

2020-2021

# RESEARCH HIGHLIGHTS



SAN DIEGO STATE UNIVERSITY

# Insights from the Vice President

## The importance of community collaboration



**Hala Madanat**

As COVID-19 began spreading in the U.S., my fellow SDSU researchers and I quickly began having conversations with local partners about leveraging community health workers to reduce the spread of the deadly disease in the county's hardest-hit neighborhoods. Cases were increasing at an exponential rate, and underserved communities were being hit the hardest.

Those conversations led to a partnership between SDSU and the County of San Diego Health & Human Services Agency that has been incredibly successful in stemming COVID-19 transmission locally.

Such a partnership wouldn't have been possible without decades of thoughtful collaboration between SDSU researchers and community stakeholders embedded in vulnerable populations. It laid the groundwork for a wealth of other COVID-19

related programs, including efforts funded by major national federal funding agencies and international coalitions.

This is just one example of a guiding principle that makes SDSU a successful research institution, particularly in the San Diego community. Our researchers build partnerships through engaging community stakeholders in activities that are critical to our region. They establish themselves not only as brilliant scholars, but also valuable collaborators who will work in concert with community partners in a spirit of trust and cooperation.

The 2020-21 year was an exceptional one, with \$140.6 million awarded for research, scholarship and creative activities at SDSU. You will see this principle of community collaboration in nearly every project highlighted in this publication. Faculty last year partnered with tribal nations to combat climate change; worked with the transgender community to reduce exposure to HIV; teamed up with local industry to develop oil slick detection technology; collaborated with California community colleges to examine the impact of COVID-19 on racial equity efforts; worked alongside local nonprofits to improve employment stability after incarceration; interviewed Marines to create a podcast about their experience in Afghanistan; joined forces with local municipalities to mitigate coastal flooding and so much more.

I am incredibly proud to work alongside our faculty who are both gifted scientists and scholars, and also valued community partners. I hope you enjoy learning about their work as much as I have.

## Hala Madanat

Interim Vice President for Research and Innovation

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## 2020-2021 RESEARCH HIGHLIGHTS

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# Close up

## INSIGHTS FROM THE VICE PRESIDENT

### MACHINE LEARNING/ARTIFICIAL INTELLIGENCE

Junfei Xie, *electrical and computer engineering*  
Andre Skupin, *geography*  
Reza Akhavian, *civil, construction and environmental engineering*  
Xiaobai Liu, Marie Roch, *computer science*

### CLIMATE RESILIENCE

Megan Jennings, Lluvia Flores-Rentería, *biology*  
Eunha Hoh, Kari Sant, *public health*, Natalie Mladenov, *civil, construction and environmental engineering*  
Forest Rohwer, Jason Baer, *biology*  
Hassan Davani, *civil, construction and environmental engineering*

### INNOVATION

Chris Harrison, Jessica Torres, *chemistry and biochemistry*  
Matt Anderson, *physics*, Dave Pullman, *chemistry/biochemistry*  
Ahmad Bani Younes, *aerospace engineering*  
Doug Stow, Peter Coulter, Andy Loerch, *geography*  
Linda Abarbanell, *psychology, Imperial Valley*  
Kimberly Kras, *public affairs*

### LGBTQ+ COMMUNITY

Erik Storholm, *public health*  
Godfried Asante, *communication*  
Jennifer Felner, *public health*  
Aaron Blashill, Kristen Wells, *psychology*

### MILITARY AND SECURITY

Gregory Daddis, *history*  
Emily Schmied, *public health*  
Aaron Elkins, Bongsik Shin, *management information systems*  
Xiaofeng Liu, *aerospace engineering*

### HEALTH SCIENCE

Jillian Wiggins, *psychology*  
Dwayne Roach, *biology*  
Shirin Hooshmand, Mark Kern, Changqi Liu, Mee Young Hong, *exercise and nutritional sciences*, Scott Kelley, *biology*, Erica Forsberg, *chemistry/biochemistry*  
Mary Baker-Ericzén, *administration, rehabilitation and postsecondary education*

### CONFRONTING COVID-19

Eric Felix, *administration, rehabilitation and postsecondary education*  
Laura Owen, *counseling and school psychology*  
EJ Sobo, *anthropology*, Noe Crespo, *public health*  
Susan Kiene, Eyal Oren, Corinne McDaniels Davidson, Hala Madanat, *public health*  
Annie Keeney, *social work*

### RENEWABLE ENERGY

Chris Mi, *electrical engineering*, Kevin Wood, *mechanical engineering*  
Sung-Yong (Sean) Park, *mechanical engineering*  
Yong Yan, *chemistry/biochemistry*

## 2020-2021 BY THE NUMBERS

On the cover: SDSU scientists are deploying first-of-their-kind floating habitats in an attempt to rebuild damaged coral reefs. Photo by Mark Little



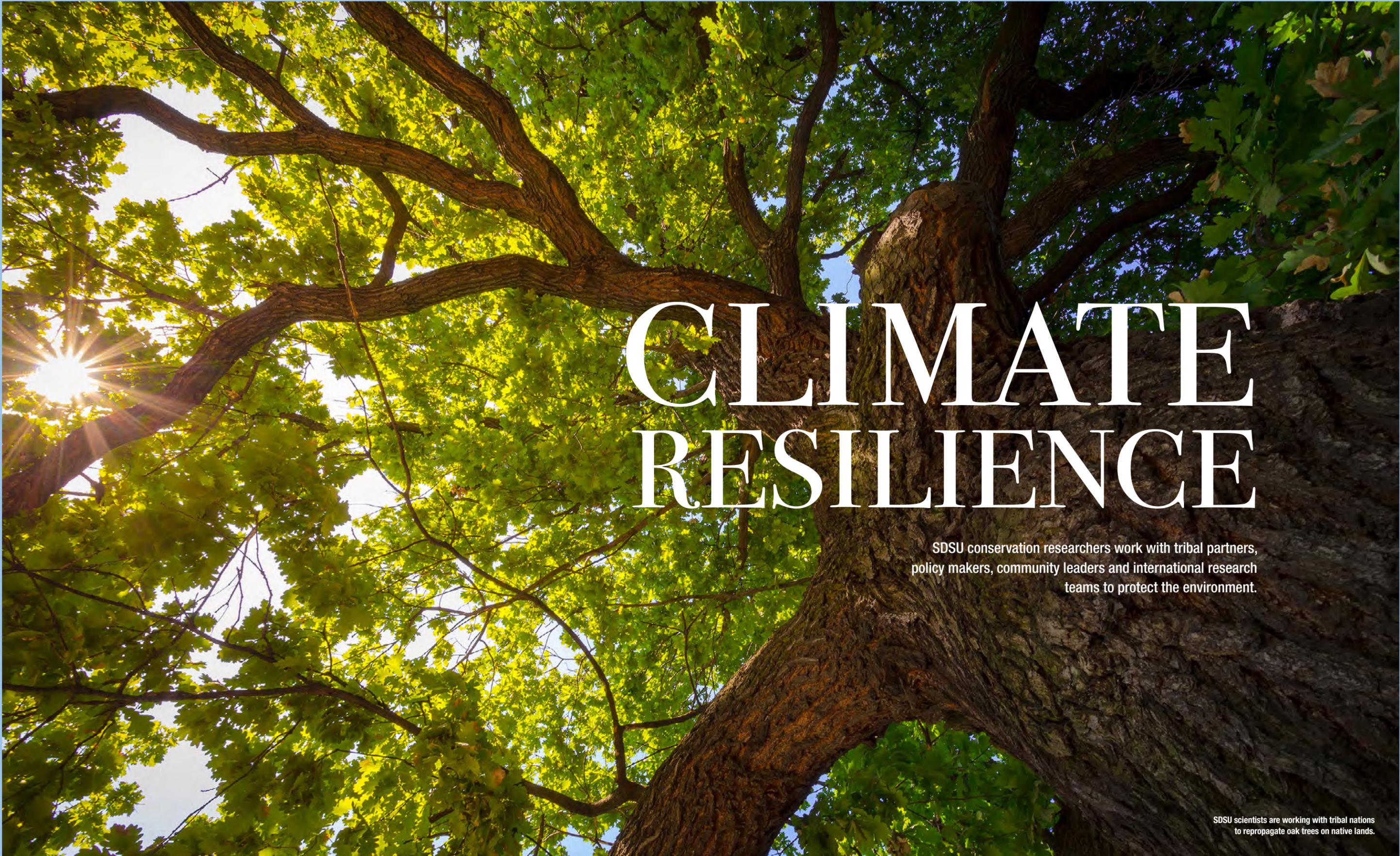
# MACHINE LEARNING

# ARTIFICIAL INTELLIGENCE

SDSU scientists leverage artificial intelligence to improve drone computing, health outcomes, construction safety, conservation efforts and more.

Engineer Junfei Xie's research will allow drones to complete several complicated tasks at once.





# CLIMATE RESILIENCE

SDSU conservation researchers work with tribal partners, policy makers, community leaders and international research teams to protect the environment.

SDSU scientists are working with tribal nations to repropagate oak trees on native lands.

# Helping tribal nations adapt to climate change

By Padma Nagappan

San Diego State University ecologists **Megan Jennings** and **Lluvia Flores-Rentería** spent much of the past year and a half collecting acorns from Indian reservations, storing them at home to keep them fresh, and germinating and growing them in greenhouses.

They aim to use the acorns to repropagate oak trees on native lands.

The pair is part of a team of scientists, student researchers and tribal nations working to preserve native species of historic, spiritual and cultural significance, and help threatened flora adapt to a changing climate.

Their work is part of the Resilient

Restoration project, supported by California Strategic Growth Council's Climate Change Research Program and conducted in partnership with the Climate Science Alliance (CSA) Tribal Working Group, which consists of more than 20 Southern California tribes that advise the researchers. The three-year restoration project is led by University of California, Riverside ecologists Helen Regan and Janet Franklin.

Acorns were, and still are, a significant staple of the diet for tribal nations in Southern California. They are dried, deskinning, powdered and made into drinks and jelly-like sides that accompany barbecued meat, beans and rice.

High in protein and good fats, they can be a key source of protein in the winter months when game is scarce. But as Native Americans were forced to assimilate to a western diet, this staple became far less common in native diets.

"We have been resilient through a long history of colonization, but we have also lost a lot of knowledge about our life ways and our food was especially impacted," said Will Madrigal who is Cahuilla/Luiseño, and the tribal capacities and partnerships program manager with the Climate Science Alliance.

"We were put in concentration camps—Indian reservations—so we couldn't go to our gathering spots and



Master's student Yazmin Lommel shows the root system of a Coast live oak seedling. Photo by Lluvia Flores-Rentería

commune with our oaks. They made us eat over processed food by way of government rations, sugar, lard and grains that were alien to us," Madrigal added. "Going back to our acorns and teaching our ways to our next generation has enabled us to continue and strengthen our traditions."

Efforts are now underway to revitalize indigenous stewardship and restore plant species that hold considerable importance for local tribes. These efforts will support adaptation to the pressing threat climate change poses to tribes, particularly for native plant species such as coast live oak and Engelmann oak that are important to traditional and cultural practices.

"We focused on acorns because it's the lifeblood for many tribes," Jennings said. "Close to 2,000 acorns have been germinated and established at our greenhouse at SDSU; once our drought experiment is completed we will return them to our tribal partners to plant them on their lands. We are also working with them on launching pilot projects to build capacity for restoration and propagation efforts."

Jennings continued: "My hope is that this will provide additional support and information for our tribal partners to advance their restoration efforts for climate adaptation." **U | G**



Microplastics, tiny plastics less than 5 millimeters in size, are pervasive in oceans worldwide.

## SPOTLIGHTS

### Microplastic study informs policy

Chemicals from microplastics are leaching into our oceans and putting vulnerable marine ecosystems at risk—a perilous situation that is only expected to worsen in the coming years. In a project funded by the California State University Council on Ocean Affairs, Science & Technology (COAST), public health researchers **Eunha Hoh** and **Kari Sant** and engineer **Natalie Mladenov** are examining the chemicals that leach from two of the most commonly identified microplastic pollutants, tire particles and microfibers, and sharing their results with California lawmakers in an effort to inform strategies aimed at reducing microplastics. **U | G**

 [Read companion article](#)

### Protecting endangered reefs

In an effort to better understand at-risk coral reefs and help support and preserve them, ecologist **Forest Rohwer** and doctoral candidate **Jason Baer** have launched structures called Coral Arks that act like floating zoos into the ocean. The aim of the Arks is to create miniature coral reefs suspended off the seafloor, providing improved conditions for corals and all the other organisms that help keep them healthy. Eventually, the team hopes to use what they learn from these Arks to create Reef Ark Parks to house, protect and propagate global coral reef biodiversity.

 [Read companion article](#)



Ph.D. candidate Jason Baer and the Coral Arks team successfully deploy a Coral Ark. Photo by Mark Little

### Keeping Imperial Beach above water

With funding from the National Science Foundation, engineering professor **Hassan Davani** and public affairs professor Megan Welsh are teaming up with local scientists and governments to determine whether rain barrels can offset environmental problems that leave South San Diego's Imperial Beach vulnerable to chronic flooding. The team is studying the interaction of shallow groundwater and drainage infrastructure in the border community to better understand existing infrastructure issues. Researchers plan to encourage local residents to use the barrels to collect rainwater that would otherwise drain into streets and cause flooding. **U | G**

 [Read companion article](#)

Rain barrels may reduce flooding in Imperial Beach.



Researchers visit the Rancho Jamul restoration project led by Emma Havstad and Francis Ulep of the River Partners, a conservation organization. Photo by Lluvia Flores-Rentería



Two SDSU researchers are working with industry to create tools that identify early signs of offshore oil spills.

# INNOVATION

SDSU scholars think outside the box—developing new ways to communicate from space, prevent wildfire, detect oil spills early, discover life on other planets and more.

# Chemist identifies new way of finding extraterrestrial life

By Sarah White

A team of San Diego State University chemists is developing new ways to search for signs of life on other planets.

After collaborating with researchers at NASA's Jet Propulsion Laboratory (JPL) in 2019, **Jessica Torres**, a doctoral student studying chemistry, began investigating methods for extracting and identifying amino acids, the building blocks of proteins, from porous rocks.

Torres is teaming up with SDSU chemist **Chris Harrison** on the project, which is funded by NASA.

Previous research has looked for evidence of other life forms in water and soil, but not from solid materials.

Continued on next page



## SPOTLIGHTS



### Industry partnership supports new slick detection device

Chemistry professor **Dave Pullman** and physics professor **Matt Anderson** are working with San Diego-based InterOcean Systems to create tools that identify early signs of offshore spills. The duo received funding to develop new sensors that will quickly detect oil on the ocean's surface from high above the water. The first of its kind, the non-contact oil spill monitoring technology uses ultraviolet light bouncing off surfaces to detect spills—bringing big advantages in terms of maintenance and ease of use when remotely monitoring pipelines miles offshore. **U | G**

 **Read companion article**

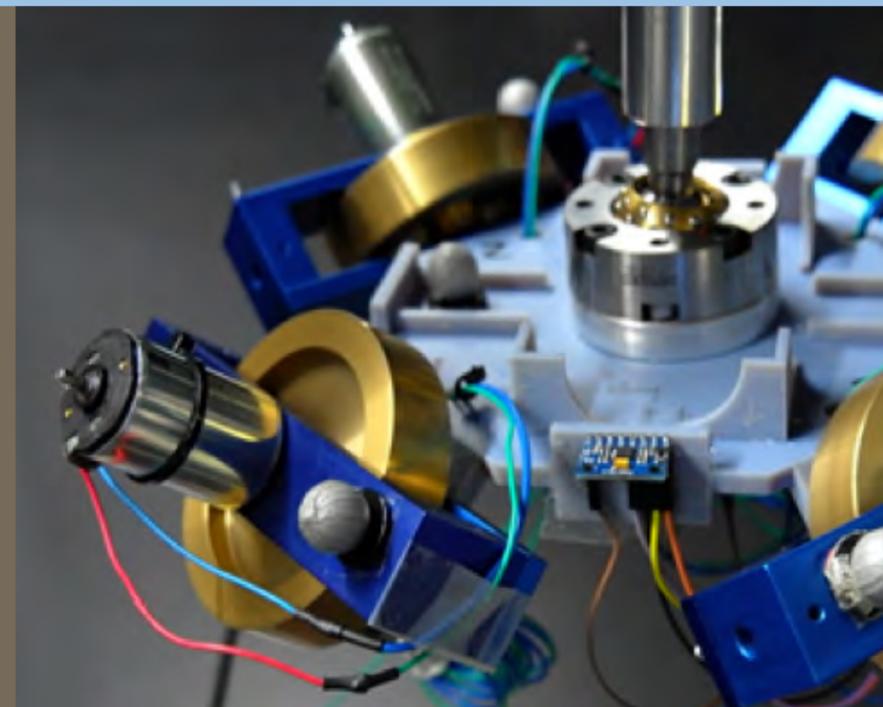
Dave Pullman (left) adjusts optical components while Matt Anderson (right) monitors the signal from their fluorescence sensor. Photo by Chris Leap

### Improving communication from space

Space missions need faster ways to transmit information back to Earth. According to NASA, laser communications could solve this challenge by allowing exponentially more data transmitted back to Earth than current radio frequency systems. In work supported by Space Micro Inc., engineer **Ahmad Bani Younes** is modeling a laser communication terminal that would require less volume, weight and power than traditional radio frequency systems, providing more room for instruments and less drain on the spacecraft's systems.

Bani Younes directs SDSU's Spacecraft Platform for Astronautics & Celestial Emulation (SPACE) Lab, which enables ground-based systems to mimic the conditions of a weightless satellite in space and allows the design and testing of guidance, navigation and control techniques before they are used in orbit. **U | G**

Spacecraft attitude testbed (SAT) simulator emulates spacecraft in orbit. Credit: SPACE Lab



# Novel project could detect life on other planets

**Continued from previous page**

Current methods for identifying amino acids can't differentiate versions created by a living organism from those formed through random chemical reactions. And existing techniques usually require water—which would freeze or evaporate if placed on a space probe traveling to Mars or Europa, the ice-covered saltwater moon of Jupiter.

"The true novelty of our project is to approach detection of life using alternative solvents that are better suited for space instead of water and organic solvents, which are very suitable on earth," Torres said. "We hope to develop a microfluidic device that can extract, sample and identify amino acids in rocks. This is particularly novel because JPL does not have a method to approach this quite yet."

Torres is developing novel chemical solvents specifically made to operate on an automated rover visiting another planet, where water and other common solvents like alcohols and acetone would not be viable.

Describing the chemical process that his lab researches, called capillary electrophoresis, Harrison said, "It's a cheaper way to detect life, and better in a lot of ways."

Capillary electrophoresis involves separating molecules by passing them through a liquid-filled tube narrower than an average human hair. Based on their size, electric charge, and how they react with other chemicals, different amino acids move through the tube at varying rates. At one end of the tube, a laser is shining, waiting for any amino acids with an additional

glow-in-the-dark molecule attached. If an amino acid passes in front of the laser, a sensor will show a spike of laser-induced glow. Figuring out how to have a unique spike for each of the 20 different amino acids is Torres's current challenge; she hopes to eventually be able to identify



an amino acid, even if there is only one present among a billion other molecules.

"We're really lucky with the equipment we have here. I can do the exact kinds of things that I would do at JPL here at SDSU," said Torres. She was originally supposed to return to JPL during the summers of her Ph.D., but has worked remotely during the pandemic.

Once they have optimized the chemicals they use to reliably separate and identify each of the 20 amino acids, the team plans to test their process on sample rocks from the moon, the Mars-like Atacama Desert and Mono Lake, which is two to three times saltier than Earth's oceans.

"What we'll bring with this new solvent will add flexibility to analysis on Earth and beyond," said Harrison. "Sometimes it is hard to see the impact of fundamental science until you get it in the hands of others and see which problems you've already solved for them." **U | G**

On left: Material used in identifying amino acids that could signify extraterrestrial life (penny for scale).

Top: Chris Harrison and Jessica Torres in their chemistry lab. Photos by Sarah White



## Technology aims to reduce wildfires

Geographer **Doug Stow**, along with collaborators **Pete Coulter** and **Andy Loerch**, studies how drones can be used to monitor power infrastructure and prevent wildfires. Their patented technology, called Repeat Station Imaging, uses drones to collect images of specific locations in the sky over time and automatically monitor changes in electrical power infrastructure. Partially supported by a grant from the SDSU Division of Research and Innovation's Pilot Innovation Fund, the technology has significant implications for minimizing wildfire ignitions. The fund helps faculty transition their research-based innovations toward commercial readiness and has awarded \$114,200 to faculty in 2021. **G**

Researcher Doug Stow's drone technology could prevent wildfires.



## Examining shifting cultural values

As part of an international team examining the effects of education on science and religion narratives across cultures, SDSU Imperial Valley psychology professor **Linda Abarbanell** is studying the shifting values, beliefs and practices in a Tzeltal Mayan community in Chiapas, Mexico. She is considering factors—such as education—that cause people to leave traditional beliefs and community practices and move to more mainstream religions. Abarbanell aims to develop best practices for conducting large-scale comparative cross-cultural work. Her research is supported by the University of Texas at Austin. **U | G**

**"Understanding how education transforms our basic values, beliefs, and practices—and how these processes are shaped by cultural and individual-level factors—will illuminate basic questions about human nature and how our culture shapes our worldviews."** Linda Abarbanell



## Does employment support success after conviction?

In California, 50% of parolees return to prison within three years of being released. The formerly incarcerated also face significant barriers to employment, which can impact recidivism.

Public affairs professor **Kimberly Kras** is working with the non-profit Kitchens for Good to find a solution to this problem. She is evaluating an apprenticeship program that provides job training for the formerly incarcerated in an effort to reduce violence and substance abuse and improve employment stability. Kras is examining how employment can improve quality of life after reentry and support remaining outside the justice system. **U | G**

Kitchens for Good Chef Instructor Alan Wittenberg describes an Afghan-inspired dish to graduate students Carina Rodrigues and Sheri Gudez. Photo by Kimberly Kras



# LGBTQ+ COMMUNITY

How do we reduce health disparities for LGBTQ+ individuals? SDSU scientists dedicate their lives to this task, gaining the trust of community advocates and collaborating to improve outcomes for this vulnerable population in the process.

Researchers aim to reduce disparities in the LGBTQ+ community.

# New transgender lab addresses health inequities

By Peggy Pico

In a vital effort to reduce health disparities and barriers in the transgender community, San Diego State University public health researcher **Erik Storholm** has established an innovative lab and research partnership with the Transgender Wellness Center (TWC) in Los Angeles.

Storholm, who leads a transgender and

non-binary research lab at SDSU, aims to reduce cases of HIV among transgender women by increasing their use of HIV-prevention medicine.

Transgender women, especially Latinx and Black transgender women, urgently need more HIV-prevention and treatment services—according to a comprehensive Centers for Disease

Control and Prevention report published in 2021. Data from the report revealed 40% of transgender women surveyed in the United States have HIV and found significant racial disparities. Sixty-two percent of Black respondents and 35% of Latina respondents had HIV, compared to 17% of white transgender women.

Almost all HIV infections in the U.S. can be averted with the once-a-day, low-cost HIV-prevention medicine pre-exposure prophylaxis (known commonly as PrEP). Yet only about a third of transgender women take PrEP. Obstacles like socioeconomic barriers, stigma, racism, inequities in employment and housing limit PrEP uptake.

Citing his research focused on HIV, barriers to treatment, abuse, and sexual health in the LGBTQ+ community, advocates in Los Angeles reached out to Storholm and asked him to develop a project to help increase the use of PrEP by underserved transgender and nonbinary women in Southern California.

“Members of the transgender community came together and advocated to have their own brick-and-mortar Trans Wellness Center building in Los Angeles,” Storholm explained, adding that the center was the first of its kind in the U.S. “They asked me to collaborate on an intervention-based HIV prevention research project to address barriers. I am honored to be a part of this opportunity.”

With funding from the California HIV/AIDS Research Program, the PrEP project will put scalable policies and partnerships in place to ensure low cost or free access to the medication. Storholm’s research leverages intervention science and promotes the adoption of evidence-based practices and policies into health care settings.

“We have to ask what’s going to be sustainable within the community. I think there is a movement towards implementation science and really studying the strategies of implementing interventions,” Storholm said. **U | G**

## Fostering culturally sensitive advocacy

Communication professor **Godfried Asante** examines LGBTQ+ empowerment in West Africa. Collaborating with human rights organizations, Asante uses participatory action research methodologies to investigate social issues caused by the criminalization of same-sex sexual relations. His work, which is partially funded by the Waterhouse Family Institute for the Study of Communication, aims to develop culturally acceptable ways to conduct human rights advocacy work in international settings. **U**

## Intersectional tobacco use inequities

LGBTQ+ youth are more likely to use tobacco than heterosexual, cisgender youth. But little is known about how these inequities among LGBTQ+ youth vary by other identities, including race, ethnicity and socioeconomic position.

In a study funded by California’s Tobacco-Related Disease Research Program, community health scientist **Jennifer Felner** is examining tobacco-related inequities among LGBTQ+ adolescents. Felner and colleagues’ publication in the journal “Nicotine & Tobacco Research” revealed disproportionate vaping inequities among transgender adolescents of color, particularly Black and Latinx adolescents, compared to white transgender and cisgender adolescents. Their research sheds light on which adolescent sub-communities have the greatest needs for tobacco prevention and identifies opportunities for intervention. **U | G**



## Suicide prevention for LGBTQ+ youth

Suicide is the second leading cause of death among youth and young adults, and LGBTQ+ youth are at particularly heightened risk of suicide. Yet no known empirically supported suicide prevention programs exist for this population. Psychology professors **Aaron Blashill** and **Kristen Wells** are developing an intervention that will address this disparity. Their National Institute of Mental Health-funded research considers ways to help people overcome barriers to mental health care, build coping skills and increase their connection to the LGBTQ+ community. By targeting mechanisms theorized to underlie suicidality—for example, decreasing thwarted belongingness and increasing suicide-related coping skills—their work aims to improve the mental health of a globally vulnerable population. **U | G**

“Our intervention is not meant to replace therapy, but rather to connect participants with such treatment and support resources and to help them develop coping and safety planning skills.” **Kristen Wells**



LGBTQ+ community members at the Transgender Wellness Center in Los Angeles. Researcher Erik Storholm is partnering with the center to conduct a first-of-its-kind research project. Courtesy photo



# MILITARY AND SECURITY

Whether they are examining the experiences of service members or using state-of-the-art technology to improve military vessels and security systems, SDSU researchers work closely with the nation's top security agencies to ensure health and safety.

The story of Marine Michael Dutcher (pictured above), who was killed in an explosion during the Afghanistan War, is featured in 'Third Squad'. Photo by Elliott Woods

# Documentary podcast walks in Afghanistan veterans' boots

By Leslie L.J. Reilly

Historian **Gregory Daddis**, director of San Diego State University's [Center for War and Society](#), and journalist and former combat engineer **Elliott Woods** received a National Endowment for the Humanities Chairman's Grant to produce a documentary podcast on U.S. Marines in the Afghanistan War.

"Third Squad" explores the wartime and homecoming experiences of a group of Marines who served during the 2009-11 troop surge, the most violent phase of the war.

The podcast explores factors that contributed to making the Afghanistan War as distant from public consciousness as it is from American soil, Daddis said.

"It also examines the potential consequences of failing to adequately reckon with its history," he continued. "During the last 20 years we, as a society, have not been fully engaged with our overseas military ventures. As a society we've become numb to it."

Woods, who served in Iraq with the National Guard in 2004-05, was embedded with a Marine platoon in 2011 as a photojournalist at their patrol base in Sangin, Helmand Province, Afghanistan, where he completed interviews, created portraits and followed along on their daily patrols.

One of the Marines, **Michael Dutcher**, a soft-spoken 22-year-old from Asheville, N.C., made a particularly deep impression. Tragically, Dutcher stepped on an improvised explosive device and was killed just a few weeks after Woods left the patrol base.

"Third Squad" tells the story of Dutcher's life and examines how his death affected the lives of his fellow Marines and his family in the decade since.

Since coming home from Afghanistan, the 11 surviving squad members have wrestled, each in their own way, with the trauma of the war and the challenges of adapting to civilian life and moving through the normal stages of adulthood—from finding long-term employment to marriage and raising children.

The podcast shows how the war experiences shaped them, how they make sense of the extremely dangerous and difficult mission they were tasked with, and how their thoughts about the war have evolved over time.

## Long journey

Woods, who joins SDSU as a history lecturer in the spring of 2022, drove 12,897 miles and spent 300 hours behind the wheel while traveling the U.S. in March and April to interview the squad members and members of Dutcher's family.

"I knew I was going to ask them about extremely personal and traumatic memories and I wanted to handle the conversations with sensitivity. I had no idea how they would react," Woods said.

In the end, his anxieties proved to be misplaced.

"Each of the Marines welcomed me into their lives just as they'd welcomed me into their squad ten years ago," Woods said.

The resulting interviews paint a poignant portrait of these men, during and after their time in Afghanistan—telling a story of the long-lasting effects of war. "Third Squad" will also provide new perspectives for the public and for policymakers moving forward.

"I hope we can educate listeners about the personal history of the Afghanistan 'surge,' but I also hope that we can encourage people to talk about the post-9/11 wars with their friends, family, and communities," Woods said. "As an Iraq veteran, I can say that the hardest part of readjusting has been the silence—the near-total disconnect between the wars and society back home."

"We need to talk about the wars, and we also need to listen. I hope our podcast is an invitation to start doing both," Woods continued.

The 12-part podcast hosted by Woods and produced by Airloom Media is distributed by iHeart Media and available for streaming on all major podcast platforms.

 [Listen to the "Third Squad" trailer.](#)



Gregory A. Daddis



Elliott Woods

## SPOTLIGHTS

### Preventing military suicide

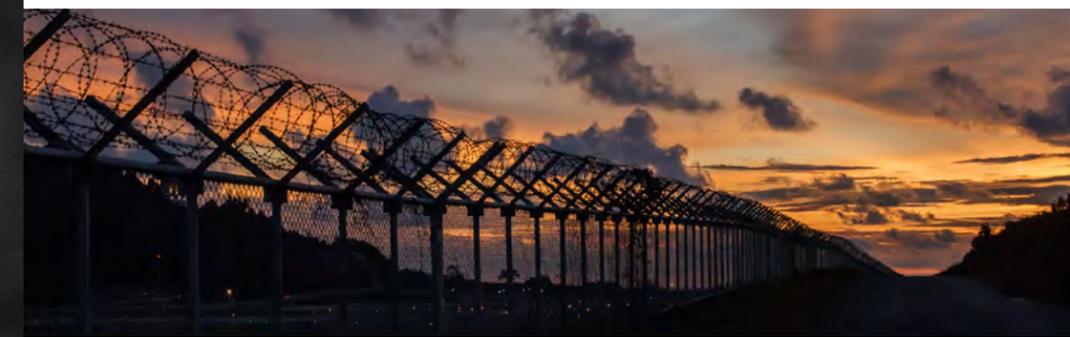
Suicide rates among military service members have risen in recent decades. When someone dies by suicide, they leave behind family and friends who may be profoundly affected by their deaths. With support from the Military Suicide Research Consortium, public health researcher **Emily Schmied** is examining the effects of suicide exposure among active duty military service members. Schmied's research will help mental health providers understand how service members are affected by suicide and inform the development of tailored programs designed to help those bereaved by suicide cope.



In 2020, 580 U.S. active duty service members died by suicide.

### Using augmented reality to improve security

Augmented reality has the potential to revolutionize how we work, collaborate and process digital information through three-dimensional space by allowing the viewer to experience a real situation in a digitally enhanced way. Management information systems professors **Aaron Elkins** and **Bongsik Shin** are developing augmented reality- and artificial intelligence-based systems to support smart maintenance operations, prevent terrorism and improve border security. With funding from the U.S. Navy and Department of Homeland Security, the pair is creating system prototypes that will help U.S. Navy technicians and border security staff work more efficiently and effectively. **U | G**



Innovations from SDSU can help make the U.S.-Mexico border safer.

### Enabling faster and more efficient vehicles

Engineer **Xiaofeng Liu** studies turbulence flow in vehicles like warships, submarines and aircraft. With funding from the U.S. Army, Liu has acquired a toolkit that allows his lab to measure turbulence with extreme accuracy. The equipment uses particle image velocimetry to take ultra-fast images—anywhere from 20,000 to millions of frames per second—of particles in water or air flows. Paired with a newly built state-of-the-art water tunnel, the equipment measures velocity and pressure distributions non-intrusively, leading to data that is highly detailed and placing Liu's lab as a cutting-edge hub of turbulence research.

"These instruments allow us to obtain accurate, three-dimensional turbulence data, which is essential in designing and building faster, more efficient and less noisy ships," Liu said. "With improved design and less drag, there is a phenomenal economic savings on fuel."

 [View companion video](#)

# HEALTH SCIENCE

From the neurons in your brain to the microbiota in your gut and beyond, SDSU researchers are improving human health from every angle.

Does consuming less than the recommended levels of apples and other common fruits noticeably affect health? SDSU researchers are embarking on a study to find out.

# Childhood irritability may signal future problems

By Padma Nagappan

Tantrums in the supermarket and meltdowns at social gatherings are almost a rite of passage for many children—and a lesson in patience for their parents.

But what if this irritability is chronic and a sign of serious mental health issues that may only present later in life?

That's the question researcher **Jillian Lee Wiggins** focuses on in her quest to develop a model for assessing whether a child will outgrow fractious behavior or if it presents a risk for conditions such as depression, anxiety and suicidal thoughts, or poor academic outcomes.

The San Diego State University psychologist recently received two significant grants from the National Institutes of Health to study early childhood irritability and the neural mechanisms of risk for serious issues as they transition to adolescence.

Wiggins first embarked on this research pathway as a postdoctoral researcher at the NIH in Bethesda, Md. Her **TEND** (Translational Emotion Neuroscience and Development) lab at SDSU focuses on the development of

social and emotional functioning.

Wiggins' **Brains in Growth (BIG) Emotions** study will examine behavioral issues as preschool-age children transition to kindergarten by conducting brain scans at the SDSU MRI Center and videotaping their interactions with parents. Her collaborator Lea Rose Dougherty, a psychologist at the University of Maryland, will code the children's behavior and facial expressions, mapping the differences between how they look on the outside compared to how they are wired on the inside.

For the adolescent group, Wiggins will review brain imaging data from a larger study of 11,000 children conducted by a consortium of universities across the country to map neural mechanisms that indicate signs of deeper trouble.

"Jillian Wiggins applies state of the art neuroimaging techniques in creative

ways to gain important, practical insights into child and teen behaviors," said Jeff Roberts, dean of the College of Sciences. "She exemplifies SDSU's commitment to research that makes a difference and better the human condition."

Wiggins is hoping her research can lead to more efficient and inexpensive ways to treat childhood irritability.

"Right now, if you take a tantrum-throwing child to a psychologist, they'll have you try one method, then another and another. It's a terrible way to go about it," she said. "I'd like to see a family come to a physician or psychologist and share behavioral issues, then be given a lab test, based on our MRI research, which would indicate whether they need treatment and if so, which one."

An evidence-based screening method, Wiggins adds, will help providers better tailor treatment to children. **U | G**

## SPOTLIGHTS

### Combating antibiotic resistant biofilms

Overuse of antibiotics has led to the emergence of multidrug resistant pathogens, which render even the most effective antibiotics ineffective. More than 90% of chronic wounds contain microbial biofilms that exhibit antimicrobial resistance. Eradicating these pathogens from chronic wounds is challenging, but bacteriophage therapy is emerging as a new tool to combat biofilms.

Virologist **Dwayne Roach** develops bacteriophage-based therapeutics and examines how phages influence human health. In collaboration with CFD Research Corporation's Innovation Center, he is developing a microfluidic impedance-based bacteriophage capture and antibiotic film analyzer. The portable tool will provide a robust and cost-saving system for evaluating environmentally sourced bacteriophages that kill drug resistant pathogens. **U | G**

### Does two cups of fruit a day keep the doctor away?

Current fruit consumption is well below federal recommendations, but little research exists on the role of increased fruit consumption on specific disease prevention strategies.

Professors **Shirin Hooshmand, Mark Kern, Scott Kelley, Erica Forsberg, Mee Young Hong and Changqi Liu** are addressing this gap with the first randomized clinical trial examining consumption of fruit and resulting changes in the gut microbiome and metabolome.

By studying the impact of a combination of the six most commonly eaten fruits—apples, oranges, bananas, grapes, strawberries, and watermelon—at the government-recommended level (two cups per day) vs. a more typical intake level (1/2 cup per day), their work provides important information about differences in gut microbiota, risk factors for cardiovascular disease, cognition and motor performance in healthy adults. **U | G**



Graduate student Shania Zingales demonstrates the use of the Purdue Pegboard, which researchers use to determine if fruits can improve motor control. Photo by Chris Leap

### Improving outcomes for autistic adults

A services cliff exists for people on the autism spectrum as they enter adulthood, resulting in reduced life expectancy, high rates of health conditions and other chronic issues. In work supported by the National Institute of Mental Health, **Mary Baker-Ericzén** measures the health, function, and social well-being in these adults.

Evaluating autism services requires validated patient-reported outcome measures. While such measures exist for many outcomes related to the autistic community, most have not been adapted to meet the needs of autistic adults. Baker-Ericzén and a team of researchers are partnering with autistic adults, family members and service providers to create targeted evaluations of interventions for autistic adults. Their end goal: improving services and quality of life. **U | G**



Researchers are developing targeted interventions for adults on the autism spectrum.



# CONFRONTING COVID-19

From health disparities to educational setbacks, SDSU researchers address the pandemic's impact on vulnerable populations.

SDSU nursing students help administer vaccines. Courtesy photo

# Examining COVID-19's damaging impact on higher education



## Eliminating barriers for farmworkers

Despite the high rate of vaccination in Imperial County and the critical importance of farmworkers in this multi-billion-dollar agricultural community, farmworkers have an outsized risk of contracting and dying from COVID-19.

Social work professor **Annie Keeney** studies the social and political factors related to agricultural occupational health and safety and how community networks can improve outcomes for people in rural communities. With support from the Western Center for Agriculture Health and Safety at UC Davis and the Centers for Disease Control, Keeney and fellow SDSU researcher **Amy Quandt** are examining health and safety needs, access to COVID-19 testing and vaccination, and COVID-19 related stressors among farmworkers in Imperial County. Their work will inform county vaccination efforts by identifying barriers that farmworkers face in order to extend COVID-19 support. It will also reduce the health and safety disparities Imperial County farmworkers experience, improving safety for them and their families. **G**



Collaborator Luis Flores handing out PPE from WCAHS to farmworkers at transit sites in Imperial County. Courtesy of Imperial Valley Equity and Justice Coalition

## By Michael Klitzing

From learning loss to social-emotional wellbeing, the adverse effects of COVID-19 on K-12 education are well documented. But in higher education, the pandemic has also wrought a less publicized—but no less devastating—toll on racial equity.

Two San Diego State University College of Education faculty members are advancing research to shed light on the scope of the damage done and develop recommendations on how it can be repaired.

## Racial Equity at Community Colleges

Education professor **Eric Felix** is leading an 18-month project exploring how COVID-19 affects racial equity efforts at community colleges. With support from the College Futures Foundation, Felix is examining how the pandemic impacted the plans for addressing pressing outcome disparities put forth by student equity leaders on California campuses.

“Since the pandemic, there has been much disruption throughout higher education, including temporary pauses to on-campus programs, shifts to remote work and concerns about future budget reductions,” Felix said. “At the same time, amplified calls for racial justice have put issues of racial inequity at the center of campus conversations.

All of these changes significantly influence planned efforts to close equity gaps for racially minoritized students.”

Using a critical organizational studies lens, Felix is exploring how four different student equity leaders navigate the pandemic, their unique organizational dynamics and the challenges of remote work to sustain, adapt and advance student equity efforts. The project will inform policymakers, state-level actors and practitioners to navigate and advance racial equity efforts in our current social context.

## Investigating ‘COVID Melt’

Researcher **Laura Owen** is examining a new phenomenon called “COVID Melt.” It’s a variation of “Summer Melt”—a well-established phenomenon in higher education where a significant number of high school seniors intend to enroll in college, but do not show up to campus the semester following high school graduation.

For students from large urban school districts, that number ranges from 21% to 50%. Since the start of the pandemic, those numbers have worsened.

According to the National Student Clearinghouse, direct high school to college enrollment for Fall 2020—the first post-pandemic incoming class—dropped by 21%. At schools with high numbers of minority students, the drop is much higher at 33%.

“We have some warning alarms that are sounding and need to figure out what’s happening,” Owen said. “Our immediate concern is who will reach out to these students? They’re not high school students anymore, they’re not college students yet and no one has them on their radar. How are we going to understand who they are and where we can reach them?”

With funding from The Kresge Foundation, Owen is piloting surveys to develop an understanding of the complex factors that led students to withdraw from or not enroll in

college amid the pandemic. She plans to develop counseling and advising resource tools based on the archetypes that emerge, and disseminate that information through a partnership with the [American College Application Campaign](#).

**“We are not willing to let the pandemic erase gains.”**

**Y. Barry Chung**

## A focus on diversity and access

Both projects exemplify the College of Education’s social justice mission — particularly its central tenets of advancing diversity and expanding access to a quality education.

“Our faculty have been at the forefront of the effort to close equity gaps and break down barriers to higher education,” said **Y. Barry Chung**, college dean. “Studying the intersection of COVID-19 and equity is crucial and I am excited to see the solutions the work of Eric and Laura will uncover.” **G**



SDSU educators are studying how COVID-19 has affected racial equity efforts at community colleges.

# International coalition works to increase vaccination in underserved communities

By **Leslie L.J. Reilly**

COVID-19 vaccination rates in South San Diego County have risen above the national average, thanks in part to the heroic efforts of San Diego State University anthropologists and public health experts.

“We are helping to crack open the nut of vaccine hesitancy,” said **EJ Sobo**, chair and professor of anthropology, and a leader of SDSU’s CommuniVax program.

ComuniVax, a national coalition led by Johns Hopkins Center for Health Security and Texas State University and funded in part by the Chan Zuckerberg Initiative and the Rockefeller Foundation, selected six research teams from across the nation to collaboratively strengthen vaccination efforts for underserved communities. The San Diego team’s selection reflects SDSU’s deep roots within the Latinx community, proximity to the border region, and its

designation as a Hispanic-Serving Institution (HSI).

The SDSU CommuniVax team’s local report, released in September, recommended three essential actions based on nine months of fieldwork:

1. Elevate community health workers (also known as promotores or promotoras) to a central position in the public health enterprise.
2. Ensure that vaccination sites feel safe, welcoming and accessible to all.

3. Provide technology skills education and promote digital media, scientific and health literacy.

Further, to create systems-level changes and advance health equity broadly, the report endorsed developing a national immunization program, rebuilding the public health infrastructure to properly staff it for community engagement, and providing stability for the community health system as the backbone for equity and resilience.

**Corinne McDaniels-Davidson** and **Susan Kiene** and graduate students **Diego Ceballos** and **Sarah Song**.

Project manager **Griselda Cervantes**, who holds a master’s in public health, coordinated the team’s interviews with community leaders and community members to learn about their experiences during the pandemic and thoughts about COVID-19 vaccines. The team also held focus groups and connected with leaders to

“We are moving the dial toward a better infrastructure for disenfranchised communities.”

EJ Sobo

In fall 2021, public health professor and CommuniVax co-leader **Noe Crespo** briefed senior White House advisors on the coalition’s findings, related to health disparities, COVID-19 equity and public engagement.

“One of our goals was to generate evidence, and recommendations that can then be used to inform policy,” Crespo said. “We were pleased that they were very engaged and receptive to the information we shared.”

In addition to Sobo and Crespo, the core SDSU CommuniVax team includes public health professors

hear their perceptions about what their communities need in order to recover from the pandemic.

The team worked with the Mexican Consulate, the San Diego County Health and Human Services Agency, the Diocese of San Diego, the Chula Vista Community Collaborative, and other local Hispanic-serving organizations, making helpful connections and providing funding guidance. Cervantes said community-based organizations don’t always know about all the funding sources that they can tap into to support their efforts. **U | G**

## Confronting health disparities

The university’s largest pandemic-related program, Communities Fighting COVID! (CFC), supported by the National Institutes of Health and the County of San Diego Health and Human Services Agency, has reached roughly 27,500 people through contact tracing and vaccine outreach and 22,000 people through testing efforts.

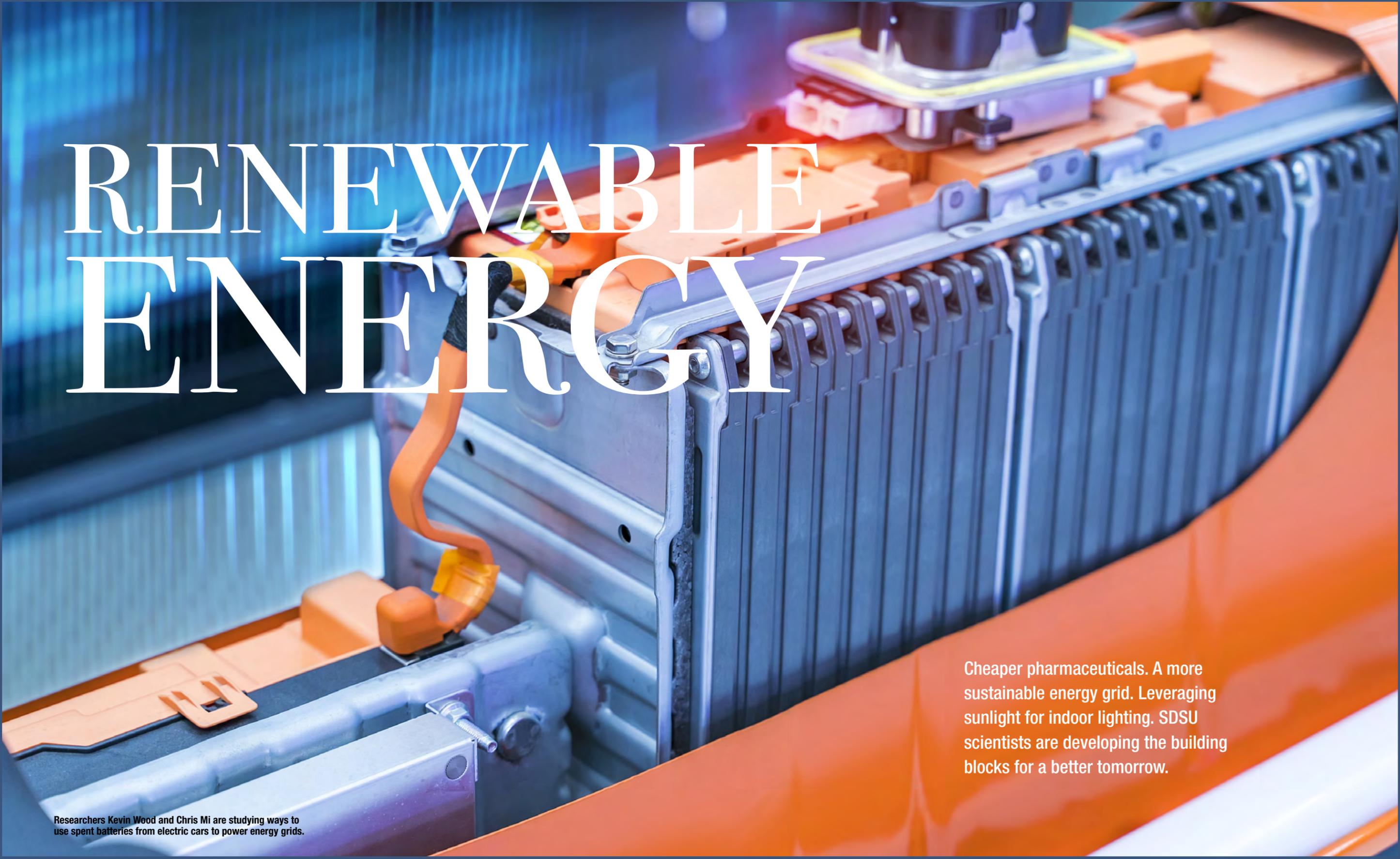
Due to factors ranging from language barriers to transportation issues, people of color are disproportionately affected by COVID-19 and more likely to get seriously sick from the disease. Led by public health researchers **Susan Kiene**, **Eyal Oren**, **Corinne McDaniels-Davidson** and **Hala Madanat**, CFC focuses on combating these health disparities and improving outcomes for underserved communities. CFC has supported the reopening of schools in underserved communities by expanding on-site testing in schools, and the researchers are determining how to best scale up free at-home COVID-19 testing for students, school staff and their families in an effort to further reduce the number of COVID-19 cases in schools. **G**



An SDSU community vaccination site. Courtesy photo



SDSU-trained community health workers were essential to reducing COVID-19 in San Diego. Courtesy photo



# RENEWABLE ENERGY

Cheaper pharmaceuticals. A more sustainable energy grid. Leveraging sunlight for indoor lighting. SDSU scientists are developing the building blocks for a better tomorrow.

Researchers Kevin Wood and Chris Mi are studying ways to use spent batteries from electric cars to power energy grids.

# Tomorrow's energy grid could use yesterday's spent batteries

By **Melinda Sevilla**

By 2035, all new cars and passenger trucks sold in California must be zero emission vehicles.

The state executive order aligns with increased demand for electric power nationwide, highlighting the need for sufficient power grid capacity to power so many zero emission vehicles.

Electrical engineer **Chris Mi** and mechanical engineer **Kevin Wood** are working on a three-year, California Energy Commission-funded project to do just that.

The pair is developing a commercial scale power grid system using photovoltaics—converting light into electricity to generate power—to create reliable and cost-effective

repurposed electric vehicle (EV) batteries.

The novel approach uses the sustainable solution of storing this generated power within second-life EV batteries.

Second-life EV batteries, or EV batteries that reach below 80% power, are typically considered to be no longer useful. However, recycling options are costly and energy-consuming.

“If we wanted to take those batteries and re-mine the components out of them, it would take a lot of energy,” Wood said. “We thought, why don’t we use these batteries, even though they’re at 80%? That’s more than fine for grid scale storage.”

To find used electric vehicle batteries to work with, Mi and Wood work with automakers and salvage yards to obtain defunct batteries for the project.

Once a site is selected, the researchers will work on the physical construction of the grid systems. They plan to base grid construction off of predictive modeling to ensure a long grid life.

“We’ll figure out the specific sites’ energy demand usage to forecast what we’re going to need to do in terms of maintenance, replacing parts, and seeing how quickly the grid degrades,” said Wood.

The project aims to ensure that the second-life EV batteries will last for a minimum of 10 to 15 years as part of a grid storage application with a degradation rate of 3% or less annually. To monitor this and to avoid any safety concerns, the team has created a communication system for the future battery operation systems to easily identify the health of each battery.

“I see batteries as a black box; I focus on how to make the status of the battery more accurate and safer overall,” said Mi.

This added power grid storage will ultimately allow for greater reliability of electricity to California ratepayers, a priority after a power crisis in Texas earlier this year left millions without power and in unsafe conditions.

Mi and Wood hope their work will prove that second-life batteries save money and offer a sustainable solution to the growing demands on the nation’s energy grid. The project is projected to save households and companies at least 30% on energy costs.

“This project will help the environment by reducing recycling and reducing the need for raw materials,” Mi said. “It will also resolve conflicts and tensions over raw materials in certain regions.”

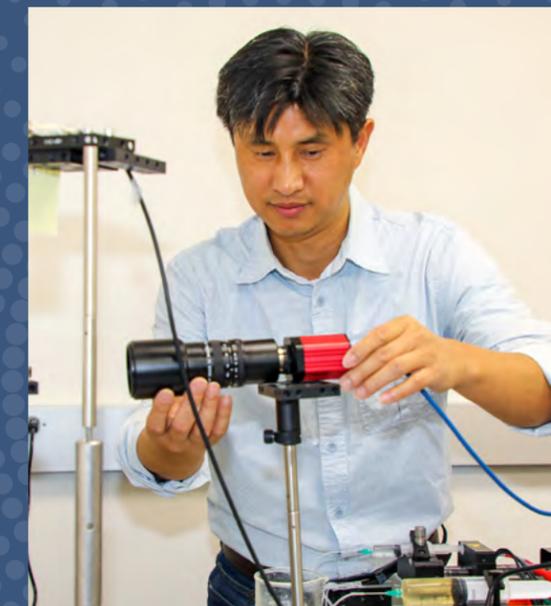
Mi and Wood envision many benefits from the project, including a planned pilot demonstration project in the San Diego region in 2022 and expanding the technology to further locations to meet demands as electric vehicles increase in popularity.

“Currently, just five people on a block charging their electric vehicles can cause grid issues,” explained Wood, who envisions his power grid system being a game-changer for a green future. “We want everybody to be able to charge their electric vehicle and be able to turn their lights on.” **G**

## Improving solar lighting

Engineer **Sung-Yong (Sean) Park** studies the intersection of light and the behavior of fluids through small channels for energy systems, called optofluidics, which enable technologies like solar energy. Park received a highly selective National Science Foundation CAREER award to develop a novel optofluidic lighting approach that uses rooftop solar energy and excess sunlight to illuminate the inside of commercial buildings—which are the largest source of energy consumption in the country. Park’s optofluidic method allows for more sunlight to be directly used for indoor buildings, and for the user to have control of the brightness level and power status of the lighting. **U | G**

 [Read companion article](#)



Sung-Yong Park demonstrates of the optofluidic process. Photo by Scott Hargrove

## Developing more sustainable pharmaceuticals

By leveraging renewable solar energy, SDSU chemistry professor **Yong Yan** has developed a more sustainable way to produce the critical chemical bonds necessary to make pharmaceuticals. Yan’s novel process uses a solar cell material called perovskite to act as a catalyst, spurring the chemical reactions needed to bond elements and make drugs. Perovskite is exponentially cheaper and more efficient than other catalysts currently used in drug synthesis. Yong’s Department of Energy-supported work allows him to collaborate with the National Renewable Energy Laboratory and develop a more affordable and sustainable method of using solar energy to produce highly valuable molecules. **U | G**



Yong Yan discusses catalyst design with graduate student R. Zhao. Bottom: Perovskite is a powerful catalyst that strongly absorbs and emits light. Photos by Scott Hargrove

 [Watch companion video](#)

Second-life electric batteries may be the key to developing more sustainable energy grids.

# 2020-2021 by the numbers

**3**

SDSU PILOT  
INNOVATION  
FUND AWARDS

**296**

STUDENT RESEARCH  
SYMPOSIUM  
PARTICIPANTS

**\$16.9M**

GREW FACULTY  
AWARDS

**72%**

ARE FEDERAL  
AWARDS

AWARDS  
**\$140.6**  
MILLION

NIH  
FUNDING  
**\$32.3M**

**5**

NIH EARLY CAREER  
K AWARDS

**\$9M**

NSF  
FUNDING

**\$7.6M**

COVID  
AWARDS

NUMBER OF  
SPONSORS

**289**

**5,583**

GRADUATE  
STUDENTS

**4**

NSF CAREER  
AWARDS

**320**

NUMBER OF  
PRINCIPAL  
INVESTIGATORS

NUMBER OF  
AWARDS

**723**

**23**

DOCTORAL  
PROGRAMS

HISPANIC  
SERVING  
INSTITUTION  
GRANT FUNDING

**\$1.7M**



SAN DIEGO STATE  
UNIVERSITY

HIGHLIGHTS 2020/2021