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Impact

Spring 2021

RUTGERS
School of Engineering

WeRUnited

This past year, the global coronavirus pandemic continued to challenge School of Engineering spirits and resilience and I am immensely proud of how our community responded.

Always dedicated to student success, our faculty, deans, and advisors pivoted seamlessly to deliver an exceptional – albeit remote – education. For the fall, we are collaborating with Rutgers leadership and following state guidelines to plan in person campus activities that are the hallmark of a School of Engineering education. I very much look forward to seeing more activity on campus.

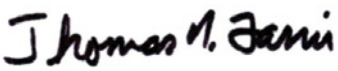
This past year undergraduate and graduate students alike have adapted and flourished, winning coveted fellowships and international competitions, garnering post-graduation job offers, and furthering research that will make a positive impact on people's lives. We take pride in the efforts of a number of our responsive faculty, alumni, and students who identified opportunity in the midst of an unprecedented worldwide health crisis and have made worthy contributions that are helping to win the war against COVID-19.

Electrical and computer engineering professor Wade Trappe, for instance, created a new research-oriented course on "Engineering and the Immune System" so students could explore using the tools of math and science in determining the effectiveness of vaccines and whether we will reach herd immunity, while alumnus Steven Levine's Living Heart Project is helping researchers understand the long-term effects of COVID-19.

Such exploration and innovation fulfill our mission as engineers to surmount and solve problems that will lead to a more just, sustainable, and healthier future for us all.

Yet today, perhaps, it's more important than ever to remember to take the time to enjoy ourselves whenever we can. As someone who works to create interactive, immersive entertainment experiences, class of 2010 alumnus Vincent Logozio puts it this way in this issue of *Impact*, "If you can really light up someone's life with an amazing experience, that's doing a good thing for the world."

I am certain that we will continue to do good things for our world because the future must be built.



Thomas N. Farris, Dean
Rutgers University School of Engineering

Photo credit: Dennis Connor

OutFront

SoE Professors are Charged Up

Rutgers Chancellor's Fund Supports Collaborative Lithium-Ion Battery Research Projects

Zhimin Xi, an assistant professor in the Department of Industrial and Systems Engineering, is a co-PI on two year-long research projects funded by Rutgers University and the School of Engineering. The projects focus on developing resilient lithium-ion battery systems for future use by unmanned aerial vehicles (UAVs) with shared battery systems and electrified roads with integrated systems of renewable energy. Xi's research on these projects aligns with his National Science Foundation (NSF) funded project on lithium-ion battery health management of electrified vehicles.

"Through the call for Team Science Initiative proposals from the School of Engineering I connected with mechanical engineering assistant professor **Laurent Burlion** and civil engineering associate professor **Hao Wang**, who each needed lithium-ion batteries for their applications," Xi recalls. "Thus, we quickly came up with the ideas for the two projects."

The Team Science Initiative supports collaborative research efforts among new faculty from diverse backgrounds.

Exploring Battery Sharing for UAVs

Xi has teamed up with Burlion on a multidisciplinary project at the frontier of aerospace and electrical engineering.

According to Xi, since unmanned aerial vehicles are powered by lithium-ion batteries, any changes in design or maneuverability impact the power consumption of the batteries, which, in turn, directly relates to the UAV's mission success.

"We're developing more efficient drones for which the battery and flight control algorithms are designed at the same time," explains Burlion.

"I can quickly provide feedback to Burlion to let him know if his UAV design and control are energy efficient," Xi explains. While current technology requires that a UAV return to a charging station, the project will also explore real-time charging of UAVs during flight by shared battery systems.

Burlion adds, "we will work on a modular drone that requires the in-flight assembly and disassembly of a fleet of drones that can share their batteries. Such in-flight charging could be used to keep one of the drones in flight indefinitely."

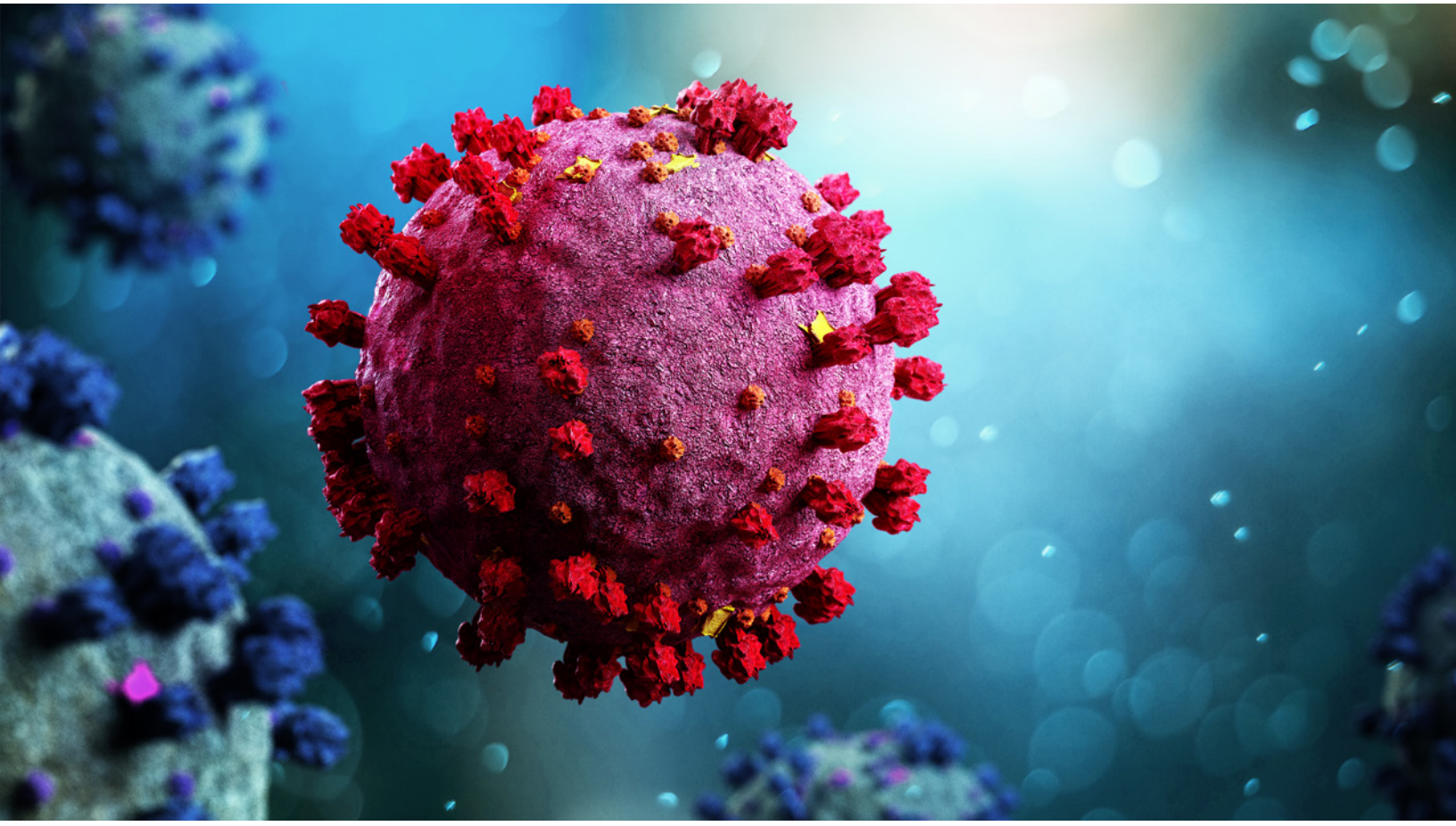
Sustainable Electrified Roads for Electrified Vehicles

As co-PI with Wang, Xi is working on a theoretical project that envisions a future transportation system of electrified roads able to charge electrified vehicles as they drive.

While the technology to do this is available through wireless charging, Xi notes that in order to provide enough power to an electrified road, renewable solar and wind energy would need to be harvested from roadside assets. "Renewable energy is not stable and would need to be stored to lithium-ion battery energy storage systems," he says. "With sufficient capacity, these battery storage systems could power the electrified road when there is a high charging demand from electrified vehicles." Ultimately, after studying the feasibility of the system in terms of cost, scalability, and environmental and societal impacts, Xi hopes that such large-scale lithium-ion battery storage systems could be an ideal buffer system among renewable energy, an electrified roadway, and the power grid.

OutFront
Combatting COVID-19

SoE faculty and alumni are helping to win the war against the coronavirus



The world is a far different place than it was a year ago, when the global coronavirus pandemic impacted the way people work and live. While a vaccine roll-out of unprecedented speed, coupled with common sense measures such as mask-wearing, social distancing, and frequent hand washing have done much to mitigate the virus' spread, more can be done before life can return to pre-pandemic "normal."

Rutgers School of Engineering faculty and alumni are confronting head-on ongoing challenges posed by COVID-19 from detecting viral mutations to developing a vaccine supply chain.

A Simpler Test for COVID-19

Edward DeMauro, an assistant professor in the Department of Mechanical and Aerospace Engineering (MAE) is the principal investigator on a NIH RADx-Rad award in collaboration with Rutgers HealthAdvance™. DeMauro is working with three SoE co-PIs – MAE colleagues German Drazer and Hao Lin, and electrical and computer engineering associate professor Mehdi Javanmard – to develop a rapid COVID-19 sensor able to detect the presence of the SARS-CoV-2 virus within a person's breath.

When the pandemic shut university labs down from March to July 2020, DeMauro says he and his colleagues were determined not to sit idly by. Instead, they looked for new areas of research to explore.

"We said, 'What if we put all of what we've been working on together to develop a rapid diagnostic device that could be used to detect a COVID-19 infection simply by having someone breathe into it,'" DeMauro recalls. "We're developing a system for capturing viral particles from the patient and depositing them in an electronic sensor.

"We wanted it to be so simple that a four-year-old could breathe into it without being scared and that wouldn't expose a medical professional to the virus. And we wanted to have a final result that would be available within five to fifteen minutes without having to go to a lab for processing."

The team hopes to develop a device that could not only detect the coronavirus, but that could also detect other diseases and pathogens by changing viral antibodies in its capacitor-like sensor.

Making N95 Masks More Effective

Rutgers engineers have developed a plant-based spray that could be used in N95 protective masks, electronics and energy devices, and potentially create human organs, as reported in *Materials Horizons*.

Working in his Hybrid Micro/Nanomanufacturing Laboratory, mechanical and aerospace engineering assistant professor **Jonathan Singer** collaborated with Binghamton University engineers to develop a method that sprays methylcellulose – a renewable plastic material derived from plant cellulose – on everything from 3D-printed objects to LEDs.

While long-term Singer sees the spray as a first step in the 3D manufacture of organs with properties seen in nature, he predicts a more immediate benefit. "In the nearer term, since N95 masks are in demand as PPE during the COVID-19 pandemic, our spray method could add another level of capture to make filters more effective," he says.

Measuring the Ability to Fight Infection

Department of Electrical and Computer Engineering assistant professor **Umer Hassan** recently received a National Science Foundation grant to develop a next-generation in-vitro diagnostic platform for measuring the ability of an individual's blood cells to kill pathogens.

According to Hassan, when an infection occurs, the human body's immune system mounts a defense. "Blood cells follow a pathway culminating in killing the infecting pathogens. This process, known as phagocytosis, is critical to a patient's timely recovery from bacterial, viral, and fungal infections," he explains. "Determining an individual's natural phagocytic ability will be tremendously important in stratifying high-risk individuals."

"Although this grant specifically explores the sepsis/bacterial infections and phagocytosis, the device – which will require only a single drop of whole blood and provide a rapid time to result – could easily be used for viral respiratory pathogens like SARS-COV-2 as well," Hassan predicts.

Prof. Hassan's device for detecting pathogens.

Exposing a Potential Public Health Threat

Civil and environmental engineering associate professor **Nicole Fahrenfeld**'s team of researchers is exploring the public health threat posed by the microbe-laden biofilms adhering to sewer walls. Study results published in the journal *Environmental Science: Water Research & Technology* could lead to a better understanding of the coronavirus and other sewer pipe microbial contaminants – and to more effective disinfection methods.

Hotbeds for antibiotic resistance gene (ARG) carrying bacteria, these biofilms can compromise water quality during sewer overflows and even distort wastewater-based epidemiology (WBE) findings.

When it comes to the coronavirus, wastewater monitoring, according to Fahrenfeld, can be a helpful tool in lieu of frequent and widespread testing of individuals. "Given the current interest in WBE for monitoring the coronavirus, our study highlights the need to consider sewer processes and how best to combat pathogens."

"There isn't evidence that SARS-CoV-2 remains viable in wastewater, nor has it been detected in drinking water," reassures Fahrenfeld, adding that disinfection techniques for wastewater and drinking water do work on the coronavirus and other enveloped viruses.

Tracking Viral Mutations

Since viruses mutate rapidly, a fuller understanding of viral evolution in single cells could speed the development of successful vaccines and treatments. **Laura Fabris**, an associate professor in the Department of Materials Science and Engineering, has developed a new technique that identifies and measures viral RNA in individual living cells – and also detects the small changes in RNA sequences that might give viruses a winning edge.

Fabris' research efforts have benefitted from her share of a $5.2 million Defense Advanced Research Projects Agency's (DARPA) grant to design TIPS – therapeutic interfering particles – able to infiltrate and outcompete influenza and other viruses.

Laura Fabris

"The DARPA program seeks to develop new vaccines and treatments based not on traditional routes, but on using viral RNA to fight itself," she says. "Our role has been supportive – to provide imaging tools that make it possible to look at what happens inside a single cell as it replicates."

Using surface enhanced Ramen Spectroscopy (SERS), her team detects Influenza A viral RNA and its mutations in living cells – a technique that could be applied to other viruses – including SARS-CoV-2 that causes COVID-19.

Fabris hopes to contribute further to the fight by identifying regions of the COVID-19 genome to target with SERS probes to aid virologists in diagnostics.

SoE Alumni Making Contributions

Alumnus **Steven Levine** who earned his bachelor and doctoral degrees in 1982 and 1986 in ceramics and materials science, is today the senior director, virtual human modeling and founder of the Living Heart Project at Dassault Systémes. Levine's virtual 3D model of the human heart is not only revolutionizing the treatment of heart disease (which you can read more about on page 10), it is also contributing to the understanding of the long-term effects of the coronavirus.

While doctors can practice on a simulated heart before performing cardiac surgery to avoid mistakes, the Living Heart Project may also provide some welcome answers for COVID-19 long-haulers who continue to suffer from chronic illness. Levine reports, "A couple of groups, including one at McGill University in Montreal, have been modeling COVID-19 patients in order to see the effects of the virus on long-haulers."

He adds, "We're already working on helping to establish a national center for studying the long-haulers, where we'll build virtual hearts, brains, and lungs and see what is happening inside," he adds.

Like Levine, alumna **Vita Lanoce**, who received her master's degree in biomedical engineering, notes a new research interest in long-haulers. She is currently CEO of Linical Americas – a leading contract research organization (CRO) focused on oncology, vaccines, and general medicine.

While effective COVID-19 vaccines are now becoming widely available, Lanoce reports that the successful roll-out of these vaccines has boosted the development of new drugs and vaccines in many areas, as well as a new focus on using these platforms for other infectious diseases and oncology indications.

As vice president, Janssen Supply Chain at Johnson & Johnson, chemical and biochemical engineering alumnus **Remo Colarusso** is responsible for the global manufacturing and supply management of all J&J pharmaceutical brands. This has included work on the single-shot J&J coronavirus vaccine developed by Janssen Pharmaceutical, which the FDA authorized for use in late February.

As part of Johnson & Johnson's global enterprise supply chain, Colarusso leads the Janssen Pharmaceuticals supply chain within it. In this capacity, he worked closely with the COVID-19 vaccine team designing the end-to-end supply chain needed to source, make, and supply the vaccine to those who need it. "This wasn't in our plans going into 2020," he admits. But J&J has met the challenge of making a vaccine available for emergency use in the fastest time possible.

Photo credit: Don Hamerman

OutFront

Imagine That!

SoE Alumni's Imaginations Run Wild

Omega Mart "Dramcorp Factory"

For **Vincent Logozio** ENG'10 a childhood trip to Disney World sparked his imagination. "I kept wondering how things worked and who gets to make this stuff," he recalls. By high school, he wanted to go into themed entertainment and work for Disney. When he learned that the Walt Disney Imagineering Imaginations Design Competition for college students was a potential pathway to fulfilling his dream, he was determined to submit a winning entry.

As a mechanical engineering major at the School of Engineering, Logozio – along with electrical and computer engineering major and classmate **Raymond Scanlon** and two other team members from the College of New Jersey and Rowan University – were part of a Rowan University team that won the 2009 competition with their "Disney Spaceport" design. All four members of the team eventually landed jobs as Disney Imagineers – people who work to devise and engineer attractions at Disney theme parks. While Scanlon remains an Imagineer, Logozio is currently senior director of design and production at Meow Wolf, a Santa Fe-based arts and entertainment group that creates immersive and interactive experiences.

Lockheed Martin Virtual World Labs' senior software engineer **Eric Burns** ENG'02 became intrigued by virtual reality at a childhood birthday party at a Dave & Busters. "We put on headsets and played the shooter game Dactyl Nightmare for maybe five minutes. I remember thinking that was the coolest thing I'd ever experienced," he recalls.

Their time at Rutgers put each of these SoE alumni on the path to careers that depend not only on their engineering skills, but also on their willingness to let their imaginations run wild. As Burns succinctly puts it, "I get to do creative, fun stuff."

Photo credit: Meow Wolf

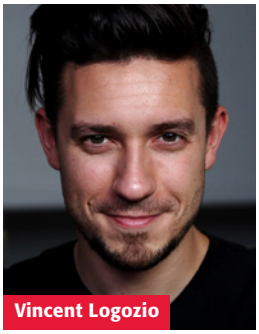
Creating Amazing Experiences

Logozio is clear about the value of his SoE degree. "Learning how to think and how to learn and how to break a problem down into individual components and optimize different parameters is amazingly helpful in the professional world," he says. Nonetheless, he recommends that current students look beyond the classroom to develop at least one personal project that showcases their abilities to do something creative on their own. "You really want to be able to show prospective employers what you can actually do. You'll get hired as a specialist if you can do one thing well, but you get to stay on if you're a Swiss Army knife."

His work on the prizewinning "Disney Spaceport" project did just that, by leading to a Disney internship in concept design right after the competition. "A year later, as I was finishing senior year, they called me back and offered me an internship opportunity with the research and development group focused on animatronic design that ultimately led to full-time work," he says. "I hadn't done any significant robotic design at that point, but I was going to learn how to do it." He eventually worked on the animatronics figures of "Mater" and "Luigi" in the Cars Land Radiator Springs Racers ride at Disney California Adventure for two years.

Ray Scanlon working with fellow Imagineer Sara Thatcher

Logozio later transitioned into special effects, where he worked on his favorite project, the Haunted Mansion's resurrected "Hatbox Ghost," before joining the Play Disney Parks project team, which could trigger special effects on smart phones so that queue lines could be more fun.



Vincent Logozio

Ray Scanlon

Eric Burns

Having fun on the job matters to Logozio. "I've always loved the problems that I got to solve," he says. "In my current role with Meow Wolf, that's very important. You have to get down with the problem – then you'll have a good time."

His latest project? Managing a team of 56 artists, fabricators, and tech designers who have been working on Meow Wolf's "Omega Mart," an immersive, interactive permanent art experience installation that recently opened in Las Vegas.

"I always wanted to go into themed entertainment to help make experiences that are going to change people for the better," Logozio says. "If you can really light up someone's life with an amazing experience, that's doing a good thing for the world."

Making Dreams Become Real

"Inspiration comes from a bunch of different places – there's a spark moment that comes from a bunch of different sources. And once you bounce an idea off other people, you know you're onto something," says Scanlon.

According to Scanlon, Rutgers gave him the skills he needed to do this. "I learned how to learn. I learned how to figure things out. One day I might work on something with fireworks and I have to learn about that and be able to pick up new skills and apply them," he says.

"For me, an influential course was in the principles of programming languages, which focused on four different languages throughout the semester. This was the beginning of a toolkit I could use – and I've used all the different languages I learned in that course." Equally influential was ECE professor Kristin Dana. "I did my capstone with her and I still have one of my notebooks from her computer vision class."

While today he is a senior R&D at Walt Disney Imagineering, winning the competition in his junior year at Rutgers gave him his start. "My internship led to my full-time position," he says. "It is really impactful and one of the big sources for getting new and diverse talent for the organization. I take part in the intern program that Imagineering has each year – I'm sort of a continuing mentor for the competition and help students hone their projects."

His regular responsibilities include keeping on top of the technologies coming out across the industry and applying them to the theme park resorts. "We're looking to see how to use these different things to make new experiences and attractions that improve the overall guest experience," he explains.

It's a job that, as he puts it, "goes across the board. One day I work on a creative initiative, the next day I'm deep into the engineering side of things. You see it in the title 'imagineer' – a little bit of creativity, a little bit of engineering.

"A big part of what we do is challenging ourselves with ideas on how to make the most amazing, wildest things we can dream up come to reality," he adds.

Playing with Ideas

As a student, Burns wanted to set himself on a path to a successful career. "I wanted to become an engineer because I heard they made a lot of money. I also was going to go for Rutgers' five-year Engineering/MBA program. I was going to make so much money," he says.

The best laid plans, as Burns would cheerfully admit, often go awry. He credits his ECE mentors, Professor Emeritus Grigore Burdea, Professor Kristin Dana, and Professor Deborah Silver, with interceding when he wanted to make "non-optimal" career choices.

A virtual reality elective and a special project and class in computer graphics were great fun – and a great inspiration – for him. "So many times I bumbled my way into the best possible situation."

When Silver asked him about his summer plans, he said he was thinking of taking an internship with Merrill Lynch because they would pay a lot. "She was crestfallen and asked if I would consider a research position." In the end, she helped him get an internship at Sandia National Laboratories in Livermore, California that paid almost as much.

Orion spacecraft

"I had so much fun there – it was the best job I ever had," Burns enthuses. "They had all this technology we could just play with. If we had an idea, they would say 'go do it.' Every day I thought I was playing. I came back with a changed world view and decided I didn't want an MBA – I wanted to get a PhD and go into research. I'd learned that my future happiness depended on more than how much money I'd make."

Burdea encouraged him to get his doctorate in interactive 3D computer graphics, with a dissertation on virtual reality, at the University of North Carolina in Chapel Hill, which boasted the nation's leading program in the field.

A stint with start-up software company 3DSolve, which built training programs for everything from military flight training to icing donuts, gave him expertise in virtual training and a breadth of knowledge. He landed at Lockheed Martin when it acquired the company 14 years ago.

These days, he pursues his passions for space and virtual reality by developing virtual simulations at Lockheed Martin. "They are for training across all domains – land, sea, air, and space. Virtual reality is a really good alternative for training whenever it is too dangerous, costly, or hard to recreate."

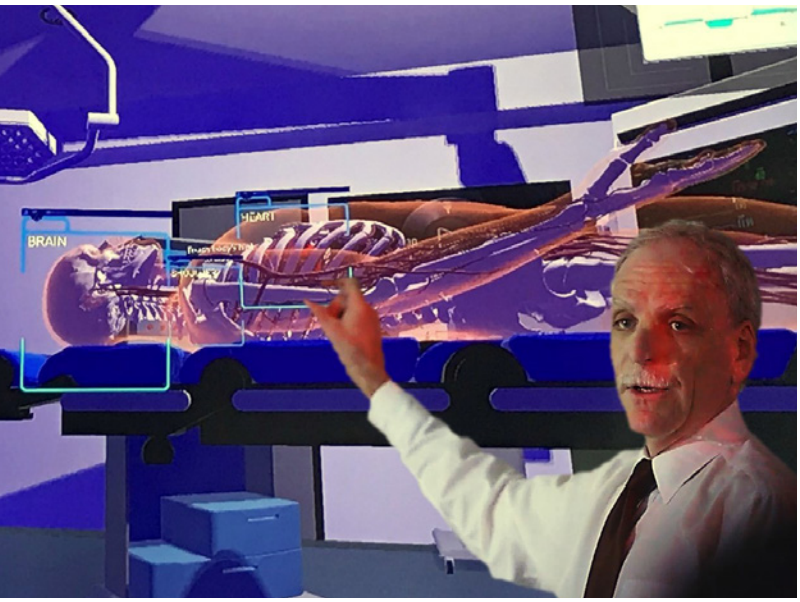
Just this past year, Burns reports, he was delighted to be able to get involved in a minor way with the Orion Spacecraft program, which is designed to take people into deep space. "I'm lucky – I got to fulfill both of my dreams."

OutFront

Steven Levine, PhD

10 Engineers Who Mattered in 2020

"Learn to listen – not only to what you are looking for but to what others have to say. So much more information is out there if you keep your mind open to it."



Steven Levine in a Virtual OR

Alumnus Steve Levine earned both his BS (1982) and PhD (1986) degrees in ceramics and materials science. He boasts more than 30 years of experience as a business development professional who has focused on Software as a Service (SaaS), research and development, life sciences, engineering, strategy, marketing, and sales. Today, he is the senior director, virtual human modeling and founder, Living Heart Project, at Dassault Systémes. By developing an accurate, virtual 3D model of the human heart, the Living Heart Project is revolutionizing the treatment of the world's leading cause of death – heart disease. Levine, a fellow of the American Institute of Medical and Biological Engineering Society, was named one of "10 Engineers Who Mattered in 2020" by Engineering.com.

Why Rutgers engineering?
Rutgers had a great reputation. I knew I was interested in engineering, but I wasn't sure what I wanted to focus on. I liked the blend of science, technology, and engineering that a major in ceramics and materials science offered.

What do you value most about your Rutgers education?
It provided key foundations in cutting edge areas of science and engineering that I could build on. Looking back, one of the places I liked to go to study on Busch campus was the Library of Science and Medicine. What have I done in my career? I've worked to combine engineering, science, and medicine.

What sparked your epiphany that led to found the Living Heart Project?
My daughter Jesse was born with a rare congenital heart condition in which her left and right ventricles were reversed and for which there was very little reliable medical data and that was nearly certain to shorten her life.

I wanted to find a way to help save her life.

At Dassault Systémes, I was working on helping companies that build planes and cars make sure they are safe before they are built by using 3D computational crash test models. I wondered why we couldn't do that for the medical field by building a realistic virtual human heart. I believe that in medicine – as in so many other areas – a picture is indeed worth a thousand words.

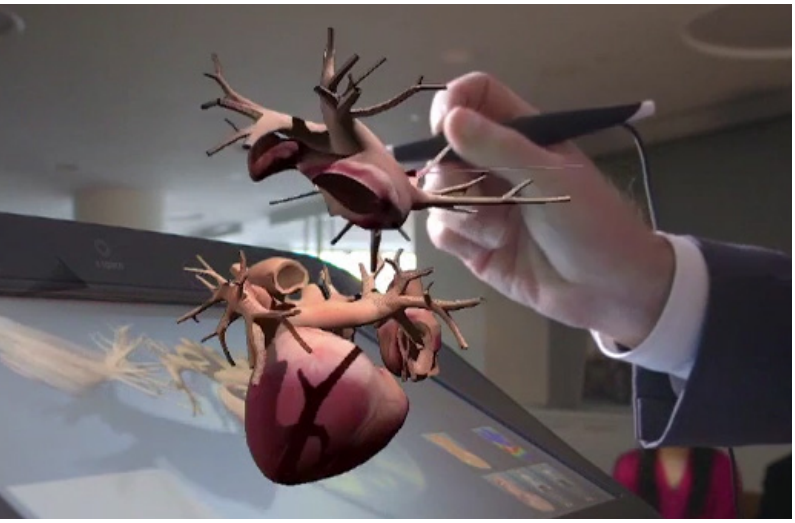
Was Jesse involved in the project in any other ways?
The first year, I didn't let anyone at work know about Jesse. I hadn't brought her into the story, because I didn't feel comfortable about bringing her into my professional life.

But at one point, she asked me why not? She said that if it would help one more kid to share our experience, it would be worth it. She is truly a testament to what can happen when you are forced to face tough situations. Jesse chose to shape it in a constructive way and not feel like a victim. As Jesse has said, "The best thing you can do is take what you've been given and be inspired by it."

How is Jesse today?
She received her MD and PhD in neuroscience from New York University and is currently a first-year pediatric neurology resident in Houston.

What did it take to build a living heart model?
It took a lot of collaboration among cardiologists, engineers, and scientists. Hundreds of people who only had one piece of the puzzle shared their best knowledge so that we could develop the first simulation of the entire human heart.

Was the FDA on board with the project from the start?
It took a while, but the FDA stepped up when they realized the Living Heart Project can save lives – and costs – when you get it right the first time. You can do 90% of a clinical trial virtually and then validate it, which saves massive amounts of time and money. The FDA knew it was a journey worth going on when they agreed to come on board.



A Dassault Systémes Living Heart

What kind of an impact has it had?
I firmly believe that the best way to improve our healthcare system is to give people the tools to help them manage their health better.

Today, for example, doctors at Boston Children's Hospital can practice before performing cardiac surgery, which can prevent them from making mistakes and save lives.

We've set up virtual tablets for patients to interact with so they can see and really understand what is happening.

Has the coronavirus pandemic affected your work?
The story really hasn't been told yet. The science world is changing as a result of the pandemic. The WHO open agreement for researchers to share their data on COVID-19 has changed everything. The FDA can approve things in a couple of weeks because people are sharing information.

It's a wake-up call that we have to be more open about things. My paradigm has been that we need to compete based on how well we use information, not just how well we protect it.

Are researchers studying the long-term effects of COVID-19 using the Living Heart Project?
Yes. A couple of groups, including one at McGill University in Montreal, have been modeling COVID-19 patients in order to see the effects of the virus on long-haulers.

Some of our collaborators are studying COVID-19 patients and we're already working on helping to establish a national center for studying the long-haulers, where we'll build virtual hearts, brains, and lungs and see what is happening inside.

What does your recognition as an Engineer Who Mattered in 2020 mean to you?
The recognition is meaningful as it isn't typical for the engineering world to acknowledge publicly that your work really does matter. One reason I think I was recognized was because COVID-19 shone a big light on the limitations of our medical system. People looked around to see how we could do things better.

How do you share your story?
I've become conscious of how much more we can achieve if we allow people to really understand what they're dealing with. It's deep in my soul to help build systems to educate parents and patients because I felt helpless as a parent for so many years.

I can talk to the world's most sophisticated cardiologist and to a teenager and they both get value out of the same information.

I recently gave a webinar, for instance, to students at the New Jersey STEM Academy in Brick Township. They observed a heart transplant in the morning, and spent time in the afternoon with a Living Heart Project heart.

What advice do you have for today's engineering students?
Learn to listen – not only to what you are looking for but to what others have to say. So much more information is out there if you keep your mind open to it.

Impact

Students Explore Coronavirus Vaccine Strategies Using Mathematical Modeling

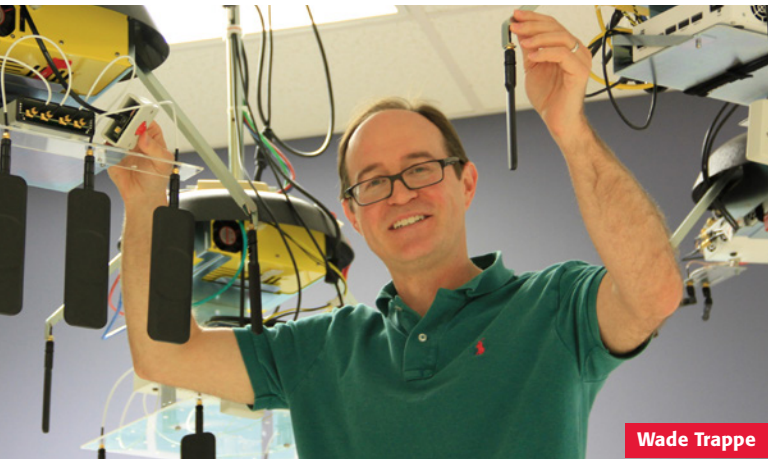
Professor encourages students to ask questions first – then seek answers

At first glance, teaching a course on "Engineering and Controlling the Immune System" might seem like an unexpected departure for electrical and computer engineering (ECE) professor and undergraduate program director **Wade Trappe**, whose research has focused on cybersecurity and communications systems. Yet the self-described "nerd of all colors" says his interest in using electrical engineering to solve health-related problems makes sense. "If you can fix computer networks, you could learn to attack diseases."

A passionate teacher, Trappe also wanted to give undergraduate students a topical, research-oriented experience. "These undergraduate students are looking for opportunities to do things beyond what's in the classroom," he insists. "They are some of the most creative, inquisitive people, but their natural tendency to ask questions isn't necessarily encouraged in the traditional classroom setting. I wanted to give students a science classroom experience in which they could drive the questions."

His ECE Topics class of eight students more than rose to the occasion.

"The students directed the course," says Trappe. "I am personally interested in what is going on inside of a person's body – in antibodies and adaptive immune systems, for example – but they were more interested in COVID-19's effects on society and what was in the news."


Wade Trappe

They wanted to understand vaccine effectiveness and what is causing infection to spread so fast to so many different people. They wanted to know, Trappe reports, "if we can even believe we will ever hit herd immunity, and what we need to do if we're able to get there. Or will variants prevent this?"

Working in two-person teams, with the guidance of Trappe and PhD student **Vahideh Vakil**, the students developed mathematical models to explore these questions. "I tried to convey my experience in mathematical modeling and simulating the dynamical systems to the class," Vakil says. "At a high level, I can say the students learned how to scientifically approach a real-world problem like the COVID-19 crisis, through their expertise as engineers. They learned how to use available, real-world data, such as the virus transmission and vaccination rates in different countries to establish models that predict the pandemic's trend. They also learned how as engineers they could affect public health decisions through their modeling tools."

Graduating senior ECE major **Rebecca Golm** opted to take the class because it aligned with her COVID-19 related independent honors thesis to work on a project that could project deaths and infections at current vaccination rates to determine how to improve outcomes. "Mathematical modeling is a powerful tool that can help us make optimal decisions that create better outcomes," she explains.

Golm, who will pursue her PhD in ECE at the University of Illinois at Urbana-Champaign after graduating, says, "The course, alongside capstone and independent research, allowed for independent decision-making and being able to follow research questions that were of interest to me. I enjoyed the group discussions and being able to guide the material of the course as a class."

The only non-ECE student to take the course was **Michaela Lozada**, who earned bachelor degrees in visual arts and computer science from Mason Gross School of the Arts and the School of Arts and Sciences. "I was honored to have the chance to take this course, which I did in an effort to expand my knowledge, and ability to work in XR, or extended reality, and to interact with an incredible professor and peers," she explains. Equally important, Lozada says she learned how critical it is to ask the right questions. "This class brought me a new appreciation for the power of simply re-framing original problems or questions."

She is currently working with WINLAB (Wireless Information Network Laboratory) to develop her own design for an interactive, augmented reality memorial she says she has designed as "a creative process to heal COVID-19-related trauma.

Another classmate and ECE major **Sabian Corrette** will pursue a master's degree in ECE at Rutgers while continuing to work in the school's engineering computing services as a web administrator and web developer. He decided to take the class after talking with Trappe in the fall.

"I'd expressed how it would be nice to have a course in which students can apply the theoretical knowledge we learned through our time here at Rutgers," he remembers. "Given the current pandemic, Professor Trappe proposed a course where we were able to do just that: apply what we learned to create meaningful models to predict trends and understand, mathematically, how we could fight something like COVID-19."

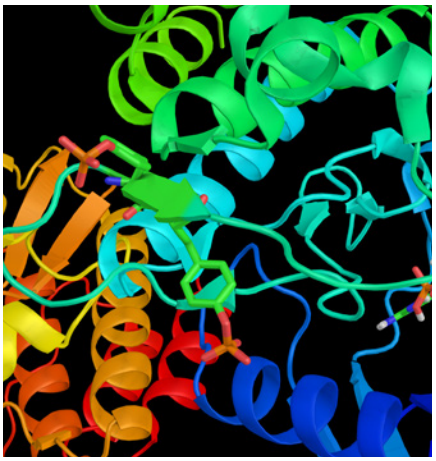
Gaining research experience that tackled a timely topic was important to Corrette, whose project with fellow student **Malav Majmudar** asked if "we vaccinate faster with a less effective vaccine, will the overall result be more favorable than if we don't vaccinate with it at all, or if we vaccinate at the slower rate as for a more effective vaccine."

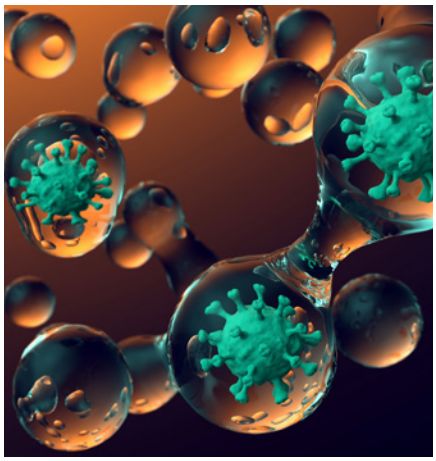
So far, Corrette reports, the overall trend indicates that by vaccinating quickly with a vaccine like J&J while still administering Moderna or Pfizer vaccines at a more modest rate would dramatically decrease the number of infected people.

As far as some of the other lessons learned go, Trappe reports that since it's important to vaccinate as fast as we can, it doesn't make sense to prioritize two-shot Pfizer or Moderna over the one-shot, shelf-stable J&J vaccine. "The models also showed that the faster we get vaccines out, the greater the likelihood we will be able to curb the virus variants," he says. "Basically, we need to vaccinate as many as possible and do it quickly."

Pleased with the success of his course that he believes unlocks untapped student potential by educating them the way they need to be taught, Trappe intends to offer the course again next year. "I love this class – and I love what my students are doing," he says.

Impact
Grants and Awards





Rutgers University's 2020/2021 Provost's Award for Excellence in Teaching Innovations were awarded to **Kristen Labazzo**, biomedical engineering assistant professor of research practice, and **Laurent Burlion**, assistant professor of mechanical and aerospace engineering. This award recognizes faculty members whose teaching practices involve innovative approaches to enhance learning outcomes, new forms of pedagogy, instructional technologies, or innovative multimedia.

Biomedical engineering associate professor **Nada Boustany** and School of Arts and Sciences cell biology and neuroscience professor Bonnie Firestein were awarded a $431,444 National Institutes of Health NIH-R21 grant from the National Institute of Neurological Disorders and Stroke for their project *"Determining a Role for Protein Kinase A in Dendrite Development using a FRET-based Sensor."*

Electrical and computer engineering assistant professor **Umer Hassan** is the recipient of a $360,000 award from the National Science Foundation for the project "*An Electronic-Sensing & Magnetic-Modulation (ESMM) Biosensor for Phagocytosis Quantification for Personalized Stratification in Pathogenic Infections.*"

Mechanical engineering distinguished professor **Yogesh Jaluria** was selected to receive the 2020 Thermal Fluids Engineering Award from the American Society of Thermal and Fluids Engineers (ASTFE). This award recognizes substantial contributions to thermal and fluids engineering.

Edward DeMauro, an assistant professor in the Department of Mechanical and Aerospace Engineering (MAE) is the principal investigator on a NIH RADx-Rad award in collaboration with Rutgers HealthAdvance. DeMauro is working with three SoE co-PIs – MAE colleagues **German Drazer** and **Hao Lin**, and electrical and computer engineering associate professor **Mehdi Javanmard** – to develop a rapid COVID-19 sensor able to detect the presence of the SARS-CoV-2 virus within a person's breath.

The Office of Naval Research has selected assistant professor **Jonathan Singer** for its 2021 Young Investigator Program, which includes a $510,000 grant from 2021-2024. His project is supported by the Aerospace Structures and Materials program and will investigate the manufacturing of carbon fiber composites with functional porous matrixes for antifouling, electromagnetic shielding, and energy storage.

Ryan Sills, materials science and engineering assistant professor, was awarded a Young Investigator Program (YIP) award from the Solid Mechanics Program at the Army Research Office. The award includes funding to support research efforts aimed at developing a dislocation network theory of plasticity.

Professor **Kimberly Cook-Chennault** received the "I Can STEM Role Models Award" from The New Jersey STEM Pathways Network (NJSPN). NJSPN honors diverse STEM leaders who have made and continue to make significant contributions in STEM.

WeRUnited

Senior Spotlight

Joseph Salguero ENG'21

A Cardiac Challenge Sparks a Passion for Biomedical Engineering

Joseph Salguero

Rutgers School of Engineering (SoE) biomedical engineering graduating senior **Joseph Salguero** was not planning to attend college until he faced a battle with myocarditis, a life-threatening inflammation of the heart muscle, in 2017.

He spent several weeks in the Robert Wood Johnson ICU and continued therapy and sessions with his cardiologists for about a year before he was considered fully recovered.

"One of my cardiologists majored in engineering as an undergraduate and was a huge influence on my decision to change my mind and pursue a degree after high school," Salguero recalls. "Throughout my stay in the ICU, he always explained the different technologies – ECGs, ultrasounds, catheters, etc. – that I interacted with. Being able to see first-hand how technology created by biomedical engineers has the potential to extend and improve the quality of patients' lives helped me realize this was the community I needed to be a part of."

For Salguero, the SoE Educational Opportunity Fund (EOF) program – a state-supported program that gives academically and economically disadvantaged students access to higher education – helped lay the groundwork for his subsequent success as a biomedical engineering student. "If it were not for SoE/EOF, I truly would not be where I am today," he says.

Salguero enjoyed two design engineering co-op rotations with Ethicon, a Johnson & Johnson medical device company. During his first rotation in Cincinnati, Ohio, he led the early-stage development of surgical device technologies involving computer automated design work, design of experiments (DOE), as well as statistical and computational analyses.

As a first-generation student, whose mother came to this country from Ecuador, his success, he believes, is also a tribute to the countless sacrifices made by his parents. "It's also served as an example that has motivated my family to never lose touch of our work ethic and the drive that we all share and that has brought us this far."

Engineers of the Future

The School of Engineering's Engineers of the Future Program (EOF/EOP) fosters the educational, personal, and professional development of talented, highly motivated NJ students who are interested in a career in engineering and come from educationally and/or financially disadvantaged backgrounds. Through a myriad of programs, EOF/EOP recruits, retains, and graduates a diverse and socially, culturally, academically, and professionally competent population, while also building awareness of the field of engineering for students, parents, and educators.

You can support the School of Engineering with contributions toward this important and life-changing program. Visit **https://soe.rutgers.edu/giving** and select the **Give Now** link.

Photo credit: Nick Romanenko

WeRUnited
Student Achievements

Not even a global pandemic can stop SoE students – and recent graduates – from succeeding in highly competitive endeavors and collaborative partnerships. Here is just a sampling of our recent student success stories.

Collaboration with Matheny Yields Master's Project

Madara Dias, who earned her MS in biomedical engineering in May along with a certificate in medical device design and development, has always wanted to help people. "I set my heart on majoring in biomedical engineering," she says. "I saw this as a career path that would allow me to make a direct and positive impact on people's lives – and maybe even save lives."


Madara Dias

For her master's degree thesis, Dias partnered with the Matheny School, a school for children and adults with medically complex developmental disabilities in Peapack, New Jersey, to develop an innovative lateral support for wheelchair users. Since 2016, BME's collaborative relationship with Matheny has included a week-long immersion program for students as part of their senior design capstone project.

Dias worked for a year on developing a device that would greatly increase the users' range of motion while improving their quality of life. "The project was a great reminder of why I chose biomedical engineering – which was to help people," says Dias, who will apply all she has learned in a full-time position at Merck as part of their Manufacturing Leadership Development Program.

Recent Graduates Named Matthew Isakowitz Fellows

SoE alumni **Madeline Bowne** ENG'20 and **Raymond Martin** ENG'21 are among 30 students selected from 280 applications for the 2021 class of the Matthew Isakowitz Fellowship Program. The program, which is tailored to the next generation of commercial spaceflight leaders, honors the memory of an engineer, entrepreneur, and associate director of the Commercial Spaceflight Federation. Program fellows are assigned to paid internships at leading commercial space companies.


Madeline Bowne


Raymond Martin

Hoping to one day work on something that would bring people to space, Martin elected to major in aerospace engineering. This summer, he will intern with aerospace manufacturing and sub-orbital spaceflight services company Blue Origin, where he hopes to work on the company's lunar lander. "Hopefully, it will be selected by NASA to bring astronauts to the surface of the Moon by 2024," he says.

Bowne is currently pursuing a master's degree in aerospace engineering at Georgia Tech, where she also works as a research assistant in the Aerospace Systems Design Laboratory. "I've always been a futurist and daydreamer at heart, so the space industry was a natural fit for me," she says.

This summer she will intern with Florida-based Made in Space, which develops space manufacturing technology that supports exploration, national security, and sustainable settlement in space.

The students pictured from left to right are: **Kyle Mani, Joseph Nguyen, Megan Maniar,** and **Kyle Lee**.

SoE Team Wins Rice 360° Global Health Design Competition

Their design of a cancer-diagnosing smartphone app able to classify breast tissue as benign or malignant captured first place for Rutgers' Team Patho-ML in the international Rice 360° Institute for Global Health student design competition.

Team Patho-ML members **Kyle Lee, Kyle Mani, Megan Maniar,** and **Joseph Nguyen** were advised by **Mark Pierce**, an associate professor in the Department of Biomedical Engineering, on their winning project, which was also their senior design project. "The inspiration for the project came from Dr. Pierce and his partnership with the Rutgers Global Health Institute to develop point-of-care tools for use in low resource settings," recalls Nguyen.

The team used machine learning to classify microscope images of biopsied breast tissue that are uploaded through an app to a cloud-based algorithm. Their app was 96% accurate in classifying benign or malignant tissue and 78% accurate in identifying subtypes of tumors.

The students are confident that there is a bright future for their app. "I believe it can be successfully implemented in the future, as it drastically improves patient outcomes in locations without extensive and expensive medical devices," says Nguyen.

Read more about the Rice 360° Competition:
https://go.rutgers.edu/jh05i5dp

Learn more about the SoE Isakowitz Fellows:
https://go.rutgers.edu/1ddm17dt

Get the full story on the Rutgers-Matheny Collaboration:
https://go.rutgers.edu/1n0vw6w1

WeRUnited

Alumnus' Scarlet Promise Grant to Benefit SoE Students

Mechanical and aerospace engineering alumnus **Michael Inglese** is quick to acknowledge that Rutgers engineering, with its emphasis on an analytical approach to problem solving, taught him how to learn. Today he is chief executive officer and member of the board of directors of Aircastle Limited, a major passenger aircraft leasing company.

Mike Inglese (right) with SOE Dean Tom Farris at the 2019 Medal of Excellence awards dinner.

From first-generation college student 40 years ago to accomplished business leader and 2019 SoE alumni achievement honoree, Inglese was pleased to reconnect with the school through SoE dean Tom Farris and spend a day on campus with students.

While on campus, he visited some classes, including an aerospace engineering class, where he talked about his company and what it means to be an engineering student.

"As an engineering student, there are so many things you can do. Your education can be used in so many different fields and businesses."

Inglese is quick to acknowledge that Rutgers engineering, with its emphasis on an analytical approach to problem solving, taught him how to learn. "What do I know or not know and how can I translate that into solving problems is what I tried to convey to the kids at that time."

That experience initiated Inglese's recent $25,000 gift to the university's Scarlet Promise Grant program to help SoE students. His determination to help current and future students enjoy the benefits of a Rutgers engineering education was further sparked by the coronavirus pandemic.

"COVID is the worst thing to happen in the history of aviation. For the last year, the whole aviation industry has been struggling," he explains. "I'm still a fortunate person. I thought it was a good time to think about people's ability to stay in school. It's an honor to be able to give back and give others a chance – and help students to do what I was able to do."

Scarlet Promise Grants, a university-wide financial aid and emergency support program for Rutgers undergraduates, gives relief to thousands of students each year. University president Jonathan Holloway gave the critical program a boost on his very first day in office in July 2020, when he announced a campaign to raise $10 million for the grants. To learn more, visit: **https://soe.rutgers.edu/giving**

Photo credit: Roy Groething of Jersey Pictures, Inc.

WeRUnited

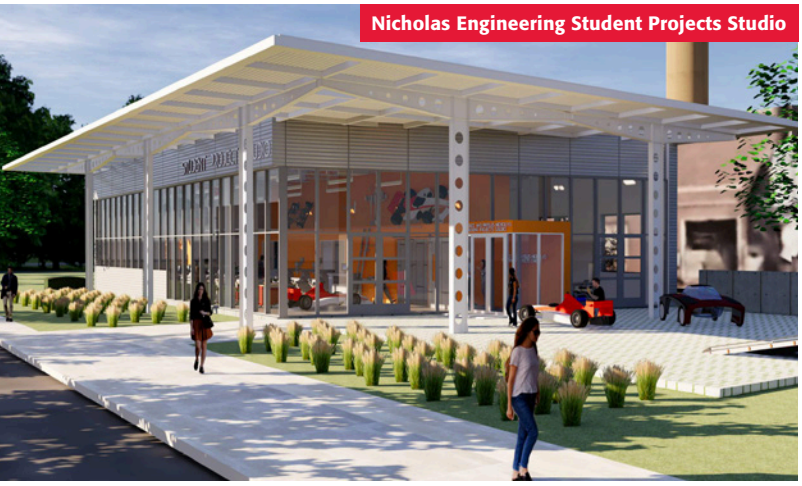
Built for Now

SoE Alumnus Funds Facilities Matching Gift Challenge

In 2018, the School of Engineering cut the ribbon on Richard Weeks Hall of Engineering, opening a gateway to a new Rutgers Engineering experience. With cutting-edge labs, technology-enhanced classrooms and lecture halls, student gathering spaces, and the dedicated home of civil and environmental engineering, this new facility was a leap forward in realizing the school's fullest potential.

Dedicated Student Project Space

More recently, construction of the Bruce and Phyllis Nicholas Engineering Student Projects Studio has been approved by the Rutgers Board of Governors with the project expected to be completed by May 2022. This dedicated space will provide students the opportunity to conceptualize and build scale-sized projects for the purpose of inter-collegiate competition.



Nicholas Engineering Student Projects Studio

New Home for Chemical and Biochemical Engineering

Additionally, the school's long-term effort to reshape the engineering campus quadrangle continues to move forward with an initial focus on the creation of a new home for the Department of Chemical and Biochemical Engineering (CBE). An anonymous alumnus donor has recently committed up to $375,000 in a matching dollar-for-dollar gift towards this effort. This exciting new project will set in motion replacing the aging Busch campus Engineering Building with a cutting-edge facility where faculty and students will be able to meet the academic and research needs of a 21st-century engineering school and the challenges of a rapidly changing world.

This transformative 73,000-square-foot expansion project will provide much needed space for CBE and will feature interdisciplinary research space able to accommodate evolving research collaborations. The facility will also house faculty and their research groups with offices, wet and dry research labs, student space, and more.

Engineering Campus Expansion

School of Engineering Dean Tom Farris says, "This matching donation and support from one of our graduates is a significant stake in the ground for our school's continued physical needs shaping the important, innovative work that will define and advance our future as one of the nation's leading undergraduate and graduate engineering schools."

Join the Campaigns

For more information on how you can support these important projects, including naming opportunities, contact Meera Ananth at **meera.ananth@rutgers.edu.**

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School of Engineering

Rutgers University-New Brunswick
School of Engineering
500 Bartholomew Road
Piscataway, NJ 08854
soe.rutgers.edu