Fall 2020

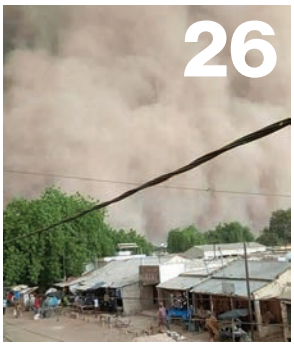
Impact

The Magazine of the College of Earth and Mineral Sciences

PennState
College of Earth
and Mineral Sciences

CONTENTS

Features



Sections

On the cover...

Penn State is part of the team investigating if Mars ever was, or is, habitable to microbial life. Credit pixy.org

Impact

John Leone Dean
Lee Kump

Editor/Design
Patricia Craig

Writers
Matthew Carroll, Curtis Chan, Patricia Craig, Mike Dawson, Steph Krane, David Kubarek, Francisco Tutella, A'ndrea Messer, Walt Mills, Gabrielle Stewart

Email
EMSmagazine@psu.edu

Web
www.ems.psu.edu/college-magazine

Correspondence
Impact Magazine
116 Deike Building
University Park, PA 16802

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"Lessons learned. . . "

So much has changed since we sent the first issue of *Impact*. What began as a typically enjoyable and productive academic year in the fall of 2019 and early 2020 transformed abruptly during Spring Break, when the University decided to "pivot to remote." Thus began pandemic mode: a crash course in Zoom for our students, faculty, and staff; incredible efforts by all to deliver on our mission under incredibly stressful conditions; and the semester culminating in a graduation ceremony that in some aspects was more engaging than the pomp and circumstance of the traditional commencement but lacked the thrill of the in-person event. Despite hurdles this summer, courses were remotely delivered, many internships were conducted, and virtual reality field trips were offered. You'll read herein about some of the summer activities we sponsored.

The killing of George Floyd and ensuing turmoil heightened our awareness of longstanding inequities and the acute need to diversify our faculty, staff, and student body while creating a more inclusive and supportive campus environment.

This fall we offered our classes in various modes to accommodate the extra classroom space needed for social distancing, and we are doing so in the spring as well, until the virus is under control.

There are daily challenges, but as we address these we continue to plan ahead, taking the lessons we are learning from the pandemic and social unrest, asking how we might emerge a better place to work and learn.

Two lessons are clear: it is important to be considered ***essential***, and we benefit from being ***resilient***. Higher education was deemed essential, so we were allowed to continue while many businesses, including some of the auxiliary enterprises of the University, were suspended.

The economic stress of the pandemic caused many of our students, their parents, and our supporters—alumni, industry, federal agencies, nonprofits—to reconsider their investment in higher education. This tells us that we need to ensure that we continue to be considered essential to student career success, and to solving important societal problems through our research, innovation, and outreach.

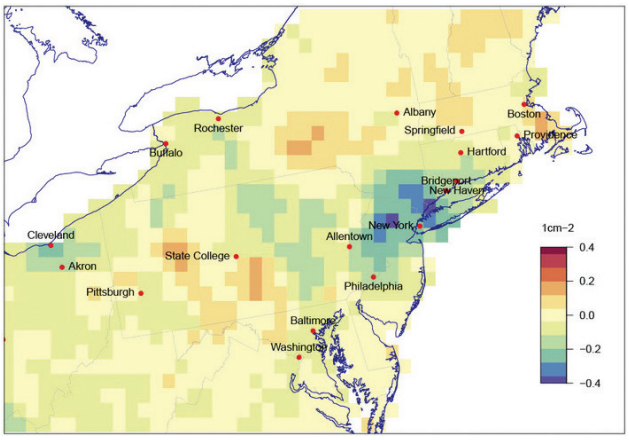
Our resilience was demonstrated through the skills of the John A. Dutton e-Education Institute learning designers, who provided one-to-one support to instructors during the transition to remote and whose expansive library of online resources, developed over the years with the faculty, was drawn upon to enhance the remote learning experience of our students. We expect that the trend toward student demand for a component of online learning will continue, and we need to grow that capacity.

Tools like Zoom proved essential to our ability not only to deliver our courses, but to stay engaged with our students through advising and to reach out to prospective and newly enrolled students through highly successful virtual events, especially Earth and Mineral Sciences EXposition (EMEX) and Total Engagement with EMS (TEEMS), the new first-year orientation and engagement event that replaced TOTEMS. We found that we were able to expand participation and reach new audiences with these virtual events; we need to avail ourselves of technological advances like this in the future to enhance our in-person events, which will return!

Our researchers were also resilient, able to progress on their projects by switching to data analysis, numerical modeling, and paper and proposal writing. We need to ensure that all of our students become proficient in data analytics and numerical modeling so that they too have the tools to be productive even when laboratories are closed and field work becomes impossible.

You'll see some instances of research productivity fueled by data analytics and relevant to the pandemic in this issue of *Impact*, including "viral" maps and understanding the threats dust storms pose to communities.

Best of luck to you all as we weather this pandemic together, and as always, stay in touch.



Air quality data during COVID-19 may help improve models, guide interventions

The measures instituted in April to help curb the spread of COVID-19 across the United States may hold clues for improving air quality, according to a team of researchers led by Guido Cervone, professor of geography, and meteorology and atmospheric science.

The scientists examined the pandemic's effects on two key pollutants—nitrogen dioxide and fine particulate matter—and human mobility. They found that as individuals limited their travel, nitrogen dioxide levels fell significantly while levels of fine particulate matter rose in certain parts of the country.

This unique moment provided a window into how much passenger traffic contributes to pollution. The study gives scientists a better idea of how the atmosphere reacts to reduced emissions from vehicular traffic, which can help to improve air quality models. https://bit.ly/2V9KSTV

Center for Nanoscale Science renewed at $18 million for six years

The Center for Nanoscale Science has again successfully renewed its National Science Foundation support in the highly competitive Materials Research Science and Engineering (MRSEC) program.

The center has two new interdisciplinary research groups. The first, 2-D Polar Metals and Heterostructures, is led by Joshua Robinson, professor of materials science and engineering, and Jun Zhu, professor of physics. It pioneers new methods of encasing 2-D metals in graphene to achieve exceptional optical properties and intriguing potential for quantum devices and biosensing.

The second, Crystalline Oxides with High Entropy, is led by Jon-Paul Maria, professor of materials science and engineering, and Ismaila Dabo, associate professor of materials science and engineering. It seeks to write a new chapter in the crystal chemistry rulebook by creating materials that take advantage of the enormous number of ways that different kinds of atoms can be arranged onto a common crystal lattice. https://bit.ly/36nxhP1

Drilling project to understand past, future ice sheet melting

The Greenland Ice Sheet holds enough water to raise sea levels nearly twenty-four feet, yet it remains difficult to predict the rate of melt and possible tipping points in the stability of the ice sheet.

A new project, GreenDrill, aimed at drilling through the ice to the underlying bedrock promises to reveal the ice sheet's past in unprecedented detail and enable more accurate predictions of how it may add to rising seas in the twenty-first century.

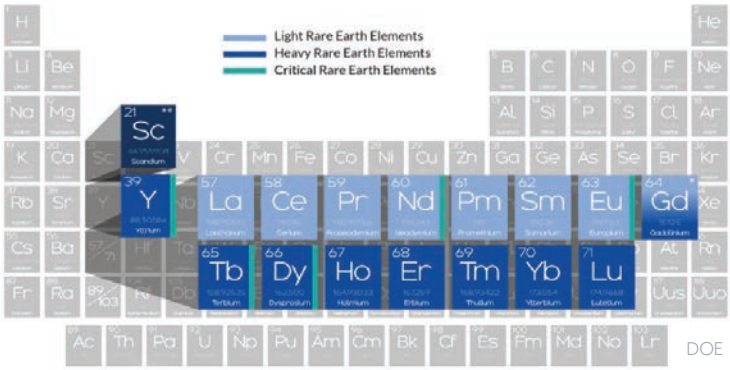
"Students and researchers at Penn State will conduct seismic, radar, and other geophysical investigations to determine the properties of the ice and rock beneath Greenland," said Sridhar Anandakrishnan, professor of geosciences and principal investigator on the project. "This work will help guide the locations of the drill and samples." https://bit.ly/3qcinTD

'Gargantuan' hail in Argentina may have smashed world record

In 2018, Argentina was pelted with hailstones so large scientists suggested a new category to describe them—gargantuan hail.

One hailstone likely measured between 7.4 and 9.3 inches across, potentially setting a new world record. The current record belongs to a hailstone that measured eight inches across that fell near Vivian, South Dakota.

The scientists, led by Matt Kumjian, associate professor of meteorology and atmospheric science, proposed hail larger than six inches should be classified as gargantuan, and said more awareness of these events, while rare, could help piece together a better understanding of the dangerous storms. https://bit.ly/36dYI34



DOE

Penn State and Colorado School of Mines partner on critical minerals

Penn State has entered a memorandum of understanding with the Colorado School of Mines to establish a collaboration designed to be responsive in supporting the United States' need for critical minerals.

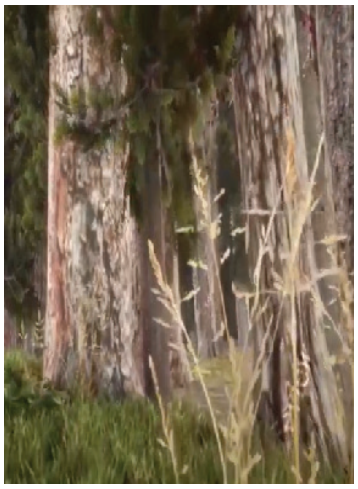
The two universities will partner on research to support U.S. producers and consumers of critical mineral commodities and help advance the country's manufacturing sector while developing a well-trained workforce to meet the demands on U.S.-sourced critical minerals.

"Both schools are committed to developing new innovations to enable a complete U.S. capability for critical minerals, from basic science to supply chain through to production," said Lora Weiss, senior vice president for research. "Together we span from Appalachia to the Rockies and collectively we have the technical base and established relationships with stakeholders to realize the full potential value of our natural resources. Our combined team is well positioned to be extremely responsive to the country's critical minerals needs." https://bit.ly/3fPIdqp

Virtual reality forests could help understanding of climate change

The effects of climate change are sometimes difficult to grasp, but now a virtual reality forest, created by geographers, can let people walk through a simulated forest of today and see what various futures may hold for the trees.

Alexander Klippel, professor of geography and director of Penn State's Center for Immersive Experience, and Erica Smithwick, E. Willard and Ruby S. Miller Professor of Geography, collaborated to create a virtual-reality experience that takes extensive climate change models, sophisticated vegetation models and ecological models, and creates a 2050 forest that people can experience by walking through it, investigating the tree types and understory, and seeing the changes. https://bit.ly/33paMr1



Cold sintering produces capacitor material at record low temperatures

Barium titanate is an important electroceramic material used in trillions of capacitors each year and found in most electronics. Penn State researchers have produced the material at record low temperatures, and the discovery could lead to more energy-efficient manufacturing.

A team of materials scientists and engineers used the cold sintering process to densify barium titanate ceramics at less than 572 degrees Fahrenheit, while maintaining the quality achieved at higher temperatures in modern commercial manufacturing.

It is the first time researchers have densified barium titanate in a single step using cold sintering. Previous attempts required secondary heating to produce materials with useful dielectric properties.

"This research shows that materials that were previously difficult to sinter can now be done," said Clive Randall, director of the Material Research Institute, who led the development of cold sintering. "It takes us to the dream that we can eventually find the right chemistry to allow all ceramic materials, and maybe even metal materials, to be cold sintered." https://bit.ly/3msBjeD


NASA

Ice melt projections may underestimate Antarctic contribution to sea level rise

Fluctuations in the weather can have a significant impact on melting Antarctic ice, and models that do not include this factor can underestimate the global impact of sea level rise.

Models have not included the potential impacts of internal climate variability, like yearly and decadal fluctuations in the climate.

Researchers found that accounting for climate variability caused models to predict an additional 2.7 to 4.3 inches of sea level rise by 2100. The models projected roughly 10.6 to 14.9 inches of sea level rise during that same period without climate variability.

"We know ice sheets are melting as global temperatures increase, but uncertainties remain about how much and how fast that will happen," said Chris Forest, professor of climate dynamics. "Our findings shed new light on one area of uncertainty, suggesting climate variability has a significant impact on melting ice sheets and sea level rise." https://bit.ly/3obfH7a


USGS

New acid mine drainage treatment turns waste into valuable critical minerals

A new way to treat acid mine drainage could help transform the environmental pollution problem into an important domestic source of the critical rare earth elements needed to produce technology ranging from smart phones to fighter jets.

A team of Penn State scientists developed a two-stage treatment process that enabled them to recover higher concentrations of rare earth elements using smaller amounts of chemicals than previously possible.

"This research shows we can modify existing treatment processes in a way that not only addresses environmental concerns, but at the same time recovers valuable elements and actually decreases the cost of treatment, said Mohammad Rezaee, assistant professor of mining engineering. https://bit.ly/2Vh4Wnc

Shelter, safest air intake locations during urban pollution events identified

Roofs and the downwind sides of buildings in street canyons have the lowest levels of particulate matter during a single-source pollution event, according to Penn State researchers. These findings have implications for improving evacuation plans during a pollution release as well as for informing ventilation system design of urban buildings.

"Previous research has focused on ambient pollution created by traffic," said Jeremy Gernand, associate professor of industrial health and safety. "We decided to investigate sources of pollution from a point source of particulate matter, such as a chemical spill or an accidental release from a factory."

This marks the first study investigating an emission event from a single source near a street canyon. https://bit.ly/3qaZ65f

Pixabay

Don Davis

Fossil carbon burned by asteroid impact contributed to dinosaur extinction

An asteroid that crashed into Earth sixty-six million years ago, leaving behind the Chicxulub impact crater in the Yucatán Peninsula, just off the coast of Mexico, may have released trillions of pounds of partially burned fossil carbon into Earth's upper atmosphere as a cloud of black soot, significantly contributing to the ensuing global darkness, cooling, and mass extinction that wiped out the dinosaurs.

Traces of burned organic material are found in the global geologic record of the Chicxulub impact. Researchers analyzed burn markers, chemical compounds called polycyclic aromatic hydrocarbons (PAHs), and found the initial release of carbon came from a fossil source that experienced rapid heating. That is consistent with rock being ejected from the impact site and vaporized. PAH evidence indicates wildfires were present but less influential on global climate and extinction. https://bit.ly/3qnuhdJ

Over $10 million awarded for energy center

Penn State will receive more than $10 million from the U.S. Department of Energy as an Energy Frontier Research Center Award. This is one of ten awards announced in 2020, and the second EFRC awarded to Penn State researchers.

The research in the center will focus on discovery of new ferroelectric materials, probing the origins of ferroelectricity, developing tools to control the functional properties, growing tailored ferroelectrics at low temperatures, integrating the new materials into a variety of memory devices, and developing processes that allow these materials to be stacked in 3-D memory arrays. Susan Trolier-McKinstry, Evan Pugh University Professor and the Steward S. Flaschen Professor of Ceramic Science and Engineering, is the director. https://bit.ly/2JuHLTM

Knowledge of severe storm patterns may improve tornado warnings

Tornado warning times have improved during the last several decades, thanks in part to numerical modeling research and intensive field campaigns, but decision-makers often must rely on readily available information like radar data when issuing storm warnings. Previous efforts using conventional radar have struggled to distinguish between tornadic and nontornadic supercells.

Scientists analyzed radar data from more than a hundred supercell thunderstorms, the most prolific producers of violent tornadoes, and found a statistically significant difference in the structure of storms that produced a tornado and those that did not. Weather radar constantly monitors storms across the country, and data similar to that used in the study are readily available to operational forecasters who issue warnings.

"Identifying which storms are going to produce tornadoes and which are not has been a problem meteorologists have been trying to tackle for decades," said Scott Loeffler, a graduate student in the Department of Meteorology and Atmospheric Science. "This new research may give forecasters another tool in their toolbox to do just that." https://bit.ly/2Jt9HYD

Ocean color satellites reveal glacier algae, insights for climate models

The brownish-grey algae that darken the Greenland ice sheet in summer cause the ice to melt faster, but only recently have scientists measured these blooms in the field, and only at few sites.

To address this, Shujie Wang, assistant professor of geography, and her research team borrowed the methodology used to measure algae in water: ocean color satellites. Algae blooms on the ice sheet can alter the surface albedo of the ice and enhance surface melting.

Their findings showed that the ocean color satellite data was highly consistent with field measurements and can be used to quantify the distribution and abundance of ice algae. Incorporating satellite data is expected to improve regional climate models. https://bit.ly/37g0Q4c

Using minerals from ancient soils to reconstruct past climate

Nearly fifty-six million years ago, the Earth's atmospheric carbon dioxide levels ranged between 1,400 and 4,000 parts per million, giving rise to sauna-like conditions across the planet, which scientists can now measure using tiny minerals called siderites.

Tim White, research professor in the Environmental Systems Institute, and an international team of researchers used siderite minerals to reconstruct the Earth's past climate.

The researchers found that the mean annual air temperature at the equator where Colombia lies today was around 106 degrees Fahrenheit. Farther north in Arctic Siberia, the average summer temperature was 73 degrees F. They also discovered that the tropics and higher latitudes would have had very high atmospheric humidity levels. Their findings suggest that today's ongoing global warming goes hand in hand with increased transport of moisture and, by extension, heat in the atmosphere. https://bit.ly/3ofyApv

Penn State launches master's degree in spatial data science

More and more companies are using location data from devices like smartphones and tablets to gain insights into choices consumers make. As the volume and complexity of location data increases, the demand for the professionals with the technical skills to leverage these data is also increasing.

A new degree in spatial data science aims to address that growing need.

Anthony Robinson, associate professor of geography and director of online geospatial education programs said students will take courses in programming, computer science, and spatial data science.

Robinson said a key part of the program for students is learning to customize mapmaking software to resolve a need that generic solutions cannot address. For instance, he said, a government agency may need a mapping dashboard that visualizes hospital and COVID-19 testing data to share with the public, the media, lawmakers, or other stakeholders. The data to populate the dashboard would come from different sources and need to be fused together to make it visually effective.
https://bit.ly/3qxCD2b

Bingo offers students in isolation and quarantine fun, engagement

B15 ... B3 ... B11 ... I17 ... G60 ... O62 ... 067 ... O70 — BINGO!

The sounds of people clapping and cheering aren't something normally associated with students residing in quarantine and isolation for COVID-19, but a new Thursday night tradition helped Penn State students through their quarantine and isolation time at the University Park campus.

Lee Kump, John Leone Dean, and his wife Michelle, pitched the idea of doing a bingo night via Zoom to support students in quarantine and isolation.

"We didn't want to just host a game—we wanted to do something that was fun, enjoyable, and surprising," said Kump.

The couple went to work, enlisting a few University leaders to serve as celebrity guest callers, including Penn State President Eric Barron, Vice President for Intercollegiate Athletics Sandy Barbour and Vice President for Student Affairs Damon Sims.

The bingo games continued until on-campus students left for the Thanksgiving break.

Deans from other academic colleges joined as guest callers, along with a surprise appearance by former Penn State quarterback Trace McSorley.
https://bit.ly/37G4VPq

Molina named Sloan Scholar

Alex Molina, a doctoral student in materials science and engineering, was named a Sloan Scholar. The goal of the Sloan Foundation-funded program is to diversify the U.S. doctoral degree-holding workforce.

"As a man of Colombian heritage, I am proud to be the first first-generation student in my family to reach for a Ph.D.," Molino said. "I am thankful to Penn State and the Sloan Foundation for providing this opportunity." https://bit.ly/3qsk5Rb

Student-led glass conference spotlights work of young researchers

For students, losing the opportunity to attend summer conferences due to the COVID-19 pandemic meant even fewer chances to advance their academic careers. Students typically have just a few years to attend, present their research, and find areas of interest they'd like to specialize in.

That was the driving force behind the Young Researchers Glass Conference, a virtual conference organized by Collin Wilkinson and Rebecca Welch, both doctoral candidates in materials science and engineering, for scientists in the glass research community.

The result was a virtual conference in July where sixty-five undergraduate and graduate attendees and early career researchers from across the globe presented cutting-edge glass research and had the opportunity to connect with others in the field.

"We created the conference with the ultimate goal of bringing the glass community together by showcasing research from students and researchers who were young in their careers," Welch said.

"Often, student presentations get overshadowed by leading experts in their field, especially undergraduates who may be presenting their research for the first time. With our conference, we wanted a comfortable environment for them so that they felt less intimidated in both presenting as well as asking questions."

https://bit.ly/3qtuHiD

Online certificate program graduates first students

The Weather and Climate Analytics program aims to help students tap into the wealth of real-time and historical weather data available today and to develop analytical tools they can use to answer scientific questions.

The program's first graduate, Jessica Levine, works for the National Oceanic and Atmospheric Administration analyzing satellite images to help monitor weather events.

Despite a busy work schedule, Levine wanted to further her education, and said the weather and climate analytics program offered valuable flexibility.

"I wanted to get my feet wet, and once I got hooked into this program, it was so flexible that it fit into my ever-changing shift schedule," she said. "I didn't feel like I had to have Tuesday off at noon to go to class for two hours."

https://bit.ly/2VUZp6l

College boasts six new NSF graduate researchers

Eighteen students were named National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) recipients for the 2020-21 academic year. A third of them are students in the college.

The six graduate students are Jeremy Diaz, geography; Karen Pham, geosciences; and Katelyn Kirchner, Patrick Rondomanski, Nicholas Trainor, and Rebecca Welch, all in materials science and engineering.

https://bit.ly/33OAANv

Kelly Núñez Ocasio named Sloan Scholar

Kelly Núñez Ocasio, a doctoral candidate in meteorology and atmospheric science, studies how tropical cyclones form and hopes to help places like Puerto Rico, where she was raised, better prepare for these devastating storms.

Núñez Ocasio said the honor means more to her than just the funding the scholarship provides. "It's my responsibility as a Latina to help younger generations and build a community of scientists that is diverse and that is equal."

https://bit.ly/3qHfWZI

Scholarship created in honor of Juan Garcia

The college created the Juan Garcia Educational Equity Scholarship in honor of Juan Garcia, who died June 30 of respiratory failure and COVID-19.

Garcia, a 21-year-old from Allentown, Pennsylvania, was majoring in energy business and finance with a minor in entrepreneurship and innovation.

https://bit.ly/33Pnfol

Weather Risk Management Club stays connected, examines pandemic impacts remotely

Members of the Weather Risk Management Club know severe weather never stops, even during a pandemic. The group meet via Zoom, carrying on their work examining the impacts of severe weather events on the economy.

"These are unprecedented times," said club member Andrew Mardirossian. "We, as weather risk students, can learn so much from this from how companies are handling the situation to what Penn State graduates out in the workforce are experiencing."

Weather risk professionals examine the impacts of weather on industries like energy, agriculture, insurance, construction, retail, and transportation.

The COVID-19 crisis, and its far reaching impacts, provides an important case study of a financial "Black Swan" event, or a rare, unpredictable event with potentially severe consequences, said George Young, professor of meteorology and the club's adviser.

"It gets the students thinking and talking about how to incorporate Black Swan resilience into weather-related markets and infrastructure," Young said.

Before the COVID-19 pandemic, the club saw an example of the far-reaching impact of weather risk professionals when they toured the facilities of an international candy manufacturer. The company employs an in-house meteorologist who helps determine the best time to buy peanuts or cocoa in bulk.

"It just goes to show how the weather affects everything, even if you don't think about it," Mardirossian said.

https://bit.ly/2JELNtd

Right: Penn State's Weather Risk Management Club visiting Mars before the COVID-19 pandemic.

The making of VIRAL MAPS

Researchers delve into dark waters of news cartography used to misinform public

by David Kubarek

Earlier this year, in more normal times, Anthony Robinson was among a handful of panelists for a symposium titled "Hacking the U.S. Election," which aired on C-SPAN.

His research on how maps are routinely used to both inform and misinform people—a visually appealing form of real and fake news—caught the attention of many of those in attendance, including Tom Ridge, the inaugural head of the Department of Homeland Security (DHS) and former Pennsylvania governor, who was featured at the event organized by Penn State's Institute for Computational and Data Sciences and Dickinson Law.

"Afterwards, he came up to talk and was like 'wow,' " said Robinson, associate professor of geography and director of Online Geospatial Education Programs at Penn State. "He started DHS. He worked in emergency management. He approaches my work with a lot of context. And he was surprised to the extent that maps can be used to misinform."

On maps that go viral, Robinson's research is two-pronged. He wants to better understand what causes them to go viral to get a handle on who is creating maps that misinform and for what purpose. He also wants to chart elements that promote popular maps to improve their power to inform.

Maps, after all, are designed to inform.

"There is a simultaneous problem of maps being a powerful way to inform, yet only if it's done well. People need to consider the source of the data and know that even great mapmakers are making editorial decisions as they boil down complex problems into simplified visual elements."

~Anthony Robinson

His research lays out a framework for understanding what a viral map is, how we can define it, how we can verify its origin and data, and how we can learn from it. He looks at criteria such as a map's purpose, audience, content, social engagement, and visual variables, and uses machine learning to automate the process of analyzing the contents and potential origins of viral maps and the maps they have inspired. Many viral maps, he said, spawn a myriad of offshoots that themselves often go viral.

The research began in response to the 2016 election when the FiveThirtyEight map "What if only Women Voted" went viral, spawning more than 500 offshoots, some with seemingly malicious or misinformation purposes. Robinson and his team used machine learning tools such as Google Cloud Vision to analyze these variations and created the site MapReverse.org to visualize these trends.

Tracking the trajectory

Robinson and GeoVISTA postdoctoral researcher Xi Zhu created MapReverse to look at maps shared in social media to uncover their potential sources and derivatives. It combines visualization with machine learning techniques to track when and where maps are published. It can also spot variations in a map.

"Because MapReverse relies on tools still under development and requires advanced computational resources, the project is still in its initial stage," Zhu said. "We envision that the system can one day provide customized and real-time viral map data that shows where the map originated and its path to going viral."

One example Robinson looked at was the "Try to Impeach This" map that went viral after being shared in 2019 by Lara Trump, the daughter-in-law and campaign adviser of President Donald Trump. Robinson's tools noted the map first appeared on a blogger's website but portions of the map were altered in late 2016 in a now removed story by the Huffington Post, according to CNN. The Huffington Post map contained counties won by Hillary Clinton modified to appear in red, indicating a victory for Trump. MapReverse shows that the inaccurate map was the one that went viral.

One map that went viral in 2019 was the "Try to Impeach This" map. Researchers used tools to spot the point in which the map went viral and was altered to give inaccurate voting results.

Another viral map, one claiming to portray the flight routes of 60,000 Wuhan residents during the COVID-19 pandemic, originated in a tweet from researchers at the University of Southampton. Further posts clarified that the map was merely an illustration—gleaned from a 2017 map created to show global air traffic patterns—but that didn't stop major international news outlets such as the United Kingdom's Sun and Daily Mail from sharing it.

> *"You can imagine a scenario where this can cause real harm."*
> *~Anthony Robinson*

Robinson has also looked at viral maps depicting the Australian wildfires, the radioactive fallout of the Fukushima Daiichi Nuclear Power Plant meltdown, and the probable path of Hurricane Dorian in 2019.

Dangers of misinformation

People often approach textual information with more scrutiny than they do visualizations such as maps, Robinson said. The lack of civil awareness is concerning, he said.

"Thematic maps are really hard in this context and a lot of what people see in social media are thematic maps," Robinson said. "There is a simultaneous problem of maps being a powerful way to inform, yet only if it's done well. People need to consider the source of the data and know that even great

mapmakers are making editorial decisions as they boil down complex problems into simplified visual elements."

Maps can be used for laughs, like the viral and sarcastic Thanksgiving Day Pie by Region map that pits key lime pie in the heart of Texas and pecan pie across the Northeast.

It can also be downright dangerous.

"You can imagine a scenario in which this can cause real harm," Robinson said. "Let's say that there needs to be an evacuation due to a wildfire. And officials release the evacuation route. Then someone else enters that situation and makes a credible looking map that shows a different way out. A bad actor could potentially be much faster or more savvy about getting the word out. That's a pretty scary scenario and a really plausible one."

On social media sites, disinformation like this is already happening. In September, *The New York Times* reported that some Oregon residents refused to leave their homes over false rumors that the group Antifa started the fires as a distraction and a way to loot residents' homes.

The role of social media

Robinson remembers a time where the very act of making a map and publishing it took time, effort and means. But that's different with easy access to digital tools. However, easily creating maps is nothing without social media, a driver that allows anyone to reach millions of people.

Robinson said social media platforms such as Facebook and Twitter are tuned into this and are sponsoring research aimed at stamping out misinformation, including via maps. But only to a point. There's a danger, he said, when companies are able to create massive channels of communication without independent research that can peek behind the curtains.

"My research is something that Facebook might not want to deal with," Robinson said. "They've done pretty well with people knowing little about what they do."

Facebook offers little data—even anonymized—for researchers to study the patterns of misinformation. Twitter, he said, releases more data and is a major focus of his research. By design, apps like SnapChat, WhatsApp, and TikTok release no information about what is shared for research purposes.

"A really big challenge here is that we're limited by the channels we can look at, at least on the research level," Robinson said. On some of these popular social media channels there's an enormous amount of communication happening that folks outside those companies have almost no access to."

The future of map research

Robinson's team has laid out a proof of concept. The next step will be securing the funding and enhancing the technology. In the same fashion that experts are following the trail of fake news to its source, Robinson wants to do the same for maps.

And each election means a steady stream of new maps to analyze.

Some questions he hopes to answer: Who is sharing these misleading maps? For what purpose are they being altered? How are they evolving?

He also hopes to raise public awareness as he did on C-SPAN. His research hits hardest among the masses of people whose news sources aren't primarily academic journals.

"Scientists and academics need to figure out what it is that draws people into our research and tell our stories in ways that leverage some of those perceptual and emotional cues used in news and maps that go viral. Because otherwise we're facing an onslaught of entertainment information," Robinson said. "And there's no way to compete with that if you just stay in your lane. If you only write papers, it doesn't land with the people who need to hear it most." ⌘

This map was originally meant to be an illustration but was quickly labeled as a map of the flight patterns of 60,000 Wuhan, China, residents amid the COVID-19 pandemic. It was shared on major news outlets before being retracted.

FROM LEAVES TO SOLAR CELLS

Biological materials boost the next generation of solar technology

by Matthew Carroll

Shashank Priya sees a future where instead of throwing away broken electronics, those devices heal themselves, and where machines evolve, even changing their form and function, to adapt to the task at hand.

It might sound like of the stuff of science fiction.

But if the technology becomes reality, it may be in part because of innovative research happening in Priya's laboratory, where scientists are combining biological and artificial materials on the molecular level to create new biophysics.

"If you think about the biological world, there are attractive properties like how we can heal from a cut, or build more muscle as we do work," said Priya, professor of materials science and engineering and an associate vice president for research. "We think it's possible to transfer a lot of these advantages into the artificial world."

Priya and his team are using biohybrid materials to boost the performance and stability of next-generation solar cells. By adding biological materials like proteins and DNA, the scientists aim to create more efficient, stable, and environmentally friendly solar technology than what exists today.

And with an almost inexhaustible bank of biological materials to choose from, the team's molecular approach could open doors to advances in other areas like sensing, energy conversion, photodetectors, and neuromorphic computing, Priya said.

"If we can merge these two worlds together, the biological and the artificial, we can create new properties that are impossible to achieve in the artificial form only," Priya said. "These kinds of hybrid materials could provide a new direction for people to do research and develop next-generation devices that are more interactive, adaptive, and long-lasting."

Mimicking nature

Outside Priya's office, elms shade the Old Main lawn in the heart of the Penn State University Park campus. Their leaves are hard at work turning energy from the sunlight into food for the historic trees.

Priya, whose team designs and manufactures cutting-edge solar material, was inspired by what's outside his window to experiment with biohybrid materials in his lab.

"The photosynthesis process used by leaves has been able to support the energetic needs of plants in all weather conditions and maintain consistent performance for decades," Priya said. "This is still challenging to achieve in traditional solar cells, and we thought, 'what if we can find a way to take some of these advantages to boost the performance of this technology.'"

Traditional solar cells, often found on roofs or in large arrays in fields, are made with silicon, but scientists believe they are approaching the saturation limits of this technology.

Perovskite solar cells, named for their unique crystal structure, have become an area of intense research because they have shown promise to be more

Pixabay

efficient at converting sunlight to electricity and less expensive to produce. But the devices are not stable enough for real-world applications.

Turning to biomaterials, Priya and his team have made a string of advances, including a study published in *ACS Energy Letters* that found wrapping perovskite material in a DNA shell boosted efficiency and dramatically reduced costs, and a study published in *Nano Energy* that found an anti-malaria drug can substantially improve the stability of these solar cells.

"By borrowing from nature, we can find biological materials that boost solar cell performance and allow us to develop cheaper, more environmentally friendly technology," Priya said. "In the future, we may essentially replace some expensive chemicals inside solar cells with relatively cheaper natural materials."

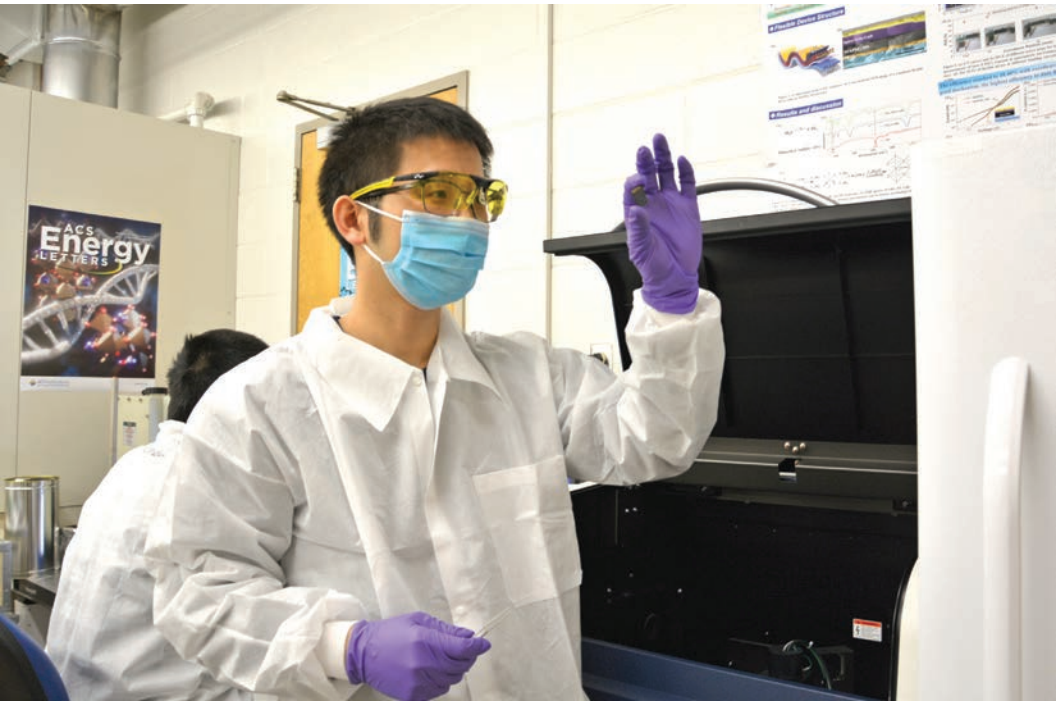
Commercial solar arrays consist of hundreds or thousands of individual solar cells, and even small technological improvements can add up to make a significant impact.

Advancing the technology may be even more important as individuals, businesses, and countries look increasingly at renewable energy sources to offset the impacts of climate change.

"By borrowing from nature, we can find biological materials that boost solar cell performance and allow us to develop cheaper, more environmentally friendly technology."

~Shashank Priya

"Professor Priya's research bridges the gap between discovering new materials with interesting properties and utilizing these materials in inexpensive devices that are typically powered by non-traditional sources of energy," said Susan Sinnott, professor and department head of materials science and engineering. "This research is important because he is translating materials development and discovery to products that will improve people's lives."



Kai Wang, assistant research professor, works with materials that can be inserted into next generation solar cells to improve their efficiency.

Finding solar's future in unexpected places

Despite concerted efforts to eradicate the scourge, millions around the world are stricken with malaria every year.

Doctors often turn to the drug Artemisinin (ART) as a front-line treatment. It is credited with saving millions of lives, and the researcher who discovered its benefits earned a Nobel Prize for her work in 2015.

That's not bad for a medicine derived from a humble herb, the sweet wormwood. But it turns out extracts from the plant may have other, unexpected benefits.

Priya and team found that adding ART to perovskite solar cells addressed a major issue with the technology—how long the solar cells can survive in real-world settings—without compromising their energy-production efficiency.

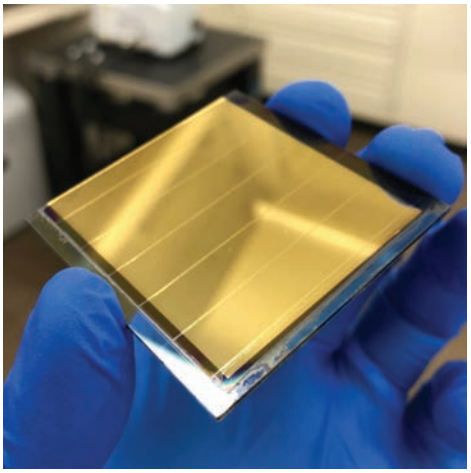
"The major issue in the ongoing perovskite photovoltaic research is their lifetime, which is at a weekly-level due to the material's intrinsic issue: the perovskite crystal is not stable in the ambient environment," said Kai Wang, an assistant research professor and member of Priya's lab. "We thought the functional chemical groups in some biomaterials, like ART, may help heal the vulnerable perovskite."

When placed in a liquid solution, the perovskite and ART automatically bonded and formed a packaging-like layer that protected the biohybrid from up to 90 percent of the water.

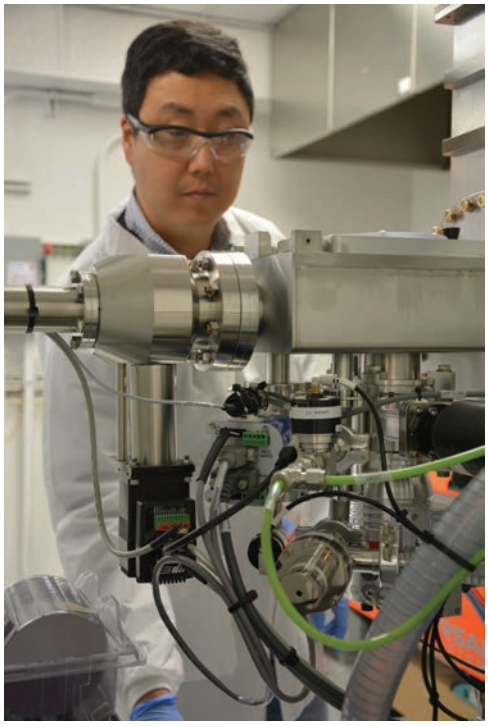
This discovery could protect perovskite solar cells from being degraded by moisture or humidity in real-world applications. The solar cells in the study retained 95 percent efficiency after a one-month deployment, the scientists reported in the journal *Nano Energy*.

Priya's research related to biophysics has been funded by the Biophysics program at Air Force Office of Scientific Research and his research related to energy conversion has been supported through National Science Foundation Industry/University Cooperative Research Center for Energy Harvesting Materials and Systems.

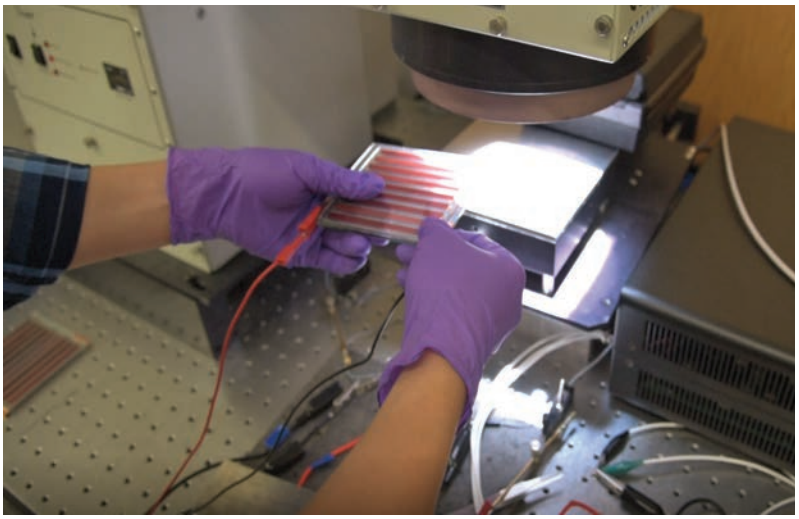
"Finding the right molecules from nature could be a much more efficient way than creating them from scratch if both could lead to the same result," Wang said. "And nature has already provided us this bank through millions of years of evolution. Collaborating with nature looks like an efficient way to accelerate our research." ⌘



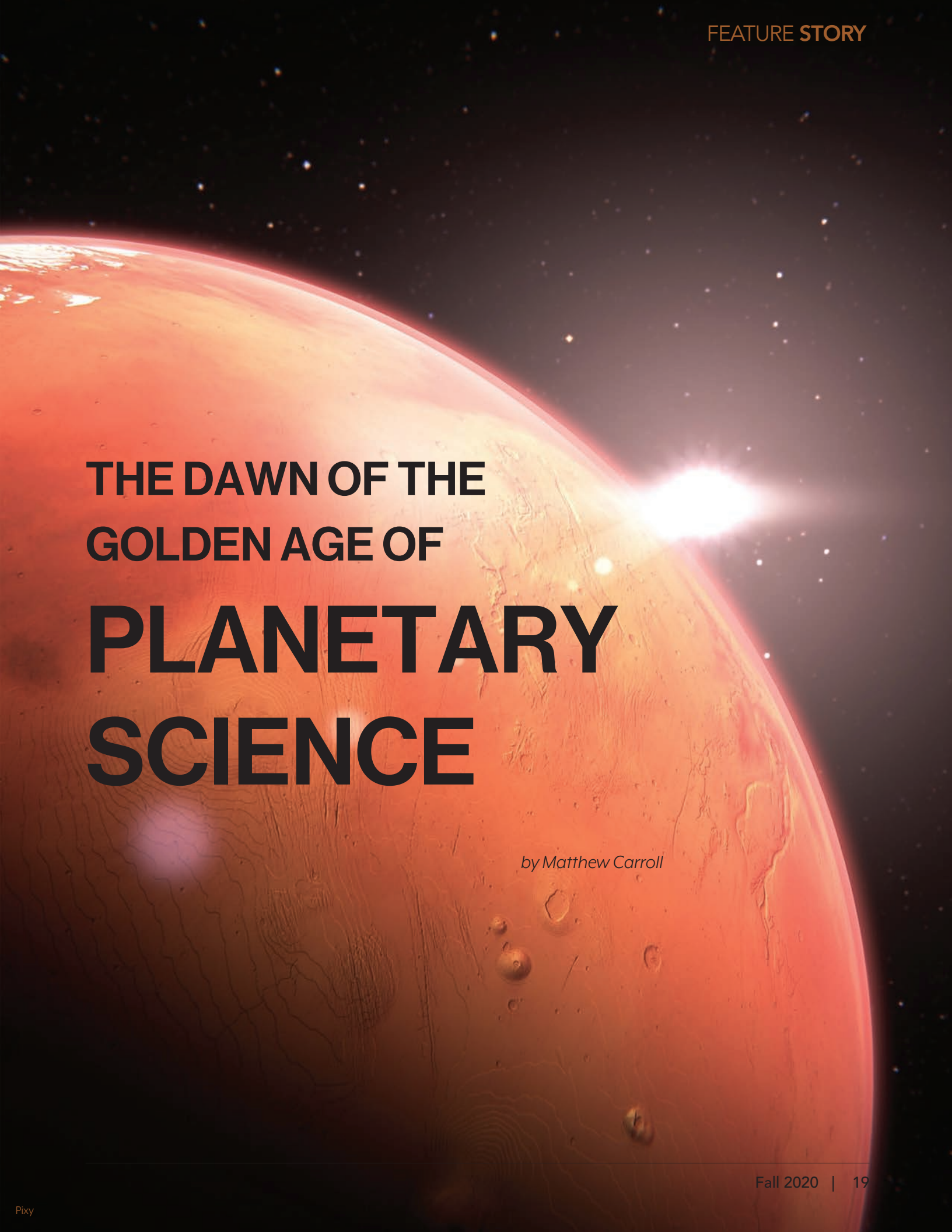
LEFT: Perovskite solar cells are an area of intense research due to their potential to offer a more efficient and less expensive alternative to traditional silicon-based solar technology.



ABOVE: Min-Gyu Kang, assistant research professor, operates equipment in Priya's laboratory that deposits thin films of functional materials on solar cells.



ABOVE: A solar simulator, capable of simulating natural light, is used to measure the performance of solar cells and modules.



THE DAWN OF THE GOLDEN AGE OF PLANETARY SCIENCE

by Matthew Carroll

Pixy

One Friday this fall, a sleepy home on a tree-lined street blocks from the Penn State University Park campus became mission control.

In a small office just off his family's living room, Christopher House studied a rust-red landscape on a large computer screen, conferred with colleagues from around the world on his laptop via video chat and helped plan a string of commands that would travel even farther.

The instructions raced some forty million miles away —straight to the surface of Mars and to the $2.5 billion marvel of engineering and science waiting for its daily agenda.

House, a professor of geosciences, is a science theme lead on the NASA Mars Curiosity rover mission, led by the Jet Propulsion Laboratory in Southern California. Several times a month, he leads the team charged with planning the rover's science tasks for the following Martian day.

"Each time we drive, we wake up to an entirely new field of view with new rocks and new scientific questions to ask," House said. "When we review these photos during our planning session, it's sort of a whole new world each time."

Launched in 2011, the NASA mission to explore Mars' Gale crater is among a fury of space exploration activity in the past decade. Probes are exploring the Moon, Mercury, Venus, Mars, asteroids and comets, and the outer solar system. NASA alone spends more than $1 billion annually on planetary science, and companies like SpaceX and Blue Origin are pioneering commercial space flight.

These missions increasingly turn to scientists like House, who has long studied ancient Earth and the conditions that gave rise to life on our planet, to apply their expertise to other worlds.

It's an exciting time to be a geoscientist.

"This is the golden age of planetary science," House said. "I hope that universally everybody can appreciate how phenomenal it is that we send these sophisticated robots across the solar system."

Christopher House reviews fresh images from the surface of Mars provided by the NASA Mars Curiosity rover, and chats with scientists around the world charged with planning the rover's movements for the next Martian day.

> *"This is the golden age of planetary science. I hope that universally everybody can appreciate how phenomenal it is that we send these sophisticated robots across the solar system."*
>
> *~Chris House*

To boldly go ...

If planetary science is experiencing a golden age, Penn State is doing its part to rise to the occasion.

The University launched the Consortium for Planetary and Exoplanetary Sciences and Technology this fall to focus efforts on studying how planets form, evolve, and become habitable, and on detecting and potentially exploring these worlds.

Leading experts in geosciences, meteorology and atmospheric science, materials science and engineering, astronomy, and engineering will collaborate to lead space missions and develop equipment used on those projects.

"Penn State already has many of the pieces in place to establish a world-class planetary science

program," said James Kasting, Evan Pugh University Professor of Geosciences and inaugural director of the consortium. "The consortium offers a unique opportunity to coordinate our efforts and to become a leader in the emerging field of planetary system science. Together, we can address some of the most fundamental questions asked by humans."

Penn State geoscientists study everything from how life thrives in some of the most extreme places on Earth, like thermal vents at the bottom of the oceans, to the locations of "goldilocks zones" in the cosmos where we may find we are not alone.

Kasting played an important role in developing the concept of these habitable zones, or areas around stars that may have conditions ideal to support liquid water and perhaps life. For him, the search for life in our solar system and around distant stars is the ultimate goal.

"Even if we search the cosmos and come up with a negative result, if we see a bunch of Earth-like planets and none of them have life, we'll know we hold a very special place in the universe," Kasting said. "But I was a fan of Carl Sagan growing up, and Sagan was much more optimistic than that. And I'm more optimistic also."

Life on Mars?

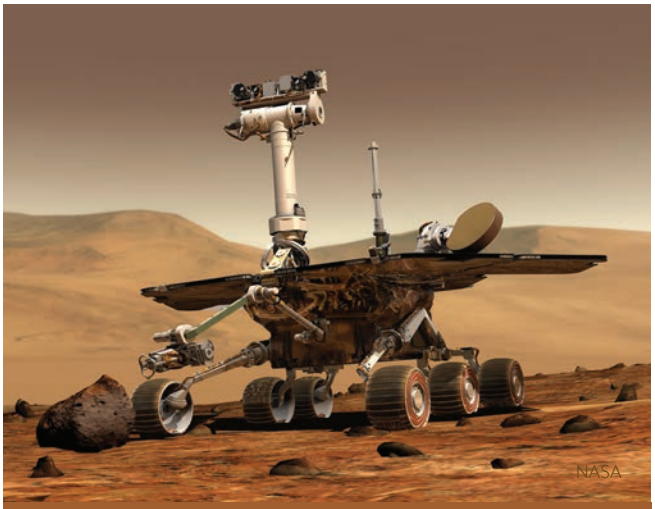
On its year-long trip up and then back down Mars' Vera Rubin Ridge, the Curiosity rover made an unplanned pit stop.

House and his colleagues noticed something strange in the latest images. On an ancient lakebed dominated by mudstone, they saw small, black, stick-like features dotting the landscape. A one-day stop turned into a week.

Curiosity snapped photos and tested samples with its onboard laboratory. The data showed the sticks were ancient iron deposits that told a complex story of liquid that lasted many millions of years on the red planet.

"That's really important because it illustrates the geological cycles and the hydrogeological cycles on Mars were persistent," House said. "This was not a story about how Mars had water one time and then didn't. Like Earth, it was a long-term, multiple-step cycle."

Scientists pieced together the story: the lakebed lasted perhaps ten million years before being buried and turned to rock, and then later flowing



NASA's Curiosity's mission is to determine whether the Red Planet ever was, or is, habitable to microbial life. The rover, which is about the size of a MINI Cooper, is equipped with seventeen cameras and a robotic arm containing a suite of specialized laboratory-like tools and instruments.

Christopher House, science theme lead on the NASA Mars Curiosity rover mission, is pictured with the test-bed Mars rover at NASA's Jet Propulsion Laboratory. He also serves as a lead for the sedimentology and stratigraphy team, which studies the rock layers on the Martian surface to interpret the environment in which they formed.

House also is the director of the NASA Pennsylvania Space Grant Consortium based at Penn State.

water leached iron from the rock, mobilized it and redeposited as the black sticks.

"What we're really learning is there was a complex history on Mars that involved water at every step," House said. "And the diverse chemistry in those fluids points to a habitable world some 3.5 billion years ago."

Future missions will be tasked with finding direct evidence of past microbial life.

Mars 2020 Perseverance Rover, which launched in July, can collect and store samples that a future mission may return to Earth. Elsewhere, space missions are working to bring samples of asteroids back to laboratories around the world.

Back on Earth, scientists like Katherine Freeman are studying isotopes, or different forms of atoms, in small organic compounds to better understand whether they carry signatures of biotic or abiotic processes.

"I'm an organic geochemist who has spent my career studying organic molecules preserved in sediments and rocks on Earth, and suddenly there is a whole new world of organic chemistry to potentially explore," said Freeman, Evan Pugh University Professor of Geosciences. "It's truly an exciting time."

Freeman serves as director of the NASA-funded Astrobiology Center for Isotopologue Research at Penn State, a new international collaboration that uses cutting-edge observational and computational tools to study these isotopic fingerprints.

Her lab is working to increase the sensitivity of the instruments so they can extract information from the trace amounts of elements found in Martian soil samples.

"There's not a lot of organic carbon on Mars—it's pretty red for a reason," Freeman said. "The things future missions bring back will be very low in concentration, so we need to be ready to make measurements on very trace amounts of carbon to help us understand its origins."

Macalady exploring the Frasassi Caves in Italy hoping to identify a biosignature that would be relevant to an actual mission to Mars—key to detecting life on other planets.

The pale blue dot

Step into the cool, damp cave where slime grows on the walls in the darkness and where sulfur is on the menu, and you may not recognize Earth.

"Conditions underground are more similar to a planet that we're only getting to know now, which is the early Earth," said Jennifer Macalady, an associate professor of geosciences. "I really think about it as a different planet entirely, because it's evolved so far away from its initial state."

Macalady is an explorer. She steps into some of the most extreme environments on Earth, like caves that contain some of the planet's most unusual lifeforms.

"What's special is you can go in there and manipulate things without a robotic arm, or a submersible or a spaceship," she said. "Yet it's still like being on another planet."

In an Italian cave affectionately known as the "slime palace," colonies of microbes—some that look like goo and others that resemble soil—cover the walls, thriving away from sunlight and photosynthesis.

The organisms can help scientists better understand life on early Earth, as those organisms had not yet learned to harvest photons through photosynthesis. Humble microbes dominated much of history of life on Earth, and so these tiny organisms are what we might expect to find on other worlds.

"I tell my students; Earth was microscopic life for eight-ninths of its history," Macalady said. "It's just the last blip that you can even see something with your naked eye. And if we don't understand what early Earth was like, how will we know where to look elsewhere?" ⌘

GETTING THEIR FEET WET, VIRTUALLY

FACULTY, INDUSTRY LEADERS SPRING TOGETHER FOR ENERGY RESEARCH INTERNSHIP OPPORTUNITIES

by David Kubarek

When COVID-19 hit, Collin Herndon, a senior majoring in petroleum and natural gas engineering, watched as his summer internship prospects quickly plummeted.

Gone were the hopes of in-person experiences. Energy companies, too, were jolted by record declines in energy prices.

But thanks to swift action by leaders in the John and Willie Leone Family Department of Energy and Mineral Engineering (EME) and several industry partners, things quickly turned around.

Herndon instead spent his summer working for Berry Petroleum assessing the secondary extraction viability for a well in the Uinta Basin in Utah. He worked closely with Hamid Emami-Meybodi, assistant professor of petroleum and natural gas engineering, and Penn State alum Manik Singh, reservoir engineer at Berry Petroleum.

He was one of twenty-five students who took advantage of one of many virtual experiences created and funded through EME and open to all majors within the department.

Herndon created a numerical model that looked at several geological factors such as permeability and rock fractures. Analyzing the results, he found that the production of Berry Petroleum's wells—now in the primary phase of oil extraction—would increase during secondary extraction through the help of cyclic steam injection.

Berry Petroleum said his findings will prompt them to conduct more field tests. Traditionally, wells that increase production through fracturing are thought of as prime candidates for secondary oil extraction.

"This experience has been pretty great because I've been able to accomplish things that I didn't even know where possible," Herndon said. "I had never worked with the software I was using. I wasn't sure that this could even be done like this remotely and that was actually pretty impressive."

Things turned out so well for Herndon that he was asked by Berry to expand the internship with additional hours and continue during the fall semester.

"I want to stay involved with the company and my industry and faculty mentors so that we can get the best results possible," Herndon said. "I'd love to see the benefits of the work I've been doing all summer."

Creating the experience

This is the kind of experience that Sanjay Srinivasan, head of EME, hoped for when he worked with colleagues and industry leaders to create the internship program. That's something he started while teaching at the University of Texas at Austin. There, he saw how the internship program aided students and promoted industry connections. He watched it grow from a handful of internships to about thirty, buoyed by a $5 million endowment from an alum.

A global pandemic—and requests from faculty members—just pushed up his timeline.

"I wanted to do this, and also expressed to the companies that we are really doing it also to support them, too, because they're also reeling from this pandemic," Srinivasan said. "We want industry leaders to stay engaged with our students. One of the useful things about the internships is that it allows the companies to assess different students and see who might be the best fit for their organization. And that's a relationship that can only be created through professional interactions."

Srinivasan, who entered the workforce during another period of tumultuous times in the energy sector, said it's important for students to make these connections and to diversify their skills while at Penn State.

"Our students learn early on that it's important to diversify," Srinivasan said. "They find work at Wall Street companies. They find work in environmental consulting companies. They find work in general engineering contractor companies. I think this is true about all professions and more true about ours. We need to make sure that our students get out with a broad set of skills that can be applicable to many areas, not just one area."

Out-of-the-box experiences

Energy companies, too, are diversifying.

And Ariadna Walsh, a senior majoring in energy engineering, was part of that transition. She worked with Athanasios Karamalidis, assistant professor of environmental systems engineering, and Schlumberger to look at how rare earth elements (REE) can be extracted from waste more efficiently.

These elements are essential for a range of electronics and other applications and can be harmful, so removing them from waste is a win-win.

Walsh pored over research articles and consulted with Karamalidis on his membrane separation techniques to help guide Schlumberger on how best to improve REE extraction.

"We looked at a lot of different techniques and using membranes—particularly polymer inclusion membranes—greatly enhances the process," Walsh said "But that's at research scale. We need to look at sizing these techniques up to industrial scale while also improving the stability of liquid membranes."

Isaac Ciprich, a senior majoring in petroleum and natural gas engineering, also found a chance to fine-tune his engineering skills.

He worked with Berry Petroleum—and well data he originally explored in the classroom—to look at improving oil extraction. Ciprich met virtually with Luis Ayala, William A. Fustos Family Professor in EME, Kristy Whitaker, earth sciences technical manager at Berry Petroleum, and Singh.

Ciprich used industry software to explore the well production for the next five years for a reservoir in Bakersfield, California. He fed data into his model and when the data wasn't available, he calculated estimates for it using similar wells.

Because each well is different, Ciprich said, the approach relies on a lot of human input. The process gave him a chance to explore the research side of things as he fine-tunes his career ambitions.

"I was really grateful for this research internship because it gave me experiences with the various software programs companies use," Ciprich said. And it didn't seem like a job. It seemed more like a learning experience with tools that I'll most likely be using in my career."

Future engineers adapt

Students praised faculty and industry leaders for establishing such relevant and insightful opportunities so quickly.

For some, the change of plans amounted to a chance to explore an area they hadn't planned on. It tested their ability to adapt, to diversify, and even to see how their work makes a difference.

"What sold me on this career is that you're able to turn research and data into an actual product," Herndon said. "We're turning data into fuel that can be used to heat homes, drive cars, and countless other things because the uses for oil are so vast." ⌘

Summer research internship examining capacity markets

Mitchell Reel, who graduated in December, spent his summer research internship investigating capacity markets operated by the New York Independent System Operator (NYISO).

"Capacity markets pay generators to maintain availability for future dates to incentivize the development of generating capacity," Reel said. "This ensures that when electricity demand peaks, the grid does not experience a blackout."

Reel said the experience opened doors for his future.

"Previously, I had focused on a career within the natural gas midstream industry," Reel said. "My internship made me aware of many opportunities outside of the pipeline business for liquids and natural gas."

Reel's adviser was Andy Kleit, professor of energy and environmental economics. Reel earned a degree in energy business and finance with a minor in land management. He works for Direct Energy as a pricing analyst. ⌘

INTERDISCIPLINARY TEAM COMBATS

AIR QUALITY ISSUES IN AFRICA

by David Kubarek

When Gregory Jenkins calls up a map of real-time air quality data around the globe, it's yet another example of the haves and the have-nots. The seemingly endless dots of data points that blanket the globe trail off as you view Africa.

Those African nations—particularly along the west coast—are home to some of the world's worst air quality due largely to biomass burning and Sahara Desert dust events. It's also home to high rates of respiratory illnesses such as asthma, bronchitis, chronic obstructive pulmonary disease, and meningitis. And yet it's so sparsely monitored.

Jenkins, a professor of meteorology and atmospheric science, geography, and African studies, sees this problem through the lens of a scientist. He views it as an opportunity to enhance air quality monitoring in the region and to build on forecasting dust events; a chance to illuminate the public health implications of poor air quality in countries with some of the fastest growing populations, according to the United Nations; and a way to use the science of forecasting storms to save lives in yet another way.

Jenkins, who has spent decades researching this region, says it's more than science—it's also a matter of social justice.

"I've always been interested in West Africa from a climate and weather standpoint," Jenkins said. "But I'm also interested in using our knowledge to better the lives of those who may not have the means."

That's what prompted Jenkins about five years ago to form an international team of experts tasked with improving air quality assessments, forecasting, and public health outcomes for West Africa.

Jenkins works with partner universities to install air quality monitoring equipment. These partnerships promote research ties and also involve local institutions in maintaining these devices. Particularly in a time of a global pandemic, it's difficult to troubleshoot devices that are thousands of miles away.

He also works with Penn State experts in public health, medicine, and architectural engineering.

The team has installed many devices across Senegal. In addition to monitoring air quality, they are also used to calibrate dust storm models, which Jenkins' team has run for more than six decades. Satellite observations are used to further fine tune the models. The team also uses a spatula technique to determine which pathogens are hitching a ride on the dust into human lungs.

Forecasting dust events

Much like a jogger in Los Angeles might check the morning air quality report, Jenkins hopes to help establish a warning system in West Africa. Fine-tuning dust models can do just that.

If his team can provide reliable models—and connect the dots between dust events and poor health outcomes—that could prompt residents to change their behavior when air quality is bad. Another focus of research for the team is indoor air quality because many residents use wood and other fuels for cooking.

So far, the research points to dangerous exposure for the region's residents.

In a 2015-16 study, the team observed air deemed unhealthy by U.S. Environmental Protection Agency (EPA) standards more than 90 percent of the time in parts of Senegal from December through March, when the presence of dust is most severe. However, unhealthy dust events are also happening throughout the summer.

According to the EPA, dust particles of less than 10 and 2.5 microns in size are considered unacceptable in certain concentrations. Air pollution is

LEFT: The European Space Union's satellite Envisat captured sand and dust from the Sahara Desert blowing across the Atlantic Ocean along the coasts of Mauritania (top), Senegal (middle), and Guinea Bissau (bottom). The cloud-covered Cape Verde islands are visible off the coast of Senegal.

Sandstorms, or dust storms, are usually the result of atmospheric convection currents, which form when warm, lighter air rises and cold, heavier air sinks. Dust from the Sahara Desert can be transported over thousands of miles by convection currents, which also cause other meteorological conditions, such as thunderstorms.

The dust is also thought to be linked to health risks, such as increased incidences of pediatric asthma attacks in the Caribbean and epidemics of lethal meningitis in the semi-arid sub-Saharan territories. SOURCE: https://bit.ly/386mdqu

a cause of respiratory disease in West Africa, according to the World Health Organization.

Jeremy Gernand, associate professor of industrial health and safety, said quickly growing places like Senegal are at the cusp of having air quality systems in place. Gernand is among Jenkins' research collaborators and brings a research background of worker and public safety into the fold.

Gernand wants to improve how engineers and policy makers understand and manage environmental health and safety risks. His background in public safety, nanoparticles, and cost-effective solutions to potential industrial problems made him an ideal fit for this research. He also spent two years working in Guinea, which borders Senegal.

In matters of public health, Gernand said the solutions often offset the costs.

"Senegal is developing pretty quickly. And they are poised to be making a lot of decisions about infrastructure and public health," Gernand said. "There are measures they can take that are cost effective and have a huge impact on people's health."

Another area of interest, which made headlines in recent months but has long been forecast using Jenkins' models, is that summertime dust events can reach eastern parts of the United States and the Caribbean. These events, followed by periods of lower air quality, came as a bit of a surprise to researchers, since they are uncommon.

Except that the models predicted it.

"Our models told us that this was going to happen, but we had no reason to believe that the model was doing things correctly," Jenkins said. "Until we saw it. That's when we realized we had a lot more to learn, and we needed more measurements to do that."

Dangers in the dust

Knowing when dust pollution is severe is one piece to the puzzle. But researchers want to know how that's impacting poor health outcomes. They also want to expose what dangers are in the dust.

Their 2016 study linked higher rates of meningitis with severe dust events in Dakar. For that work, researchers partnered with local health experts to gather data. Using two years of health records, the team also found correlations between dust events and asthma, acute respiratory infection and bronchitis.

Surveys are one way the team is tracking health outcomes. In

Dust storms are a frequent threat to public health in parts of West Africa. Jenkins is working to improve air quality observations in the region known for having the world's poorest air quality and is researching the public health effects of that poor air quality.

Africa, language, and medical records differences pose some obstacles, but Kristin Sznajder, assistant professor of public health sciences in Penn State's College of Medicine, is helping overcome those challenges. She's a field epidemiologist and associate director for International Initiatives at Penn State with an extensive background in health research in Africa.

Sznajder is helping the team get the data they need to spotlight issues and reach a solution that informs residents of dust risks. Providing health-based information and increasing access to medical care in underserved areas is a passion of Sznajder's, so she jumped at the chance to work with others outside of her field.

"This is my first and only partnership with meteorology and atmospheric science," Sznajder said. "And I think it's great that other departments are interested in looking at health outcomes and how their field can impact health in general. I'm really excited about this research, because it's innovative and exciting and has the potential to make a real impact with results that can scale to other regions."

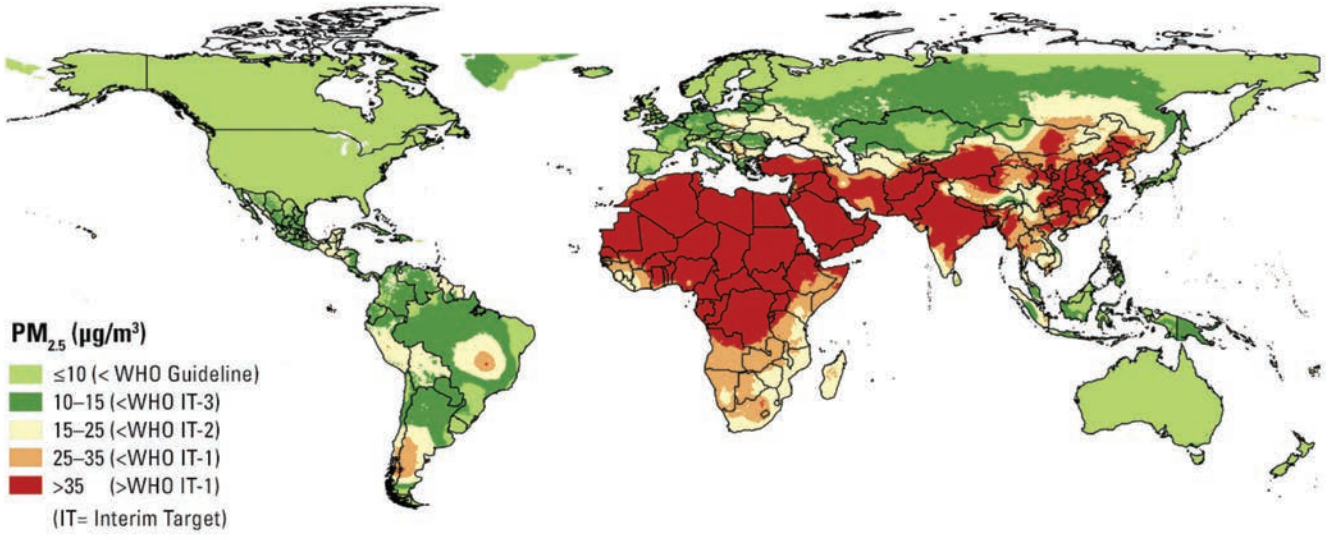
In research published earlier this year, the team found scores of living bacteria on their spatula samples. They've yet to do the legwork to link active viruses to the same particles—which requires a slightly different methodology—but that's only a matter of time. In an offshoot of this research, they're also looking to apply this approach to COVID-19 research.

Directly linking these pathogens to health outbreaks is a crucial step, but it will take more experts, more resources and more partnerships. Continuing to monitor health data is one approach, but a stronger linkage could be borne from contrasting real-time dust pathogen tests with nasal swabs of those receiving treatment at nearby medical facilities.

"There's no other way to connect to human health at the end," Jenkins said. "You can gather statistics, but that doesn't really help you to understand if a specific dust event drove a specific situation. That connection requires a clinical study."

Jenkins is driven to connect the dots to produce outcomes that save lives.

"I'm very fortunate to get to do the work that I do," Jenkins said. "And, as an educator, I'm able to bring that to our students and say 'look, we can get degrees and have great jobs. But you can also use your talents to better those in need.' When you can right a wrong or offset something bad for a population that lacks the means, then you feel a sense of pride about the work that you do." ⌘



Annual average PM2.5 concentrations relative to the WHO Air Quality Guideline

More than 90% of people worldwide live in areas exceeding the World Health Organization (WHO) Guideline for healthy air. In 2017, 92 percent of the world's population lived in areas that exceeded the WHO guideline for PM2.5; 54 percent lived in areas exceeding IT-1, 67 percent lived in areas exceeding IT-2, and 82 percent lived in areas exceeding IT-3.

Source: www.stateofglobalair.org/sites/default/files/soga_2019_report.pdf

Penn State hosted All-Atlantic Summit

The All-Atlantic Summit, held virtually in October, included the 6th High-Level Industry-Science-Government Dialogue on Atlantic Interactions (HLD) and technical sessions focused on innovation to develop inclusive ocean economies in the Atlantic region.

The summit was hosted by Penn State's Alliance for Education, Science, Engineering and Design with Africa (AESEDA) and co-organized by the Atlantic International Research Centre.

"Solutions to address important societal needs and challenges across the global North and South such as extreme events, coastal pollution, climate change, and equity can only be achieved thorough international collaboration, innovation, and community and youth engagement," said Greg Jenkins, director of AESEDA, professor of meteorology, and co-host of the summit. "The 6th HLD and technical sessions are a bold step in this direction."

It was the first meeting held in the United States and high-level officials from Europe, Africa, South America, United States, and other territories in the Atlantic region attended. Many members of the Penn State community participated virtually, including Penn State President Eric Barron, who gave opening remarks, and Lee Kump, John Leone Dean, who served as moderator for the ministerial meeting plenary session.

"The Atlantic Ocean is the fluid connective tissue that joins our countries," Kump said. "Together we will emerge from the COVID-19 pandemic, guided by science toward a blue economy that supports sustainable development goals and offsets losses from a warmer planet."

https://bit.ly/37HAkRJ

Historian Kendi discussed how to be an anti-racist at virtual event

Ibram X. Kendi, one of America's foremost historians and leading antiracist voices, discussed his 2019 book *How to Be an Antiracist* during a live-streamed event on November 18.

Kendi is a National Book Award recipient and *New York Times'* No. 1 best-selling author. His 2019 book was described by The New York Times as "the most courageous book to date on the problem of race in the Western mind."

TIME magazine named Kendi as one of the 100 Most Influential People of 2020 for providing concrete and actionable steps and recommendations that we all can take to wipe out the vestiges of racism and bigotry.

The virtual event was the kickoff event for the college's 125th anniversary commemorations. https://bit.ly/2VIlvl0


Stephen Voss

Weather World wins statewide award for hurricane series

The team at Penn State's television show *Weather World* earned first place for best series in the 2020 Keystone Media Awards Awards–TV (large and small markets) for the *Hurricane Week 2019* series.

"This is a great honor for us because this category isn't just limited to weather related television; it includes a number of qualified participants across the state," said meteorology lecturer Marisa Ferger. "That's what was exciting. It was our first year entering so we were thrilled to win."

Jon Nese, Marisa Ferger, the Nittany Lion, Rob Lydick, Steve Seman,and John Banghoff attend the National Hurricane Center's Hurricane Awareness Tour in 2019.

The series features experts from the National Hurricane Center (NHC) during their Hurricane Awareness Tour, which included a stop in Harrisburg, Pennsylvania. The series features the role of the NHC, the National Weather Service, the effects of storm surge, the pilots who brave the skies to study hurricanes, and historical hurricane data across Pennsylvania.

Penn State teaching professor Jon Nese, Ferger, and on-air meteorologist and researcher Rob Lydick created, wrote, and hosted the series. It was filmed by *Weather World's* media partner, Pennsylvania Cable Network. Sharing the honor with Ferger and Lydick are Matt Hoenig and Joe Speir, who both graduated in May with bachelor of science degrees in meteorology and atmospheric science.

https://bit.ly/3ILCHrH

Celebrating
125
YEARS
1896 - 2021

125th Anniversary Celebration

The college has a rich history dating back more than a century, from the original focus on mining engineering, to today's interdisciplinary focus on earth, energy, and materials sciences, and engineering. The college was formed in 1896 and we are embarking on a yearlong celebration in 2021 of our 125th anniversary. The college will be hosting numerous celebratory events to commemorate this milestone. Please check the website often for updates.

www.ems.psu.edu/125Anniversary

John Mauro selected for 2020 Paul F. Robertson Research Breakthrough of the Year Award

John Mauro, professor of materials science and engineering and associate head for graduate education in the Department of Materials Science and Engineering, received the 2020 Paul F. Robertson Research Breakthrough of the Year Award.

The award was created in 2012 with support from a generous gift by alumnus Paul Robertson '71 CERSE to recognize achievements for a singular breakthrough in research or in the scholarship of teaching.

Mauro was recognized for his pioneering work in decoding the glass genome—the code to design new functional glasses. This research has already led to his invention of multiple iterations of the famous Corning Gorilla Glass, which is ubiquitous in many phones and touchscreen devices used today, numbering more than two billion personal electronic devices worldwide. Recently, his genomics approach has led to new compositions of inorganic-organic hybrid glasses, the first all-new family of glass chemistry in more than fifty years. Mauro's work has led to critical breakthroughs in our understanding of glass chemistry and glass properties.

This new family of metal-organic framework glasses is so new that the phase diagrams have yet to be mapped out, and their properties combine some of the best features of oxides glasses such as optical transparency with that of metallic glasses, such as high toughness. They may also have better corrosion performance in humid environments compared to oxide glasses. https://bit.ly/3qlSJX3

Zuleima Karpyn appointed associate dean

Zuleima Karpyn, professor of petroleum and natural gas engineering, was appointed associate dean of graduate education and research. Karpyn started in her new role on July 1.

"Zuleima is an excellent associate dean for our college's Office of Graduate Education and Research (ADGER)," said Lee Kump, John Leone Dean. "She brings the breadth of experiences, and the vision, passion, and energy needed to facilitate discovery, innovation, and collaboration in our college."

Karpyn succeeds John Hellmann, who held the position in ADGER since 2012. Hellmann will continue as senior associate dean in the Office of the Dean.

"I am honored to have been selected as the next associate dean of ADGER," said Karpyn. "John has built an outstanding program and has guided the college on a path for success. I am appreciative of his leadership, and my goal is to continue to build on his legacy."
https://bit.ly/2KiglkB

Jose Fuentes honored for work on No Time for Silence team

Jose Fuentes, professor of meteorology and atmospheric science, received an American Geophysical Union 2020 Presidential Citation as part of the team that launched the anti-racism initiative "No Time for Silence."

Established in 2012, the presidential citation honors individuals or groups who work to connect science to the broader public. The award was announced at the AGU Fall Meeting.

"This group recognition shows that prestigious professional societies are saying these important issues in our field deserve attention and action," said Fuentes. "By granting this recognition, they are now indicating that they are serious about this work. And to us, that's the meaningful message."

Fuentes said previous approaches have failed to address issues of racism systemically. As part of his work with the team, Fuentes helped craft specific recommendations for scientific professional societies, governmental funding agencies, and leading universities.

"I greatly appreciate and admire Jose for all that he does to help us work together in developing a community where all belong," said David Stensrud, head of the Department of Meteorology and Atmospheric Science. https://bit.ly/3rRSPfg

Virtual EarthTalks seminars focused on diversity in environmental sciences

Understanding how earth and environmental systems operate and interact with human systems is crucial for the global community, but the personnel working within these fields does not represent a highly diverse population. As our environmental problems become more globalized and more challenging, we need all perspectives to tackle both fundamental and applied environmental problems.

Sponsored by the Earth and Environmental Systems Institute (EESI), the fall EESI EarthTalks series "Changemaking made EESI: Fostering inclusive research communities in the Earth and environmental sciences," explored new perspectives on initiatives that could increase diversity in environmental fields, with a particular slant toward the college. The recordings are available for viewing online at https://bit.ly/3rRteDx

Students, faculty honored at virtual Wilson Awards ceremony

Exceptional students and faculty were recognized for their academic excellence, service, and leadership at the college's annual Wilson Awards, held virtually at the end of the spring semester. The Wilson Awards are named in honor of Matthew and Anne Wilson, major benefactors of the college.

"Even though we were unable to host the awards ceremony in person, we wanted to be able to honor and recognize the hard work of our faculty and students," said Lee Kump, John Leone Dean. "The virtual awards ceremony was well received by all." https://bit.ly/3ggs7lb

James Adair

James Adair, professor of materials science and engineering, biomedical engineering and pharmacology, was selected to present the Frontiers of Science and Society – Rustum Roy Lecture at the American Ceramic Society. The lecture honors the late Penn State Professor Rustum Roy and recognizes his contributions to science and technology and their interrelationship to society at large.

Todd Bacastow

Todd Bacastow, teaching professor in geography, was appointed to the board of directors of the United States Geospatial Intelligence Foundation (USGIF) for a three-year term. USGIF is a non-profit organization dedicated to promoting geospatial intelligence training and education and building a stronger community of interest across industry, academia, government, professional organizations, and individual stakeholders.

Timothy Bralower

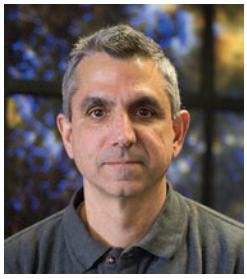
Timothy Bralower, professor of geosciences, received the Penn State George W. Atherton Award for Excellence in Teaching, which honors excellence in teaching at the undergraduate level. He worked with a team of faculty to design an online certificate program in Earth sustainability. The centerpiece of this program is the Earth Futures course that addresses climate change's impact on humans and the planet. It's offered at University Park, Penn State World Campus, and six additional Penn State campuses.

Cynthia Brewer

Cynthia Brewer, professor and head of the Department of Geography, was awarded the O. M. Miller Cartographic Medal by the American Geographical Society. The medal acknowledges outstanding contributions in the field of cartography or geodesy. The Honors and Awards Committee noted that Brewer's influence is readily seen from the widespread use of her ColorBrewer tool, which anyone can use, to the new clarity and aesthetic of the U.S. Geological Survey's national maps collection.

Long-Qing Chen

Long-Qing Chen, Hamer Professor of Materials Science and Engineering, professor of engineering science and mechanics and professor of mathematics, earned the Ross Coffin Purdy Award, which recognizes those who made the most valuable contributions to ceramic technical literature, from the American Ceramic Society.



Eugene Clothiaux

Eugene Clothiaux, professor of meteorology and atmospheric science, was named the John T. Ryan Jr. Faculty Fellow. The fellowship provides supplementary funds to an outstanding faculty member in the college to further their contributions in teaching, research, and public service.

Roman DiBiase

Roman DiBiase, assistant professor of geosciences, was named the Rudy L. Slingerland Early Career Professor of Geosciences, a distinction that honors the now retired Penn State professor and will help fund DiBiase's research studying how landscapes erode over geologic time, shaping mountains, and in an instant leading to hazards from fires, floods, and landslides.

Lorraine Dowler

Lorraine Dowler, professor of geography and women's, gender, and sexuality studies, was the 2020 recipient of the American Association of Geographers Feminist Geographies specialty group's Jan Monk Service Award. The award recognizes a geographer who has made an outstanding service contribution to women in geography and/or feminist geography.

Katherine Freeman

Katherine Freeman, Evan Pugh University Professor of Geosciences, was awarded the 2020 Nemmers Prize in Earth Sciences given by Northwestern University, which recognizes achievement and work of lasting significance in the field of Earth sciences. She was selected "for her pioneering and continued contributions to development of the field of compound-specific stable isotope geochemistry and its application to fundamental problems in Earth science."

John Hellmann

John Hellmann, professor of materials science and engineering and senior associate dean, was selected to give the ACerS/EPDC: Arthur L. Friedberg Ceramic Engineering Tutorial and Lecture. The lecture honors the memory of Arthur L. Friedberg for his teaching, research, and numerous contributions to the ceramic engineering profession.

Robert Hickey

Robert Hickey, assistant professor of materials science and engineering, received a National Science Foundation Early Career Development (CAREER) Award for the project, "Enabling the Design of Versatile Hybrid Materials using Polymerization-Induced Nanostructural Transitions."

Gregory Jenkins

Gregory Jenkins, professor of meteorology and atmospheric science, geography, and African studies; and director of the Alliance for Education, Sciences, Engineering and Development in Africa, received the Charles E. Anderson Award from the American Meteorological Society for "tireless and sustained contributions to the promotion of diversity in atmospheric science through education, community service, and engaging students in internationally-focused research."

Matthew Kumjian

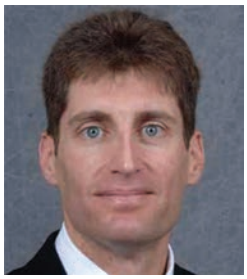
Matthew Kumjian, associate professor of meteorology, received the Henry G. Houghton Award from the American Meteorological Society for "outstanding and pioneering contributions that have advanced our understanding of precipitation physics through the novel use and application of dual-polarization radar observations."

Zi-Kui Liu

Zi-Kui Liu, professor of materials science and engineering, was named the inaugural Dorothy Pate Enright Professor. Enright, who earned her master's degree in ceramic science in 1948 from Penn State, established the professorship to provide supplemental funds to an outstanding faculty member to continue and further their contributions to teaching, research, and service.

Chiara Lo Prete

Chiara Lo Prete, associate professor of energy economics, received a National Science Foundation Early Career Development (CAREER) Award for the project, "Capacity Adequacy Options for Electricity Markets with Increasing Renewable Penetration: Equilibrium Models and Laboratory Experiments."



Jon-Paul Maria

Jon-Paul Maria, professor of materials science and engineering, was elected a Fellow of the American Ceramic Society. Fellows are members who have distinguished themselves through outstanding contributions to the ceramic arts or sciences, broad and productive scholarship in ceramic science and technology, conspicuous achievement in ceramic industry, or by outstanding service to the society.

Michael Mann

Michael Mann, distinguished professor of atmospheric sciences, received the Louis J. Battan Author's Award along with Megan Herbert from the American Meteorological Society for their book, T*he Tantrum That Saved the World*, which engages readers with empathy and compassion and empowers them to help save animals and people from the threat of climate change.

Mann, who also is the director of the Earth System Science Center, was co-awarded the 2020 World Sustainability Award, which encourages new initiatives and developments in sustainability with the ultimate aim to foster the transfer from sustainability research to sustainable practices and societies. In this spirit, sustainability is the interdependence between economic, social, and environmental concerns for mutually beneficial regional and global development.

John Mauro

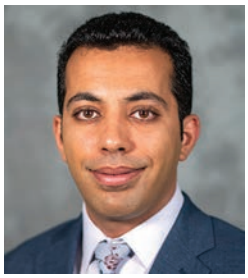
John Mauro, professor of materials science and engineering, was named a 2020 Fellow of the National Academy of Inventors (NAI). Election to NAI Fellow status is the highest professional distinction accorded solely to academic inventors. NAI Fellows are academic inventors who have demonstrated "a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development, and the welfare of society."

Shashank Priya

Shashank Priya, professor of materials science and engineering, associate vice president for research, and director of strategic initiatives in the Office of the Vice President for Research, earned a Richard M. Fulrath Award from the America Ceramic Society. The award promotes technical and personal friendships between professional Japanese and American ceramic engineers and scientists and encourages a greater understanding among the diverse cultures surrounding the Pacific Rim.

Wesley Reinhart

Wesley Reinhart, assistant professor of materials science and engineering, was among Penn State's Institute for Computational and Data Sciences 2020 cohort of faculty fellows, formerly known as faculty co-hires. The institute collaborates with colleges and departments across the University to recruit and support a cadre of faculty fellows—talented and creative researchers who are doing data- and computationally-intensive research that spans the disciplinary landscape.



Mohammad Rezaee

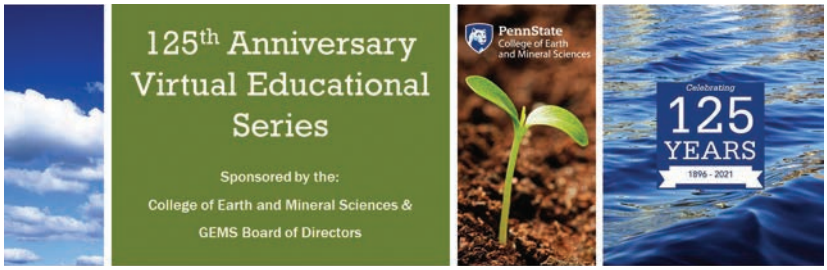
Mohammad Rezaee, assistant professor of mining engineering, received the Outstanding Young Engineer Award from the Society for Mining, Metallurgy & Exploration's Mineral and Metallurgical Processing Division. He was selected for "his significant contributions in the development of methodologies and applications of mineral processing unit operations and circuits to enhance the sustainability of mining operations."

Susan Trolier-McKinstry

Susan Trolier-McKinstry, Flaschen Professor of Ceramic Science and Engineering, was named an Evan Pugh University Professor. Named for Penn State's founding president, the distinction honors preeminent professors and recognizes the importance of research in supporting the quality and reputation of the University.

Christelle Wauthier

Christelle Wauthier, associate professor of geosciences, received a National Science Foundation Early Career Development (CAREER) Award for the project, "Numerical Modeling of Volcanic Flank Instability Processes."



125th Anniversary GEMS Educational Series launched

125th Anniversary Graduates of Earth and Mineral Sciences (GEMS) Educational Series spotlights the college's research in short, interactive webinars designed to introduce attendees to the college's world-class faculty and alumni. It is sponsored by the GEMS board of directors. The virtual educational series kicked off on December 15 and will continue throughout 2021, the college's 125th anniversary year. Visit www.ems.psu.edu/125Anniversary for more information.

Rob Lydick, 2011 meteorology alumus and executive producer of *Weather World*, presented "Weather World: The Meteorological Merger of Science and Communications at Penn State." Erica Grow, 2002 meteorology alumna and owner and principal consultant of Weather Elevate, a weather broadcasting consulting firm, served as moderator. A video of the event is online at: https://bit.ly/3n6MBoc

Sea-Fue Wang recipient of Charles L. Hosler Alumni Scholar Medal

Sea-Fue Wang, president of the National Taipei University of Technology in Taiwan, was awarded the 2020 Charles L. Hosler Alumni Scholar Medal. The award recognizes the very highest levels of intellectual achievement or academic service attained by those educated in the college. The award is named in honor of Charles L. Hosler, former dean of the college, senior vice president for research, dean of The Graduate School, professor of meteorology emeritus, and Penn State Distinguished Alumnus. Wang graduated from Penn State in 1991 with a doctorate in materials science. After the COVID-19 situation improves, Wang will be invited to Penn State for a recognition ceremony.

Tim Charatan wins GEMS Diamond Award

Tim Charatan, a 2020 graduate in materials science and engineering, received the 2020 GEMS Diamond Award. The award honors and recognizes a graduating student who shows excellence and balance in academic achievement and volunteer involvement in both University and community activities during their time as a student.

Charatan was selected for his academic excellence and accomplishments as a student leader. He served as president of the undergraduate student council and had many additonal leadership positions including EMS Benefiting THON. He was also selected as an Earth and Mineral Sciences Academy for Global Experience (EMSAGE) Laureate.

Food drive efforts earn Penn State Alumni Association Joint Activity Award

GEMS and the Penn State Alumni Association's (PSAA) Colorado Chapter shared the 2020 Penn State Alumni Association Joint Activity Award for their work organizing a food drive. They received the award virtually at the PSAA Volunteer Awards Celebration in October.

The food drive took place during the GEMS board's fall meeting in 2019, which was held in Denver for the first time. Members of the PSAA Colorado Chapter agreed to co-host the charity football game watch party and spread the word about the event. Attendees donated approximately 500 food items to the Food Bank of the Rockies, a local nonprofit that assists families in need.

"It's important to give back," said Dave Arachacki, current board president who was president-elect at the time of the event. "That is why we volunteer for the board and why we are successful as a group—because we all enjoy doing it." https://bit.ly/3mZUHPC

David Payne: GEMS Alumni Achievement Award

David Payne, vice president of health, safety, and environment at the Chevron Corporation and a 1981 graduate in petroleum and natural gas engineering, was awarded the GEMS Alumni Achievement Award. The award is given annually to a graduate who has excelled in their field.

Payne was recognized for his work at Chevron and his outreach in support of Penn State students. He was instrumental in securing the large gift made by the company to support the Chevron Drilling Laboratory and providing funding to support the work of new faculty in that area.

Payne said his efforts at Penn State—where he's also heavily involved in Penn State Chapter of the Society for Petroleum Engineers—are important to him.

"I feel like I have an obligation to give back because I don't think that I would be where I am today without my experiences at Penn State," Payne said. "I was able to make mistakes in a safe environment, and that taught me a lot. I feel like I owe Penn State something in return for allowing me to have what has been a career for which I have no regrets." https://bit.ly/38MHOU0

Thank you!

To all of the college's supporters and friends—thank you! Philanthropy helps provide the college with the resources needed to train our students to become the next generation of leaders, conduct innovative research, hire world-class faculty, and reimagine our laboratories and classrooms.

We need your help to ensure the college's success. Making an investment in the college, whether through scholarships that help provide access to a college education, or through support for engaged scholarship programs that prepare students for life after graduation, or through support for faculty that allow our college to attract and retain the brightest and best, your support is vital.

Learn how you can give as part of the "A Greater Penn State for 21st Century Excellence" campaign by visiting the following webpage: www.ems.psu.edu/giving/give-college/give-now.

If you have any questions, please contact the college's Office of Development and Alumni Relations directly at development@ems.psu.edu or call 814-863-2289 to explore providing philanthropic support.

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