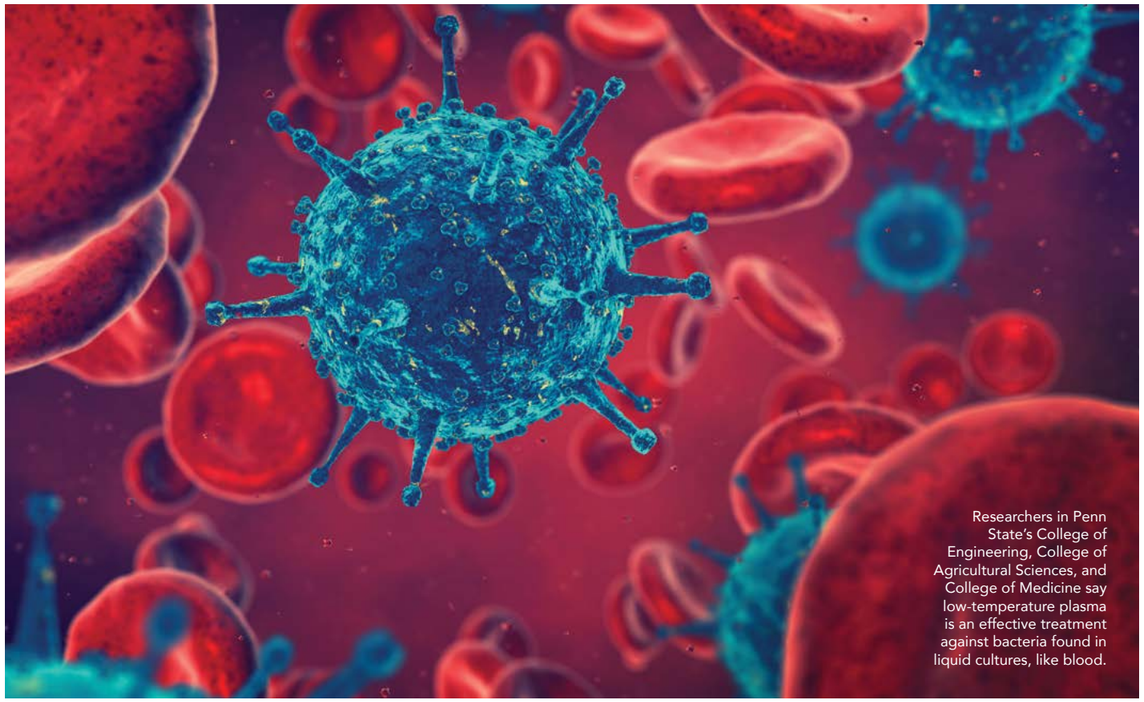
Medina said the solution to these problems is engineering a more effective synthetic nanoparticle.

"We seek to develop a nanoparticle that can improve the delivery of DNA-based inhalable vaccines," Medina said. "Once deposited in the lung, the nanoparticles target, and are internalized by, respiratory immune cells. The immune cells then process the DNA and convert it into a viral protein, which in turn stimulates the immune cells to recognize and kill the virus if the patient were to be infected."

If successful, this could potentially mean faster development of urgently needed vaccines.

"By utilizing DNA encoding viral proteins, instead of the inactive virus itself for vaccines, we could rapidly screen and develop therapeutic candidates," Medina said. "This could allow us to create, test, and then clinically deploy vaccines much faster than traditional development methods, which is urgently needed for quickly spreading diseases like COVID-19." ■

Read more



Researchers in Penn State's College of Engineering, College of Agricultural Sciences, and College of Medicine say low-temperature plasma is an effective treatment against bacteria found in liquid cultures, like blood.

Plasma medicine research highlights antibacterial effects, potential uses

by Samantha Chavanic

As interest in the application of plasma medicine—the use of low-temperature plasma (LTP) created by an electrical discharge to address medical problems—continues to grow, so does the need for research advancements proving its capabilities and potential impacts on the health care industry.

Researchers from Penn State's College of Engineering, College of Agricultural Sciences, and College of Medicine say direct LTP treatment and plasma-activated media are effective treatments against bacteria found in liquid cultures.

The team is using an atmospheric-pressure plasma jet to use room temperature—"cold"—plasma to treat bacteria.

Sean Knecht, assistant teaching professor of engineering design and leader of the Cross-disciplinary Laboratory for Integrated Plasma Science and Engineering, said this process creates many different types of reactive particles, making the likelihood of bacterial mutations to simultaneously combat all the particles almost nonexistent.

Knecht explained that the team's research results, published in Scientific Reports, show that plasma technology generates large amounts of reactive oxygen species or reactive particles created from molecules that contain oxygen atoms, including oxygen molecules in the air and water vapor. The plasma's effect on different bacteria such as *E. coli* and *Staph. aureus* is significant, resulting in many bacterial deaths through multiple generations.

> "Over the course of four generations of bacteria, these bacteria do not acquire any form of resistance to the plasma treatment."
>
> – *Sean Knecht*

The team also applied these findings to design a system that can create plasma directly in liquids and reported the initial results in the journal IEEE Transactions on Radiation and Plasma Medical Sciences. ■

Read more

BIOPRINTING

for reconstruction of face, mouth, skull tissues

by A'ndrea Elyse Messer

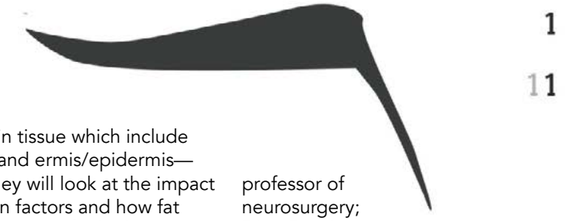
Seamlessly correcting defects in the face, mouth, and skull is highly challenging because it requires precise stacking of a variety of tissues including bone, muscle, fat, and skin.

Now, Penn State researchers are investigating methods to 3D bioprint and grow the appropriate tissues for craniomaxillofacial reconstruction.

A five-year, $2.8 million grant from the National Institutes of Health's National Institute of Dental and Craniofacial Research will allow a team of researchers to explore the use of stem cells, biomaterials, and differentiation factors to match the complex tissues of the face and head directly bioprinted during surgery.

"With the advance in 3D bioprinting, in-place reconstruction of composite tissues for craniomaxillofacial repair has recently become feasible as 3D bioprinting enables complex tissue heterogeneity in an anatomically accurate and cosmetically appealing manner," said **Ibrahim T. Ozbolat**, Hartz Family Career Development Associate Professor of Engineering Science and Mechanics, and principal investigator on the project.

The researchers are looking at ways to bioprint appropriate tissues directly into a subject to correct damage or defects. They will first investigate, in an immunodeficient rat model, bone tissue bioprinting. Next, they will investigate multilayered skin tissue which include adipose—fat—and ermis/epidermis—skin—tissue. They will look at the impact of differentiation factors and how fat influences the growth of skin tissue.



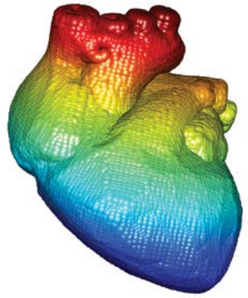
Finally, they will look at three-layer composite tissues that include bone, fat, and skin layers to determine how vascularization occurs in both soft and hard tissue regeneration.

"We have formed a complementary collaboration that merges essential domain knowledge in bioprinting, regenerative medicine, cranio-maxillofacial surgery, plastic surgery, gene therapy, gene delivery, bone mechanics, and bone and skin biology with the depth necessary to propel this work," said Ozbolat.

To meet these needs, the team consists of co-investigators Elias Rizk, associate professor of neurosurgery; Dino Ravnic, assistant professor of surgery, and Thomas Samson, associate professor of surgery, both in the Division of Plastic Surgery, and Greg Lewis, assistant professor of orthopedics and rehabilitation, all in the College of Medicine; and **Daniel Hayes**, associate professor of biomedical engineering.

The goal of the project is to produce an advanced bioprinting technology that shows the complex interactions between layers of engineered tissues and provide an understanding of how localized delivery of differentiation factors will impact craniomaxillofacial reconstruction. ■

New method analyzes images to improve health care and manufacturing



by Miranda Buckheit

Patterns appear in both natural and human made systems, but they can be difficult for humans to recognize and analyze, especially in dynamic systems like the human heart or factory machines.

To address this issue, researchers in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering have developed a novel algorithm, which has implications for health care and manufacturing.

The researchers focused on understanding patterns in nonlinear, dynamic systems, as these intricate systems are challenging to analyze due to their nature—they fluctuate over multiple dimensions, such as space and time, and are near impossible to understand via human observation.

Led by **Hui Yang**, Harold and Inge Marcus Career Associate Professor, **Soundar Kumara**, Allen E. Pearce and Allen M. Pearce Professor of Industrial Engineering, and **Cheng-Bang Chen**, lecturer of industrial engineering, the methodology was published in the American Institute of Physics Chaos Journal.

To create the novel algorithm, the team analyzed spatial data in complex, microscopic images produced by ultra-precision machining (UPM). The spatial data showed a variety of surfaces over the UPM images, ranging from flat to rough to severely rugged. Good, quality products should have a similar surface, and bad quality products might have different textures on the surface.

This operation captured and reiterated the behaviors of recurrence variations in the spatial data from the images to represent, characterize, and quantify spatial patterns in the UPM images. The surface characteristics were shown to be highly correlated with the spatial recurrence patterns within the imaging data.

Their work now allows surface roughness to be approximated by using the images, which ultimately leads to cost savings and resource conservation. ■

Read more

Engineers model mutations causing drug resistance

by A'ndrea Elyse Messer

Whether it is a drug-resistant strain of bacteria, or cancer cells that no longer react to the drugs intended to kill them, diverse mutations make cells resistant to chemicals, and "second generation" approaches are needed. Now, a team of Penn State engineers may have a way to predict which mutations will occur in people, creating an easier path to create effective pharmaceuticals.

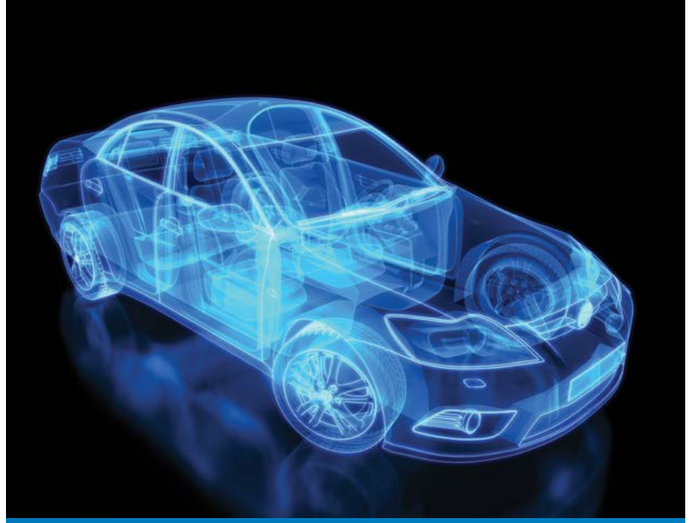
Standard practice to develop drugs is to model the structure of chemicals and their cellular targets to kill specific pathogens or cancer cells. Once mutations begin to change the cells, treatment requires new drugs. However, a variety of mutations may occur and drug developers need to target the appropriate mutation to kill the pathogen or the cancer cells.

The researchers wanted to discover what drives which mutations to grow out in the real world so that they could choose the most effective mutations to target. They reported in Cell Reports that they found that the most drug-resistant mutation was not necessarily the mutation that dominated. "Survival of the fittest" did not always hold and targeting should aim at the most probable mutation rather than the most resistant, at least for some cancers.

"We shouldn't always focus on the strongest resistance mutation because there are other evolutionary forces that dictate what happens in the real world," said **Justin Pritchard**, assistant professor of biomedical engineering and holder of the Dorothy Foehr Huck and J. Lloyd Huck Early Career Entrepreneurial Professorship. "Sometimes drug resistance relies on biased random events."

The researchers said, "Our analysis establishes a principle for rational drug design: When evolution favors the most probable mutant, so should drug design." ■

Read more



Graphene-reinforced carbon fiber may lead to affordable, stronger car materials

by Liam Jackson

A new way of creating carbon fibers—which are typically expensive to make—could one day lead to using these lightweight, high-strength materials to improve safety and reduce the cost of producing cars, according to a team of researchers.

Using a mix of computer simulations and laboratory experiments, the team found that adding small amounts of the 2D graphene to the production process both reduces the production cost and strengthens the fibers.

Carbon fiber sells for about $15 per pound today, and the team, which includes researchers from Penn State's Departments of Mechanical Engineering and Chemical Engineering, the University of Virginia, and Oak Ridge National Laboratory, in collaboration with industry partners Solvay and Oshkosh, wants to reduce that to $5 per pound by making changes to the complex production process.

A polymer known as polyacrylonitrile, or PAN, is used to create 90% of carbon fibers found in the market today, but its production process requires an enormous amount of energy.

The team reported in a recent issue of Science Advances that adding trace amounts of graphene—only 0.075% concentration by weight—to the first stages of this process allowed the team to create a carbon fiber that had 225% greater strength and 184% greater stiffness than the conventionally made PAN-based carbon fibers. ■

Read more

Researchers identify breaking point of conducting material

by Jamie Oberdick

An improved method to predict the temperature when plastics change from supple to brittle, which could potentially accelerate future development of flexible electronics, was developed by Penn State College of Engineering researchers.

Next-generation flexible electronics, such as bendable displays and medical implants, will rely on semiconductor materials that are mechanically flexible. Accurate predictions of the temperature when embrittlement occurs, known as the glass transition temperature, is crucial to design conducting polymers that remain flexible at room temperature.

All polymers become brittle when cooled. However, some polymers become brittle at temperatures higher than room temperature while others become brittle at much lower temperatures.

Conjugated polymers are an important element in the development of flexible electronics such as bendable cellphones.

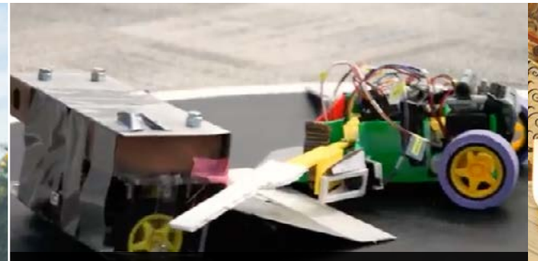
Renxuan Xie, previously a doctoral student at Penn State, found a way to measure glass transition temperatures by keeping track of the mechanical properties as embrittlement occurs, laying the foundation for understanding the relationship between the glass transition and structure. Follow-up studies then determined the glass transition for 32 different polymers by measuring mechanical properties as a function of temperature.

"This advancement, coupled with data for various polymers in our later studies, revealed a simple relationship between the chemical structure and the glass transition," said **Enrique Gomez**, professor of chemical engineering and principal investigator. "Therefore, we can now predict the embrittlement point from the chemical structure."

The work was reported in a recent issue of Nature Communications. ■

Read more

Penn State Humanitarian Engineering and Social Entrepreneurship



ME 340 Robot Competition

Penn State Apollo 11 50th Anniversary Rocket Launch

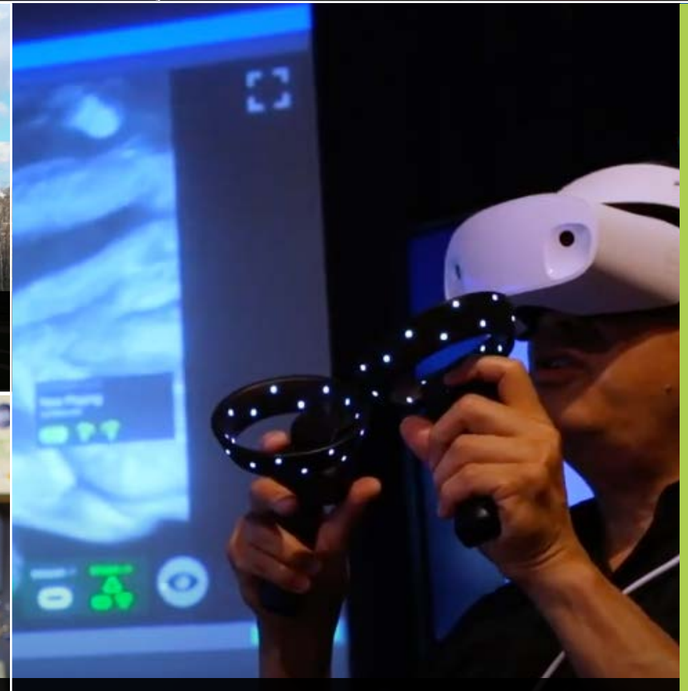
$15.5 million investment creates engineering scholars program at Penn State

Class of 2020 student marshals

Dean's message to the Class of 2020

Congratulations to the Class of 2020

What inspires me about becoming an engineer



See what awaits in the Penn State College of Engineering

INTRODUCING THE

Explore College of Engineering Majors video series

With the help of over 100 students, faculty, and alumni, we are proud to share a series comprised of 14 videos highlighting each of the College of Engineering majors available at Penn State University Park.

Thousands of students have already viewed one or more of the videos in an effort to provide direction on their choice of major.

Thanks to all who participated in this unprecedented resource for our current and future Penn State engineering students.

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View the trailer for the series or select an individual major video below to learn more.

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- Architectural Engineering
- Biological Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Computer Science
- Data Sciences
- Electrical Engineering
- Engineering Science
- Industrial Engineering
- Mechanical Engineering
- Nuclear Engineering

College of Engineering student marshals recognized for excellence

Fifteen graduating seniors from the College of Engineering were selected to serve as student marshals for Penn State's spring commencement ceremony, held virtually on May 9. The students were chosen for their outstanding academic achievements and contributions to engineering student life.

Photo credit: Ann Taylor-Schmidt

MATTHEW BROWNELL

Aerospace Engineering

Bachelor of Science in Aerospace Engineering, Summa Cum Laude

"Matthew is a top graduating aerospace senior with a near-perfect GPA. He has done exceptionally well during his undergraduate studies. Matthew has also participated in the teaching intern program and facilitated homework help sessions for a large junior class. I have no doubt Matthew will have a sterling career in the future given his intellect, tireless devotion to scholarship, and passion for what he does."

—Puneet Singla, Associate Professor, Aerospace Engineering

Read more about Brownell

DAVID GAWRYLA

Architectural Engineering

Bachelor of Architectural Engineering, Summa Cum Laude

"David's selection as the student marshal showcases more than just his academic success as it also captures the respect he has for his classmates and their respect for him. David exemplifies what a future leader in our industry will be through a mixture of his leadership skills from the military, his involvement with multidisciplinary team-based courses, and his excellent depth of knowledge in architectural engineering."

—Ryan L. Solnosky, Associate Teaching Professor, Architectural Engineering

Read more about Gawryla

YANG LI

Biological Engineering

Bachelor of Science in Biological Engineering, Magna Cum Laude; Minor in Biomedical Engineering; Schreyer Scholar; President's Freshman Award; Evan Pugh Scholar Award (junior); Alpha Epsilon Honor Society for Agricultural, Food, and Biological Engineering

"An exceptional student-scholar with growing leadership skills, Yang Li's holistic contributions to the biological engineering program will have a lasting impact."

—Virendra Puri, Distinguished Professor, Agricultural and Biological Engineering

Read more about Li

MELISSA LING

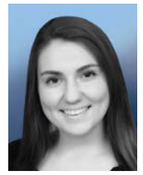
Biomedical Engineering

Bachelor of Science in Biomedical Engineering, Summa Cum Laude; Schreyer Scholar; President's Freshman Award; President Sparks Award; Evan Pugh Scholar Award (senior)

"Melissa has excelled at Penn State in classwork, research, and extracurricular activities. I am confident that she will have a positive impact in engineering and in all of her future endeavors."

—Esther Gomez, Associate Professor, Chemical Engineering and Biomedical Engineering

Read more about Ling



LAUREN MATUSZKIEWICZ

Chemical Engineering

Bachelor of Science in Chemical Engineering, Summa Cum Laude; President's Freshman Award; President Sparks Award; Omega Chi Epsilon Honor Society for Chemical Engineering

"Lauren is a very studious and hardworking student as well as being humble and helpful. We are so happy she is representing our department."

—Stephanie Velegol, Associate Teaching Professor, Chemical Engineering

Read more about Matuszkiewicz

YANRAN WANG

Civil Engineering

Bachelor of Science in Civil Engineering, Summa Cum Laude; Minor in Engineering Mechanics; Evan Pugh Scholar Award (senior)

"Yanran Wang is among the strongest, most dedicated, and driven students I have worked with in my 25 years at Penn State. Ms. Wang is a model student who brings out the best in her peers, challenging them to reach their full potential."

—Jeffrey Laman, Professor, Civil Engineering

Read more about Wang

STEVEN PETRONE

Computer Engineering

Bachelor of Science in Computer Engineering, Summa Cum Laude; Minor in Cybersecurity Computational Foundations; Schreyer Scholar; President's Freshman Award; Evan Pugh Scholar Award (senior); Eta Kappa Nu Honor Society for Electrical Engineering

"Steve is an outstanding student and researcher whose work exemplifies Penn State's motto, 'Making life better.' His work in support of algorithm development and machine learning at Penn State's Applied Research Laboratory has helped improve our nation's defenses and contributed to our understanding of statistical forecasting of dynamical systems."

—Christopher H. Griffin, Associate Research Professor, Penn State Applied Research Laboratory

Read more about Petrone

ALYSSA TICE

Computer Science

Bachelor of Science in Computer Science, Summa Cum Laude; Schreyer Scholar; President's Freshman Award; Evan Pugh Scholar Award (senior)

"Alyssa exemplifies the finest qualities of a student through her academic excellence, pursuit of research, study abroad experience, and service as an engineering ambassador, study group leader, and student teaching assistant. Underlying all of her activities are her drive to excel in all of her endeavors and her passion for assisting, supporting, and encouraging other students."

—John J. Hannan, Associate Department Head and Associate Professor, Computer Science and Engineering

Read more about Tice

KYLE BRADLEY

Data Sciences

Bachelor of Science in Data Sciences and Bachelor of Science in Mathematics, Magna Cum Laude; Schreyer Scholar

"Besides completing two majors in computational data sciences and applied mathematics, Kyle's honors thesis tackles a highly challenging and multidisciplinary problem—predicting severe thunderstorms leveraging modern AI and computer-generated simulation. His work shows feasibility of this new hybrid approach."

—James Z. Wang, Professor, Information Sciences and Technology

Read more about Bradley

ERICA VENKATESULU

Electrical Engineering

Bachelor of Science in Electrical Engineering, Summa Cum Laude; Schreyer Scholar; President's Freshman Award; Evan Pugh Scholar Award (senior); Eta Kappa Nu Honor Society for Electrical Engineering

"Erica works hard, but always finds the joy. She thinks deeper, and she never ever gives up! She is an inspiration for all of our current students, and for those yet to come."

—Timothy J. Kane, Professor, Electrical Engineering

Read more about Venkatesulu

EMILY TRAGESER

Engineering Science

Bachelor of Science in Engineering Science, Summa Cum Laude; Minor in Engineering Mechanics; Schreyer Scholar; President's Freshman Award; President Sparks Award; Evan Pugh Scholar Award (senior)

"Emily is one of the most gifted students I have worked with in my 26 years here. The ease with which she would pick up even the most difficult material was amazing. She has also been an incredible ambassador for engineering science with her involvement in so many College of Engineering organizations and her support of her fellow students."

—Gary L. Gray, Associate Professor, Engineering Science and Mechanics

Read more about Trageser

CHRISTOPHER BIESECKER

Industrial Engineering

Bachelor of Science in Industrial Engineering, Summa Cum Laude; Minor in Spanish; President's Freshman Award; Evan Pugh Scholar Award (senior)

"Chris is not only an outstanding student, but also an approachable, kind, departmental citizen. He is insightful and hardworking and an excellent representative of Penn State and his classmates."

—Sarah E. Root, Associate Teaching Professor, Industrial and Manufacturing Engineering

Read more about Biesecker

EVAN HEATHERINGTON

Mechanical Engineering

Bachelor of Science in Mechanical Engineering, Summa Cum Laude; President Sparks Award; Evan Pugh Scholar Award (senior)

"Evan Heatherington is a true mechanical engineer by heart; he is 'cranked up' by mechanical design problems that go beyond the textbooks."

—Aman Haque, Professor, Mechanical Engineering and Engineering Science and Mechanics

Read more about Heatherington

DAVID REGER

Nuclear Engineering

Bachelor of Science in Nuclear Engineering and Bachelor of Science in Mechanical Engineering, Magna Cum Laude; Alpha Nu Sigma Honor Society for Nuclear Engineering

"David is an exceptionally talented student and a role model for his peers. He has always impressed me and my colleagues on how quickly he grasps new concepts and how fast he completes exams. He is joining the Department of Nuclear Engineering as a Ph.D. student in the fall; I am sure he has a bright future ahead in research."

—Elia Merzari, Associate Professor, Nuclear Engineering

Read more about Reger

DIEGO SCOTT-MCCABE

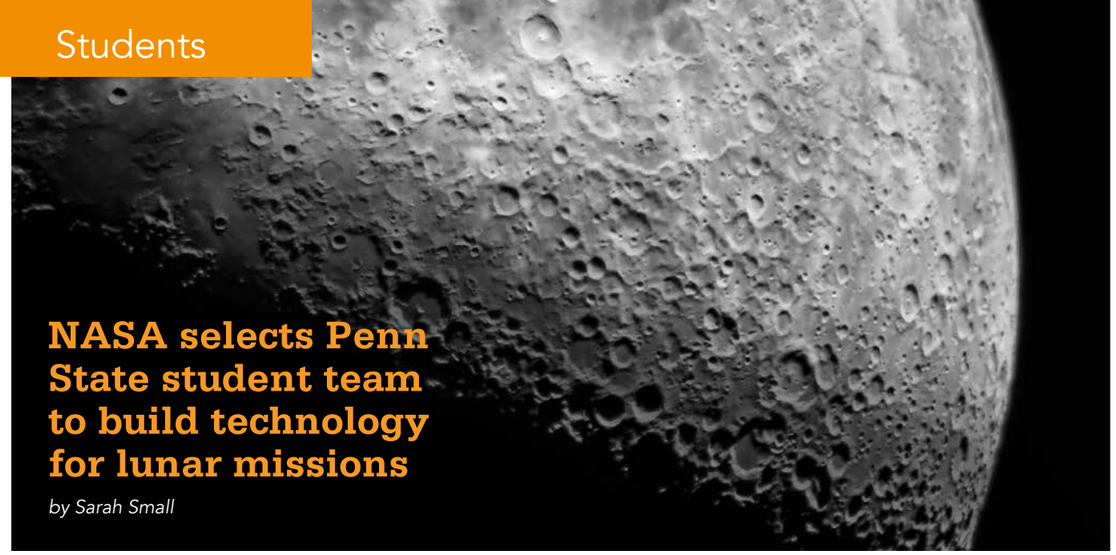
Reserve Officer Training Corps

Bachelor of Science in Nuclear Engineering, Magna Cum Laude; Minor in Military Studies

"Midshipman Diego Scott-McCabe demonstrates exemplary military leadership, discipline, character, and citizenship within the Naval ROTC Battalion. During the spring of 2020, he served as our Battalion Executive Officer, where he mentored and led over 150 fellow students. Upon graduation, he will be commissioned as an Ensign and attend Naval Nuclear Power School before serving on board a submarine. The path before him is full of opportunity."

—Capt. Wayne C. Wall, U.S. Navy, Joint Service Coordinator, Penn State Reserve Officer Training Corps

Read more about Scott-McCabe



NASA selects Penn State student team to build technology for lunar missions

by Sarah Small

Penn State students from the Student Space Programs Laboratory (SSPL) comprise one of eight university teams recently selected by the National Aeronautics and Space Administration (NASA) to develop new technology to study the surface of the moon.

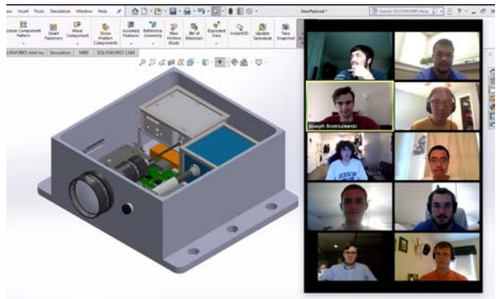
NASA selected the teams through their Breakthrough, Innovative, and Game-changing (BIG) Idea Challenge, which asked university teams to "submit robust proposals for sample lunar payloads that can demonstrate technology systems needed to explore areas of the moon that never see the light of day," according to NASA's website. The technology developed by the winning teams could be used by NASA's Artemis Program, which has the goal of landing the first woman and next man on the moon by 2024 and developing a sustained presence on the moon by 2028.

Through the BIG Idea Challenge, in conjunction with the Space Grant Project, NASA awarded a total of nearly $1 million to the eight university teams, with Penn State's team receiving $145,933 for their project.

"The challenge given to our students ... is an amazing opportunity for them to learn how space systems are designed and built to meet mission objectives."

Members of Penn State's SSPL, which is a faculty-directed, student-run research lab housed in the Department of Electrical Engineering but open to students in other disciplines, are developing an instrument called Oasis. Oasis will be used to measure the elemental composition of the soil in permanently shadowed regions on the moon.

Oasis will employ a method known as light-induced breakdown spectroscopy, which uses a laser and a spectrometer controlled by an onboard flight computer, to determine the location and concentration of resources, such as water ice. This information will allow for on-site resource utilization, which will be critical to maintaining a presence on the moon.



Student Space Programs Laboratory students, in a virtual teaming mode, discuss the design of a component of Oasis, an instrument to be used to measure the elemental composition of the soil in permanently shadowed regions on the moon. (Credit: Alvaro Guerra)

"The challenge given to our students to contribute to NASA's goals for Artemis is an amazing opportunity for them to learn how space systems are designed and built to meet mission objectives," said **Sven Bilén**, director of SSPL, head of the School of Engineering Design, Technology, and Professional Programs, and professor of engineering design, electrical engineering, and aerospace engineering. "It is a challenge I know they will meet."

The design environment for the students, however, has changed significantly in the month since the funding was awarded. The University announced that all instruction will occur via remote-learning and students were not to return to campus after spring break. The team recently met with representatives of the BIG Idea Challenge, who assured them that they understand these challenges, yet asked the team to continue their effort. Rising to yet another challenge, the students have developed a mitigation plan and are continuing their efforts via remote teaming.

Members of the team will travel to the 2020 BIG Idea Forum to present their prototypes, tentatively scheduled for fall of 2020. ■

Evans prepares samples for protein analysis in the lab of Professor of Biomedical Engineering Deb Kelly. (Credit: Jeff Rice)

Aspiring neurosurgeon mapping cancer-suppressing protein

Schreyer Scholar Madison Evans looks to enter medical school with strong research portfolio

by Jeff Rice

Madison Evans is a Penn State biomedical engineering major who would like to become a neurosurgeon.

Before she heads off to medical school, though, the Schreyer Honors Scholar is part of a research project that could change the way her future patients receive treatment.

Evans, who is working in the lab of Professor of Biomedical Engineering **Deb Kelly** in the Huck Institutes of the Life Sciences, has been mapping a full-length model of p53, a tumor suppressor protein found in various forms of cancer, in glioblastoma cells.

"I want to work with communities that are lacking resources or that don't have the education on certain treatments or vaccines, don't have access to a hospital nearby, or just generally don't have what they need to be healthy."

"If you have the structure of p53, it won't only help you with brain cancer, it will help you with pancreatic cancer, breast cancer, so many cancers," Evans said. "It'll help you to figure out better treatments because you'll understand how that protein works."

Penn State graduate student Maria Solares had previously discovered a way to isolate the p53 protein from breast cancer cells so it could be examined via high-powered micro imaging. Using the same protocols, Evans has been examining the protein in human glioblastoma cells.

"She's looking at the entire molecule in the context of brain tumors," said Kelly, the Lloyd and Dottie Foehr Huck Chair in Molecular Biophysics, "and that's never been done before."

Kelly and her team are studying how p53 can either serve as a suppressor or a perpetuator of breast, brain, and pancreatic cancers, three of the most aggressive forms of the disease; and potential applications of the team's findings for therapeutics.

"You can imagine if half of all cancers are related to this one protein," she said, "it's pretty important."

Evans had already built a strong foundation at various internships. She was a neurosurgical clinical research intern at the Hospital of the University of Pennsylvania; a research and development engineering intern at Medtronic, a medical device company; and a process development engineering intern at BioMagnetic Solutions, a biotech company in State College. She was also part of the Women in Science and Engineering Research (WISER) program at Penn State.

"I want to have the experience interacting with patients. The internships helped me figure that out," she said. "I loved the work I was doing, but I realized with those experiences that I wanted to be around patients more."

Evans, a native of Fulton, Maryland, and a global health minor, is looking forward to exploring more global health program options.

"I want to work with communities that are lacking resources or that don't have the education on certain treatments or vaccines, don't have access to a hospital nearby, or just generally don't have what they need to be healthy," she said. ■

Success through service

by Tim Schley

Abigail Cowser wanted to make an impact, so her high school physics teacher recommended she become an engineer.

"He took me and a few other students to a 'Women in Engineering Day' at Westinghouse, where I was first exposed to the vast applications of engineering in our world," Cowser said.

The Bethel Park native—who spent significant portions of her childhood participating in church mission trips and service opportunities—saw herself reflected in these engineers.

"I looked up to these women and realized this was something that I was capable of," Cowser said.

Cowser recently finished an impressive undergraduate career at Penn State with a string of accolades. The American Society of Civil Engineers named her one of the "2020 New Faces of Civil Engineering," a designation reserved for 10 collegiate "up-and-coming civil engineers" across the country.

She was also awarded one of six 2020 John W. Oswald Awards, an honor given to graduating Penn State seniors who have provided outstanding leadership at the University.

"While Abby excelled academically, she also devoted a large amount of her energy applying her academic knowledge and leadership skills to help vulnerable and underserved populations," said Brian Naberezny, lecturer in the Department of Civil and Environmental Engineering at Penn State.

Cowser's service-minded mentality was best demonstrated through her involvement with the Penn State chapter of Engineers in Action: Bridge Program, an organization that designs and builds footbridges for isolated communities to better access essential resources. She quickly accepted responsibilities in the organization and was selected to travel to Rwanda in her first year.

"Traveling to Rwanda gave me the chance to live and work alongside rural communities for a month and opened my eyes to how infrastructure changes lives," Cowser said. "Even though we were not speaking the same language, we proved that uniting over our mission of improving access was more powerful than words."

Cowser eventually assumed the role of project manager in her junior year, responsible for overseeing the organization's trip to Bolivia in 2019. That year, the team designed their bridge, raised funds, and eventually traveled to the country—and then learned that the community decided to go in another direction.

The team managed to salvage the trip, traveling to different sites and assisting other chapters' projects. Cowser left Bolivia with a new sense of humility and a deeper understanding of what it means to provide service to others.

"It taught me a lot about putting the needs of the community before my own," Cowser said.

Cowser graduated with a bachelor's degree in civil engineering in May and accepted a full-time position with HITT Contracting, a construction company that emphasizes social responsibility and community service. ■

Cowser poses in front of the bridge created in Rwanda by the Penn State Engineers in Action: Bridge Program team, during Cowser's first year in the program.

Mundinger is studying the visual experience of fine art under low illumination for his dissertation. (Photo credit: Jay Mundinger)

Architectural engineering fellow looks back on vibrant academic career

by Mariah Chuprinski

Penn State architectural engineering (AE) doctoral student **Jay Mundinger** brings color to his work, literally.

The lighting designer and color scientist is a fellow in the Graduate Assistance in Areas of National Need (GAANN) program, sponsored by the United States Department of Education, whose goal is to transform the way buildings are designed, built, and maintained, through doctoral education and knowledge creation in the delivery of ultra-high-performance buildings.

Mundinger researches spectral optimization for architectural lighting, where he studies the color and saturation of indoor environments.

For his dissertation, Mundinger is studying the visual experience of fine art under low illumination. Light levels are restricted in museums because historic paintings are susceptible to gradual degradation driven by lighting, Mundinger explained. But paintings created before electric lighting was invented are designed to be viewed in the same way as many of them were painted: in broad daylight, and not at the low light levels common in museums, which causes colors to be perceived as less vibrant and rich.

"My research focuses on the utilization of lighting gamuts that, if used correctly, can artificially compensate for perceived lost color, restoring a lot of that visual experience you would have if you were viewing a painting in daylight," he said.

Mundinger collected his data by illuminating a reproduction of a Dutch baroque painting and a modern, chromatic painting created for the study by his father. Participants viewed the paintings under different light levels and gamuts to determine how to improve viewing conditions for the paintings while still preserving them.

"Though there is no perfect solution, my experiments showed that if lighting conditions are customized to each individual painting, you can improve the appearance of the colors while not putting the paint at risk of degradation," he said.

Light and dance

After obtaining a bachelor's degree in environmental engineering from the University of Illinois in 2010, Mundinger went to work as an environmental engineer in a lighting manufacturing facility. But it was dance that got him interested in lighting.

"I started dancing as an undergraduate in 2006 and then started DJing for dance groups," Mundinger said. "Then I added a cheap light from Lowes to my setup, and just started building from there. Ten thousand dollars and multiple control systems later, I began to take lighting seriously."

He decided to hone his talents and make a career out of lighting design, which led him to graduate school at Penn State. He is now on track to graduate with his doctorate in architectural engineering this August. ■

Walter L. Robb, Penn State alumnus and philanthropist, remembered

by Jamie Oberdick

Penn State and College of Engineering faculty, staff, and students are mourning the loss of alumnus and longtime supporter **Walter L. Robb**, who died on March 23, at age 91 from complications from COVID-19 in Schenectady, New York.

Robb was born on April 25, 1928, in New Bloomfield. He left his hometown at age 17 to attend Penn State, initially with dreams of becoming a sportscaster. He soon switched majors to engineering and received his bachelor’s degree in chemical engineering from Penn State in 1948. He received his doctoral degree in chemical engineering from the University of Illinois in 1951.

Robb’s legacy at Penn State is manifold. He was one of the University’s most generous donors, having endowed two scholarships as well as the chair for the head of the Department of Chemical Engineering.

“I had the great privilege of getting to know Walt during his visits to campus and through phone calls and email exchanges,” said **Phillip Savage**, head of the Department of Chemical Engineering and Walter L. Robb Family Endowed Chair. “He was an inspiring example, both in engineering and in life, and a tremendous friend of our department and a great ambassador for Penn State.”

Robb also provided financial support and an endowment to the Engineering Leadership Development (ELD) program, housed in the Penn State School of Engineering Design, Technology, and Professional Programs. ELD focuses on helping students develop leadership skills needed to excel in an engineering career.

“The commitment Walt made to future engineering leaders was transformational,” said **Mike Erdman**, retired Walter L. Robb Director of Engineering Leadership Development. “Walt was a strong proponent of the program, not only with financial support, but also sharing his time giving invited lectures, serving on our advisory board, and providing feedback on our curriculum.”

Walter Robb during a Penn State Engineering Leadership Development Industrial Advisory Board meeting. Left to right are Bryan Senchuk of Lockheed Martin, Jeff Muthler of Raytheon, Tyler Pritz of AECOM, and Robb.

In addition, Robb was a founding member of the College of Engineering’s Leonhard Center Advisory Board and was part of the Alumni Council during the construction of the Hintz Family Alumni Center. This includes a key role in raising needed funds for the Center, both by his personal gifts and contacting multiple significant donors. Robb Hall, an event venue that is part of the Center, was named in honor of his work.

In 1987, Robb was honored with Penn State’s Distinguished Alumni Award, the highest recognition the University bestows on its graduates. In 2014, he was named a recipient of the College of Engineering’s Outstanding Engineering Alumni Award. He is also a recipient of the University of Illinois Alumni Achievement Award and the President’s Medallion.

Contributions in Robb’s memory can be made to the Walter L. Robb Excellence Fund for Engineering Leadership Development in the College of Engineering at raise.psu.edu/RobbExcellenceFund. ■

Mechanical engineering alumna named to Forbes’ 30 Under 30 in Science

by Erin Cassidy Hendrick

In the year since she graduated with her doctorate in mechanical engineering, Penn State alumna **Birgitt Boschitsch**’s life has been a nonstop whirlwind as the co-founder and chief executive officer of the startup spotLESS Materials.

But she momentarily stopped in her tracks when Forbes magazine announced she was honored as a 30 Under 30 in Science for 2020, an annual recognition of young thought leaders who have the potential to impact the world with their technical achievements.

Boschitsch launched spotLESS Materials in 2018 with her adviser, **Tak-Sing Wong**, the Wormley Early Career Professor of Engineering and associate professor of mechanical engineering and biomedical engineering.

When the team began working together in the Wong Laboratory for Nature Inspired Engineering, their academic research focused on utilizing nature-inspired concepts to design functional and adaptive interfacial materials that can provide solutions to critical engineering challenges. Their first product launch was a bio-inspired, liquid, sludge- and bacteria-repellent coating that can essentially make a toilet self-cleaning.

Whether it is experimenting to create new products in the lab or navigating the legalities of copyrights and trademarks, her education and experience at Penn State has prepared her for success.

“We want to show the world you can be commercially successful and socially responsible,” Boschitsch said. “Scientists have an extra opportunity to do that with new technology.” ■

Committee recommends building to be named after astronaut engineering alumnus

A building at Innovation Park at Penn State was recommended to be named in honor of **Guion S. Bluford Jr.**, Penn State aerospace engineering alumnus and internationally renowned astronaut and engineering leader.

“The building name acknowledges and honors Dr. Bluford’s distinguished achievements and historical significance, while also signifying Penn State’s commitment to excellence in space systems across many domains and active commitment to mentoring, equity, and inclusion,” said **Justin Schwartz**, Harold and Inge Marcus Dean of Engineering.

Bluford graduated from Penn State in 1964 with a bachelor of science degree in aerospace engineering and obtained his master’s and doctoral degrees from the U.S. Air Force Institute of Technology. He was selected as a NASA astronaut in 1979 and became the first African American in space with his first mission on the eighth NASA space shuttle mission (STS-8) in 1983. He retired from NASA in 1993 and went on to hold many leadership roles within the industry.

In addition to his professional achievements, Bluford has served as an advocate for inspiring underrepresented groups at both Penn State and on a national level. He continues to stay involved with the Penn State Department of Aerospace Engineering, visiting annually to provide outreach to underrepresented groups.

The proposed building that will hold Bluford’s name is located at 230 Innovation Blvd. at University Park, and houses the Center for Innovation Metal Processing through Direct Digital Deposition. ■

Mechanical and biomedical engineering alumnus chosen as TED fellow

by Erin Cassidy Hendrick

Khalil Ramadi, who graduated with his bachelor's degree in mechanical and biomedical engineering from Penn State in 2014, has been named a TED fellow.

Currently a postdoctoral fellow at the Massachusetts Institute of Technology (MIT) and the Harvard Medical School, Ramadi earned the distinction from TED for his potential to become a global visionary, driven by his research into microinvasive brain probes as a potential novel therapy for targeting brain microstructures in various neurologic and neuropsychiatric disorders.

The TED fellows program brings together young innovators from around the world and across disciplines, who display both outstanding achievement and exemplary character, to raise international awareness of their work and maximize their impact.

After his undergraduate education at Penn State, Ramadi attended MIT to earn his master's in mechanical engineering and his doctorate in biomedical engineering and medical physics. This is where he began exploring innovative ways to treat illnesses like Parkinson's and epilepsy.

According to Ramadi, the current instruments used to treat these conditions during brain surgery are about the size of a chopstick. In his research, Ramadi developed microprobes about the width of a human hair that can be flexibly guided into different locations of the brain to deliver medicine, administer electric stimulations, or shine light if doctors need to better examine a certain area of the brain.

The device is currently in the early testing stages and Ramadi is hopeful one day this work can benefit patients all over the world. ■

Penn State alumnus JT Marino, right, speaks at a recent conference in Phoenix, Arizona.

Disrupting the sleep market was all in a day's work for alumnus JT Marino

Penn State College of Engineering graduate **John-Thomas "JT" Marino** committed all his energy to sleep after graduating in 2012 when he started Tuft & Needle —a direct-to-consumer online mattress retailer with a "bed in a box" concept.

In June 2012, Marino and his college friend, Daehee Park, launched the beta Tuft & Needle website. "We developed a minimally viable product, put a stock photo of a mattress on the website test page, placed a Google ad, and in 15 minutes, we had our first order."

> "We developed a minimally viable product, put a stock photo of a mattress on the website test page, placed a Google ad, and in 15 minutes, we had our first order."

From June through October 2012, they built out the remainder of the platform with $6,000 of their own money. Six years later, Tuft & Needle approached approximately $200 million in annual revenue.

In September 2018, Serta Simmons Bedding (SSB) and Tuft & Needle merged, and Marino became chief strategy officer of SSB. The move gave Tuft & Needle the distribution power to expand around the world.

After Marino arrived at University Park, faculty such as **Elizabeth (Liz) C. Kisenwether**, retired assistant professor in the School of Engineering Design, Technology, and Professional Programs, noticed his unique thinking style.

"She could tell I was a different kind of student, and she was instrumental in the effort within the University to help recognize and empower me," said Marino. "This led to the development of a customized, nontraditional curriculum path, which allowed my entrepreneurial interests to be developed and my confidence to be validated." ■

[FROM YOUR PRESIDENT]

Latest PSEAS happenings: New leadership and 40 Under 40 award

As engineers, we are "wired" to solve problems, and often prevent them from occurring. I don't imagine that any of us could have prevented the impact that the COVID-19 pandemic has had, as many great minds are racing to provide solutions to stop the virus and reduce further harm. Thanks goes out to all our alumni who are fighting on the front lines and working behind the scenes to defeat this invisible enemy.

My name is **Casey Moore** ('89 CE) and I am extremely proud to be the new president of the Penn State Engineering Alumni Society (PSEAS) and to work with an excellent board of volunteers and team in the College of Engineering. I am currently executive vice president and board member of McMahon Associates, Inc., a full-service transportation engineering company with over 13 offices on the East Coast.

By serving on the PSEAS board since 2012 and working alongside incredible alumni, college employees, faculty, and bright engineering students, I have seen the wonderful impact our alumni and programs can make. I have been blessed to channel my energy and passion for Penn State engineering in meaningful ways, and I look forward to continuing to attract and engage our alumni in the months and years ahead.

On behalf of the PSEAS board, I want to thank Jane Hrehocik Clampitt, our outgoing president, for her leadership and tireless commitment to the college. Her influences and inclusive leadership style have left an indelible mark on our alumni society. She has positioned the board very well to execute upon a strategic plan that she led our membership to develop in collaboration with Dean Justin Schwartz's vision. Two key committees for strategic messaging and alumni engagement were formed to improve experiences for our alumni.

The College of Engineering is gearing up to begin its 125th anniversary celebrations this fall. I encourage all alumni to consider engaging in the events being planned. In concert with the special celebration year ahead, and excitement for the college's facilities master plan, I am pleased to announce that nominations are now open for our new 40 Under 40 Alumni award that recognizes our outstanding young alumni. The inaugural class will be competitively selected from those that exhibit leadership, career progress, community involvement, and impactful projects.

To nominate worthy candidates who are under 40 years of age as of Jan. 1, 2021, visit bit.ly/40u40-nomination. Nominations are due by Aug. 21, 2020. A selection committee involving members of PSEAS will determine the inaugural winners, whom will be invited to the University for an awards ceremony in Feb. 2021.

Stay in touch with PSEAS by joining our LinkedIn group. If you are interested in getting involved with our society, send us an email at alumni@engr.psu.edu.

For the Glory,

Casey A. Moore, P.E., '89 CE
President, Penn State Engineering Alumni Society
cmoore@mcmahonassociates.com

THE PENN STATE ENGINEERING ALUMNI SOCIETY

Building an active, engaged community of engineering alumni since 1959

The alumni society provides:

- Membership in a worldwide network of 100,000 engineering alumni.
- Fellowship among engineering alumni, faculty, staff, and students.
- Volunteer and service opportunities on campus and in your own community.

We want to hear from you! **Visit PSEAS** on the web to submit your latest news and to learn more about becoming a member.

FOR MORE INFORMATION, CONTACT:

Events and Volunteer Engagement
101 Hammond, University Park, PA 16802
alumni@engr.psu.edu

PennState
College of Engineering

The Pennsylvania State University
101 Hammond Building
University Park, PA 16802-1400

WE ARE

Responding together

As Penn State navigates the unprecedented challenges of COVID-19, **WE ARE** drawing on the strength of our entire community. Alumni and friends can now make gifts to help students who have been adversely impacted by the disease, help researchers find solutions to stop the spread of the virus around the world, and more. Visit **raise.psu.edu** for more information.

Celebrating the past and looking to the future

In January, the Penn State College of Engineering will mark its 125th anniversary. **WE ARE** planning a virtual kickoff event later this fall and a full slate of activities during 2021 to mark this milestone. You are an important part of our history and our future. We hope you will make plans to join in the year-long celebration.

Helping you to define your legacy

When you include a gift to the Penn State College of Engineering in your will or other estate plans, you create opportunities for generations of engineering students, faculty, and alumni. **WE ARE** helping you define your enduring legacy on our campus, create a brighter future for our college, and ensure your estate and your heirs receive the full tax benefits of your gift. To learn more, please contact Penn State's Office of Gift Planning at 888-800-9170 or **GiftPlanning@psu.edu**, or visit **giftplanning.psu.edu**.