
CSU
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TRANSFORMING TOMORROW
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CSU research, scholarship and creative activity positively impact student success and faculty excellence with opportunities to explore, investigate and solve the issues facing California's diverse communities, the nation and the world. The hallmark of a CSU education includes experiential learning to engage, retain and propel students to successful careers. Within the following pages are delightful exemplars from our 23 campuses and 10 affinity groups that showcase innovative applications of discoveries and the creation of new knowledge.

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AFFINITY GROUPS

CSU CAMPUSES

TRANSFORMING TOMORROW

CSU research, scholarship and creative activity provide transformational learning opportunities for students, while benefiting California, the nation and the world.

On behalf of the entire California State University, I congratulate the students and faculty who distinguish themselves through exemplary research, scholarship and creative activity. Working together, they advance knowledge, understanding and creative expression at the forefront of their disciplines to benefit California's diverse communities, the nation and the world.

Through research and the creative process, students learn to challenge their assumptions, refine their approaches and open their minds to new possibilities. They sometimes discover that facts can be elusive, stubborn and inconvenient, but that systematic investigation can open the door to new and innovative solutions. Armed with this knowledge, they develop teamwork and problem-solving skills that prepare them for a lifetime of discovery and achievement.

The success of research and creative activities across the CSU is the product of engaged faculty mentors who provide students with collaborative opportunities and informed guidance. Such activities also help faculty advance their fields of expertise, providing them with opportunities to explore new possibilities and to integrate contemporary scholarship into the curriculum.

Preparing a diverse and educated workforce grounded in the meticulous pursuit of knowledge is both consequential and transformative. It directly aligns with the vision statement of the CSU's 2019 Strategic Plan for Research to "engage students, develop faculty, grow the economy and advance the discovery and dissemination of knowledge."

I have often noted that the CSU is a powerful economic engine for California, a state ranked as the largest economy in the U.S. and the fifth-largest in the world—so it is appropriate to highlight the vital roles that research, critical analysis and innovation play in energizing that economy, while powering fundamental breakthroughs in health care, science, engineering, the arts and dozens of other fields.

At the CSU, a hallmark of our scholarly efforts is a focus on directed research, which can be applied swiftly to solve society's most urgent and vexing problems. From Cal State East Bay alumna Sara Toyloy—who develops and manages processes to ensure that drug-eluting stents for heart attack patients are approved as quickly as possible for use across the nation and around the world—to San José professor Dr. Katie Wilkinson's work on neurophysiology that identifies therapies for patients with prosthetic limbs—the research conducted by CSU students, faculty and alumni is clearly consequential.

With student success as our measuring stick and inclusive excellence as our North Star, the CSU continues to prepare each new generation of researchers, artists, performers and scholars to carry on the spirit of collaboration, innovation and community.

On the following pages, you will find compelling stories from the 23 campuses and 10 affinity groups across the CSU where students and faculty engage in research, scholarship and creative activity. While their projects run the gamut from biomedicine to the humanities and the social sciences, they all support the CSU's ultimate mission to inspire students, advance knowledge and enrich our communities.

I am confident that you will enjoy discovering how our students and faculty are transforming tomorrow.

Timothy P. White
Chancellor

SARA TOYLOY— COMMUNITY SUCCESS STORY

CSU research, scholarship and creative activity provide experiential learning that prepares leaders who enhance California communities. Alumna Sara Toyloy exemplifies the impact that CSU graduates have in transforming tomorrow. Sara reflects on her journey from CSU East Bay student to president of Fabrica LLC, a leading medical device and clinical consulting company. Sara and many others who followed in her footsteps credit CSU faculty and staff who mentored them by being outstanding guides. Sara's advice to students: "Never underestimate your capabilities."

Sara Toyloy has always enjoyed a challenge. In fact, a challenge from her cousin led her to attend what was then Cal State Hayward.

After graduating from high school at age 15, Toyloy was invited by her older cousins Joan and Ernest Simien from her small island home in the Caribbean, St. Vincent and the Grenadines, to visit them in Fremont, California. During Sara's visit, her cousins took her up to the Hayward campus to admire the bay view and asked her whether she'd want to attend school there.

Not long after, with approval from the university's president because of her age, Toyloy enrolled in classes.

"It was absolutely frightening those first few days, walking around a huge campus," she said.

She grew her career to become president of Fabrica Consulting, LLC specializing in global medical device regulatory and clinical consulting. She was previously president of new therapies and chief regulatory officer of Elixir Medical Corp. In Milpitas, California, where she oversaw the clinical, regulatory and quality teams for devices such as drug-eluting stents for heart attack patients.

It's a challenge that suits her just fine.

Although Toyloy started out as a research scientist after graduating, she transferred into the regulatory affairs department, where she quickly gained a reputation for succeeding where others hadn't and she began to receive the "disaster projects."

After learning through many difficult assignments, Toyloy landed one of her greatest successes—a device that received approval from the U.S. Food and Drug Administration (FDA) approval in only 113 days, a record at the time for the industry.

The work is intrinsically satisfying, although Toyloy says it can take stepping back from the day-to-day sometimes to see that.

"In reality, everything that we do on a daily basis also has a great impact on human life, not just in the U.S. but around the world," she said. "Heart disease is still the No. 1 cause of death but, slowly and surely, we're reducing that year over year."

Her tenacity and drive, which helps push devices through FDA regulations and other global approvals, existed long before she ever took a job in the industry. And it comes with a healthy sense of duty.

"Looking at the opportunities I was given to come to the U.S. and attend university I felt I needed to earn my opportunity and make good on that, not only in graduation but also in every opportunity that I have since had in my career, " Toyloy said when asked what drives her.

As a student, that meant taking classes such as the history of jazz that would help her, not just in school, but as a student of life.

"I would write to all my friends back home and tell them what I was learning," Toyloy said. "[Cal State East Bay] gave me a well-rounded foundation, not only in my subject matter, but also as a human being."

One class, an organic chemistry course with Leroy Chauffe, was particularly memorable. After receiving a 93 on an exam and realizing someone she regularly competed with in class received a 94, Toyloy went to Chauffe's office to contest the score. He asked her a question that she still references today.

"He said, 'Why are you here trying to get a 94 instead of being happy with your 93, which is your highest score yet? Stop and take a minute to enjoy what is good,'" Toyloy recalled.

It's a reminder she said current students should hear as well.

"Never underestimate your capabilities," she said. "You should be very proud of the education you are receiving at Cal State East Bay. It is a strong, solid foundation, and it can allow you to compete at the highest level in all career choices."

AGRICULTURE RESEARCH INSTITUTE

The Agriculture Research Institute (ARI) engages the collective expertise of CSU colleges of agriculture and other related programs across the CSU, in partnership with agricultural and natural resource industries, to conduct applied research that benefits California agriculture, natural resources and food systems while cultivating the next generation of agricultural leaders.

BIOMASS-TO-ENERGY—CARISSE GERONIMO'S RESEARCH HELPS FIGHT CLIMATE CHANGE

Clean power sources, such as wind, solar, hydropower and biomass-to-energy, will provide all of California's energy by 2045. In 2018, 91 biomass power plants in California produced about three percent (5.9 gigawatt-hours) of the state's power from biomass conversion. Primary sources of biomass are byproducts and waste from agricultural crops, lumber milling and forest residues.

Climate change has increased the frequency and depth of drought, destroying tens of millions of trees in California forests. Left standing, these dead trees fuel and increase the risk of larger and more deadly forest fires. The dead trees can be harvested, processed and shipped to biomass-converting power plants, where they are stored in enormous chip piles. Over time, the chips slowly decompose, changing their physical and chemical properties and energy content. Carisse Geronimo, a master's student at Humboldt State University, is working on a research project that will help biomass plants manage their chip piles to retain or improve the energy content of the wood chips to ensure this biomass source remains economically competitive.

Geronimo has always liked science and math. While growing up in Bakersfield, she spent a lot of time hiking in the San Gabriel and Sierra mountains with her dad. When it came time for college, she wanted a major that would allow her to combine science with resource conservation and sustainability. Geronimo started as a chemistry major at CSU Bakersfield and worked in a biochemistry lab during her sophomore and junior years. Under the direction of Dr. Karlo Lopez, she studied structure and function of lysyl oxidase, an enzyme that inhibits cancer cells during cancer's early stages, but at later stages appears to promote metastasis. By her junior year, Geronimo had second thoughts about a chemistry degree and changed her major to biology.

After Geronimo graduated from CSU Bakersfield in May 2018, she found a program at the Schatz Energy Research Center at Humboldt State that combined the technical side of science with science advocacy and policy. She applied for, and received, the Donald and Andrea Tuttle Fellowship for Clean Energy Studies. This scholarship supports students interested in reducing the effect of climate change on humanity and ecosystems. She is working under Dr. Sintana Vergara and Dr. Kevin Fingerman, both faculty research associates at the Schatz Energy Research Center.

Geronimo started work on a biomass feedstock project in fall 2018. The project, co-funded by the CSU Agricultural Research Institute, seeks to understand what factors affect the decomposition and energy content of wood within these enormous wood chip piles. In her experiments, chips of various ages and tree species are subjected to different temperatures, moisture content and oxygen concentrations, and their decomposition rates and energy content are measured. Geronimo's group monitors the physical and chemical properties of the wood chips that, during decomposition, emit greenhouse gases (carbon dioxide, nitric oxides and methane). She has found that the energy in biomass feedstock is related to its moisture content and age of the chip. As the wood decomposes, energy is released into the atmosphere, lowering the economic efficiency of the biomass plant. Geronimo's experiments will provide insight on how to manage the decomposition process and retain heating value, energy content and reduce greenhouse gas emissions. Their early data indicate that

separating chips by age, instead of mixing them, may be the easiest and most effective way to retain energy value.

Upon graduating, Geronimo would like to continue with similar environmental science-related work. Her long-term goal is to use her science knowledge and training to help inform public policy.

FROM A STABLE TO THE LABORATORY BENCH, GABI HERNANDEZ'S UNEXPECTED PATH TO A RESEARCH CAREER

Gabriella "Gabi" Hernandez grew up riding horses in Chino Hills, California. When not in school, Hernandez spent her time at the Silver Rose Ranch, where she boarded her horse, gave riding lessons and helped teach at the ranch's summer camps. From an early age, Hernandez planned to be a large-animal veterinarian. Upon the advice of an alumna from California Polytechnic State University, San Luis Obispo, she met at the ranch, Hernandez applied to and was accepted into Cal Poly San Luis Obispo. During her sophomore year, she started working at the Cal Poly feed mill, where she mixed food rations for the farm animals, drove forklifts, moved and stacked 50-pound feedbags and learned about food safety and Hazard Analysis Critical Control Points, a systematic approach to the identification, evaluation and control of food safety hazards. She participated in research studies and was responsible for adding supplements to feed. These studies required careful weighing, dosing and recordkeeping, which fit well with her detail-oriented personality, and she loved the challenge of the research and its additional responsibilities.

Cal Poly San Luis Obispo's animal science curriculum requires students to take a variety of classes, including enterprise classes, which allow students to discover the breadth of careers beyond veterinarian medicine. Enterprise classes are "learn by doing" educational experiences. In an enterprise class Hernandez affectionately called "Swine 101" (formally "Animal Science 290—Swine Management"), she learned just about everything about swine by raising her own pigs.

Swine 101 and Hernandez's job at the feed mill converged during her junior year, when she took an advanced animal science nutrition class. The professor, Dr. Rodrigo Manjarin, assigned reading assignments from science journals and asked students to submit written responses that included analyses and discussions of the research methods and conclusions described in the papers. Dr. Manjarin liked Hernandez's writing and critical thinking skills and suggested that she consider a career in research. He also suggested a research internship with Dr. Lindsey Hulbert at Kansas State University through Cal Poly San Luis Obispo's Summer Undergraduate Research Program (SURP). Dr. Hulbert's research centered on the development and validation of automated technologies to monitor health and welfare of domestic animals. Hernandez learned a lot about animal behavior, particularly pig behavior, but concluded this area of research was not going to be her career. Being far from home and school was both challenging and rewarding. She felt out of her comfort zone, without friends and family, but she said it helped her mature. She highly recommends an away-from-home research experience to her fellow students.

During Hernandez's senior year, Manjarin asked her to stay at Cal Poly San Luis Obispo to pursue a master's degree. Her research project, co-funded by the CSU Agricultural Research Institute, examined the effect of probiotics in protecting early weaning pigs from nonalcoholic fatty liver disease (NAFLD).

During pig production, newborn pigs may be weaned early to increase sow productivity. To increase their appetite, piglets are given sweeteners, which can cause an imbalance of their gut microbiota that results in diarrhea. Probiotics may help protect against the diarrhea and result in better piglet health and growth. Manjarin's research team hypothesized that the high sugar diets of the weaned piglets might lead them to develop a pattern of liver injury resembling pediatric NAFLD, and studying the effects of these diets in Iberian pigs may lead to insights into this disease in humans. Hernandez ran the Iberian Pig Enterprise, overseeing a team of undergraduates to feed the pigs every six hours for 10 weeks and weigh the pigs every three days. Their research found that neonatal Iberian pigs fed a high-fat, high-fructose diet developed a pattern of liver injury resembling pediatric NAFLD, confirming that these animals could be used as a translational model to understand the disease in humans. The second part of Hernandez's study was to determine whether a mixture of probiotics added to the pigs' feed would prevent the disease. The team found that probiotics did not prevent NAFLD from developing in pigs nor did it ameliorate its severity.

Hernandez completed her master's degree in summer 2019. Through her academic career at Cal Poly San Luis Obispo, she learned that she enjoyed managing people and had good interpersonal skills. She is now working as a research assistant at JustFoodForDogs, a Southern California company that offers fresh whole food pet food. Hernandez helps conduct research and testing of their products to ensure their claims are backed by data. She also is part of a custom formulation team, where she helps owners understand the nutritional needs of their pets and to find the best diet that addresses the pet's health needs. Hernandez said she is definitely using what she learned through her master's degree program, and enjoys her job. Her goal upon graduation was to find a job in clinical and life science where she could combine her science knowledge with her desire to communicate science to nonscientists, specifically in industries where expert knowledge is needed to help develop or market products. This job is a promising start to fulfilling that goal.

SYDNEE WINBUSH HELPS DISCOVER BACTERIA THAT DEGRADE PESTICIDES

Sydnee Winbush grew up in the Moreno Valley in Southern California. Always interested in life sciences, she took an advanced placement human anatomy and physiology class in high school. All the laboratory classes she was taking and her watching "Untold Stories of the ER" on TV convinced her she should go to medical school. Admitted by CSU and University of California schools, the biology major chose California State University, Monterey Bay. She liked the location, weather and how welcomed she felt there.

Winbush took a biochemistry class with CSUMB instructor Dr. Arlene Haffa and was invited to work in Dr. Haffa's lab. Winbush's first research project, co-funded by the CSU Agricultural Research Institute (ARI), focused on pesticide bioremediation. When insecticides are used to control pests in agricultural crops, they can end up in the soil. Over time, sunlight and microbial activity degrade the insecticides. Haffa's team hypothesized that if they could select bacteria that were particularly good at degradation, bacterial strains could be used to help rid soils of pesticide residues. They knew that most bacterial species cannot break down insecticides, but a few can, and these were the ones they wanted to identify.

Haffa's team is working with Dr. Nathaniel Jue, also at CSUMB, who is using metagenomics and bioinformatics to identify the pesticide-degrading bacteria and discover the genes and metabolic pathways that allow these bacteria to live in pesticide-laden soils. This research is on-going, but they have already identified several bacteria taxa that appear to have pesticide degrading capabilities.

Winbush worked on a second project co-funded by the ARI in which the team monitored soil anaerobic disinfestation. The idea was to force the soil to become anaerobic, which they theorized would decrease or eliminate pathogens. They accomplished this by adding a carbon source (rice bran), a potassium nitrate solution to the soil, and covered it with a thin plastic film to promote high temperatures (solarization) and inhibit oxygen, and left it on the field for three to six weeks. During this process, they monitored the gases emitted, as well as any greenhouse gases or volatile compounds emitted from the soil.

Before working in Haffa's lab, Winbush had no idea this type of research existed, let alone that she would be involved in it. She appreciated that under Haffa, she had a lot of independence but also tremendous responsibility to learn about her project, to read the scientific literature and to figure out how to solve the problems related to research projects. These aspects of the research experience were never replicated in any of her classes. Working on agricultural projects was an unexpected turn that made Winbush realize the benefits of agriculture and the challenges in producing food. Now aware that a career in the agricultural industry could be interesting, she has explored those possibilities as an alternative to a career in human medicine.

CALIFORNIA DESERT STUDIES CONSORTIUM

The California Desert Studies Consortium (CDSC) is a multicampus consortium committed to advancing education and research opportunities in arid-land ecosystems. The consortium operates the CSU's Desert Studies Center field station in the Mojave National Preserve, a premier location and resource for studying the geology, anthropology and biology—among many other topic areas—of California's deserts and the American West.

IDENTIFYING CAUSES OF GENETIC DIVERSITY USING DESERT REPTILE POPULATIONS

In the extreme heat of summer, you may find Dr. Eric Routman, professor of biology at San Francisco State, and his bold students looking for lizards on the rocky slopes near the CSU Desert Studies Center at Zzyzx, California. Dr. Routman's group is studying desert lizards to help address a long-standing evolutionary puzzle—what factors most strongly contribute to the genetic diversity of a species? Although mathematical models have been quite successful at linking genetic variation to a number of potential evolutionary drivers (drift, selection, gene flow, mutation, recombination), conclusive evidence of these links using natural populations has been far more difficult to attain. Applying traditional DNA sequencing as well as next-generation shotgun sequencing to estimate levels of genetic diversity, Routman and his students have shown that some desert reptile species possess extraordinary levels of genetic variation while others have much less, despite being found in the same desert location. The various species also differ in population sizes, potential for gene flow, generation time and other factors that are predicted to affect genetic diversity. By comparing these factors for species that are closely related and found in the same location, these desert reptile studies provide better control for variation in mutation rates and population histories than typical comparisons made across a broader taxonomic range.

TRANSDISCIPLINARY STUDIES PROVIDE KEYS TO CONNECTING CLIMATE, ANCIENT DESERT LAKES AND PEOPLE OF THE PAST

On the shores of ancient Lake Mojave (today's Soda and Silver Lake playas), Dr. Edward Knell, professor of anthropology at California State University, Fullerton, and Dr. Matthew Kirby, professor of geological sciences at California State University, Fullerton, have undertaken a transdisciplinary, long-term research program to better understand the linkages between past human lifeways and changes in past climate. The Desert Studies Center (DSC) has served as a base for this research since 2009. Transdisciplinary research collaborations focused on Lake Mojave began in earnest in the 1930s and continue today. Much like previous researchers who sought to date the shorelines and place the many archaeological sites in chronological context, Dr. Knell and Dr. Kirby have combined the efforts of archaeologists, geologists and students to address similar and more nuanced research goals, but now with the advantage of newer methods and technologies.

Kirby and his geology students focus on paleolimnology, or the study of past climates from lake sediments, to improve our understanding of Lake Mojave's shorelines, including the chronology, extent of wetland habitat and changes in past climate. These interests dovetail nicely with Knell's research on determining how past peoples adjusted their lifeways to meet changes in climate—changes that affected the availability of food resources, how people moved across the landscape and where people settled or conducted their activities along the lake margins. Together, one of

the biggest questions the Knell/Kirby collaboration is addressing is how chronological changes in lake level influenced the extent and placement of wetlands and the potential plant and animal foods available for humans. Understanding these responses will help determine how such changes affected the way Paleoindians (possibly as early as the end of the last ice age) and later groups moved to and around pluvial Lake Mojave and the playa lakes that followed (i.e., Silver and Soda Lake playas).

Some of the latest geological findings are the product of climate reconstruction from a recently acquired lake sediment core. Kirby and colleagues (including undergraduate and graduate co-authors) reconstructed 14,800 years of lake history, inferring a more complex late glacial-through-Holocene lake history than previously known. Moreover, their results suggest a strong 14,800-year coupling between Pacific Ocean-atmosphere processes and winter precipitation over the Silver Lake drainage basin. Comparisons to other regional paleoclimatic archives reveal a consistent spatial pattern of Holocene climate change in the southwestern United States, including Southern California. Perhaps most striking is evidence for a sustained, millennial-scale period of aridity in the mid-Holocene.

Knell's research began in 2009 with field seasons each summer through 2017 that resulted in the systematic pedestrian (walking) survey and in-field analysis of nearly 5,000 stone artifacts from 6.5 square miles of shoreline along Soda and Silver Lake playas. At two bedrock quarries, his team determined how stones from fine-grained volcanic outcrops were reduced at the quarry sites and then transported to shoreline sites for further modifications. Furthermore, by making geochemical links between the stone artifacts and specific quarry sources, he determined that people arrived at Lake Mojave primarily from the northwest, where obsidian from the Coso volcanic field (about 175 km to the northwest) and Goldstone dacite (about 70 km to 80 km to the northwest) are found. Others came from directly north, from the Shoshone Mountain obsidian source (about 140 km).

Knell and Kirby's teams consistently include graduate and undergraduate students from Cal State Fullerton and other CSU and state university schools. Participants have used their experiences to produce anthropology master's theses as well as geology master's and bachelor's theses. While stationed at the Desert Studies Center for fieldwork, students not only gain important hands-on experience in their field of science, they also understand how their science links to the many past and present natural and cultural phenomena around the center. This transdisciplinary archaeology and geology research helps students make these important connections, which has made the DSC an invaluable aspect of their joint research program.

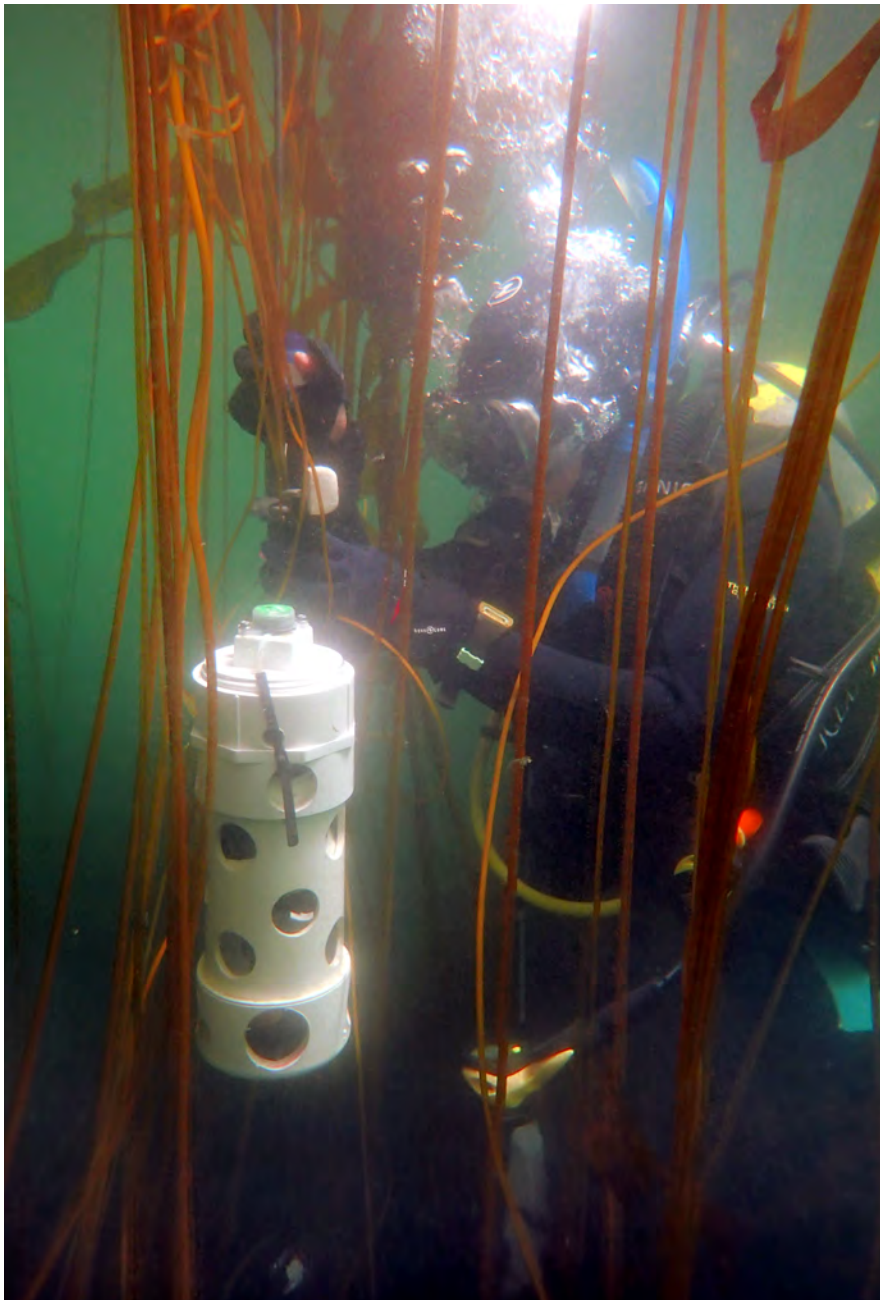
UNDERSTANDING CONFLICT IN A MUTUALISTIC RELATIONSHIP—JOSHUA TREES AND THEIR YUCCA MOTH POLLINATORS

With support from the Judith A. Presch Desert Research Scholarship, Albert Dang and his master's thesis adviser—Dr. Jeremy Yoder, assistant professor of biology at California State University, Northridge—have used the Desert Studies Center as a base to study one of the most iconic Mojave Desert plant species, the Joshua tree (*Yucca brevifolia*) and its pollinators. Yucca moths deliver pollen to fertilize yucca flowers after laying eggs in them so that their larvae can feed on developing yucca seeds. This creates an evolutionary conflict because selection should favor moths that lay as many eggs as possible in a single flower and put as little effort as possible into collecting and delivering pollen—while selection in the host plant should minimize the number of seeds lost to moth larvae. Dang and Dr. Yoder's research will lead to a better understanding of how this conflict is resolved so that the yucca moths' interests (the laying of many eggs) best align with their hosts plants' interests (the receiving of lots of high-quality, diverse pollen). They will use genetic analysis of the Joshua tree seeds from throughout the range of the species to see whether fruits that received more diverse pollen contain more seeds and also support more moth larvae. In other words, to find out whether moths that provide better pollination service might be rewarded with higher seed availability for their offspring.

Dang exemplifies the value of programs like Desert Studies and places like the Desert Studies Center—where unique experiences may lead to an otherwise unrecognized career path. Dang grew up in the Bay Area, the son of immigrants. He is among the first generation of his family to attend college. At San Francisco State, he discovered a fascination with insect diversity, which he pursued in a summer field course in Ecuador and volunteer work at the Essig Museum of Entomology at University of California, Berkeley. He came to CSUN to pursue research on the yucca-yucca moth mutualism with Yoder.

COUNCIL ON OCEAN AFFAIRS, SCIENCE AND TECHNOLOGY

The Council on Ocean Affairs, Science and Technology (COAST) integrates resources across the CSU and promotes interdisciplinary multi-campus collaborations to advance our knowledge of coastal and marine resources and the processes affecting them. COAST serves faculty and students engaged in marine, coastal and coastal watershed-related research at each of the CSU's 23 campuses and supports research providing innovative solutions to economic, sociological, ecological and technological challenges along our coast.



OCEAN WARMING, ACIDIFICATION, PURPLE URCHINS AND BULL KELP

Increasing levels of carbon dioxide (CO_2) in the atmosphere from anthropogenic greenhouse gas emissions are raising global temperatures and changing ocean chemistry. Ocean waters are becoming more acidic (increased acidity of seawater is represented by lower pH values), which presents challenges for marine organisms, especially those that build their skeletons and shells out of calcium carbonate ($CaCO_3$). These organisms may have to expend significant amounts of energy to cope with increased water temperatures and ocean acidification, leaving them with less energy for growth, feeding and reproduction. Over time, this can lead to population decreases and subsequent shifts in ecosystem dynamics.

In Northern California, bull kelp is the foundation of highly productive kelp forest ecosystems, providing food and habitat for many economically important marine species and creating hot spots of marine biodiversity. Kelps can affect the chemistry of the seawater around them through photosynthesis and may even be able to reduce the acidity of the water surrounding them. Urchins, one of the major grazers of kelp, have calcareous shells that are sensitive to changes in seawater pH. Recently, Northern California bull kelp forests have been rapidly reduced to unproductive urchin barrens by a multitude of climate-driven events and widespread disease that wiped out many sea stars, the urchins' main predator. Humboldt State University faculty members Dr. Paul Bourdeau, assistant professor of biological sciences, Dr. Brian Tissot, professor of biological sciences and director of the HSU marine laboratory, and Dr. Eric Bjorkstedt, adjunct professor of fisheries biology, are working together to better understand the dynamic interactions among ocean acidification, bull kelp and purple urchins.

HSU graduate and undergraduate students play a large role in this research. In summer 2018, graduate student Kindall Murie and three HSU undergraduate dive assistants completed 134 dives to characterize spatial variation in kelp and urchin abundance and collected more than 300 water samples in and out of kelp forests at two locations in Northern California. Data collected from this project will form the basis for Murie's master's thesis.

The team also has developed a multistressor laboratory mesocosm system that can simultaneously manipulate pH, dissolved oxygen (DO) and temperature to mimic current and predicted future ocean conditions to determine how they may affect urchin grazing on bull kelp. This design and implementation of this mesocosm system has been logistically difficult but has provided HSU graduate and undergraduate students the opportunity to gain valuable experience in circuit schematics and building, computer program coding and experimental design.

Preliminary results indicate that bull kelp can ameliorate local conditions. Even in small, remnant stands of bull kelp, daytime pH and DO were higher in kelp canopies, where photosynthesis primarily occurs, than near the seafloor or in nearby urchin barrens where no kelp was present. These differences were as great as they are in and around large persistent kelp forests off the coast of Washington, demonstrating that even small fragments of bull kelp forest may provide potential refuge from ocean acidification for marine species living in the kelp canopy. This information can help natural resource managers prioritize areas for conservation and restoration efforts to mitigate the local impacts of climate change.

CONTAMINANT CYCLING IN COASTAL LAGOON SYSTEMS

Dr. Priya Ganguli and Dr. Scott Hauswirth, assistant professors in geological sciences at California State University, Northridge, are studying the transport and fate of contaminants in ephemeral lagoons that form along the coast where streams meet the ocean. These lagoons receive watershed runoff that is often contaminated with nutrients, metals and sediment. This project was originally intended to assess mercury toxicity in coastal lagoons, which are biological hot spots. Mercury is released into the atmosphere by artisanal and small-scale gold mining and coal combustion, and eventually it settles out on to surface waters or land where it can be washed into lakes, streams and the ocean. Bacteria in low-oxygen environments can transform inorganic mercury into organic methylmercury, a highly potent neurotoxin that builds up in the tissues of fish, shellfish and animals that eat fish, including humans.

The recent wildfires throughout California have demonstrated that fires can impact water quality in coastal watersheds and lagoons as well. The 2018 Woolsey Fire led to an expansion of this study to include polycyclic aromatic hydrocarbons (PAHs), many of which have toxic, mutagenic and/or carcinogenic properties. PAHs form when wood and other organic materials burn and are, therefore, a serious water quality concern in fire-affected watersheds. Additionally, mercury binds to carbon, resulting in direct links between mercury and PAH biogeochemical cycling. Metals and PAHs stick to particles, so any activity that generates sediment runoff will increase the concentration of particle-bound contaminates. Thus, significant post-wildfire erosion can mobilize significant amounts of metals (including mercury) as well as PAHs.

This project focuses on the Malibu Lagoon system in Southern California with the goal of developing an approach to assessing contaminant cycling that can be applied to other West Coast lagoon systems. Beginning in 2012, Malibu Lagoon underwent a massive restoration effort designed to enhance circulation during the dry season when the lagoon forms and tidal exchange with the ocean is diminished or nonexistent. Under these conditions, oxygen levels in the water column and sediment drop to very low levels, which can enhance the production of methylmercury by anaerobic bacteria. Malibu Lagoon is at the outlet of the Malibu Creek watershed, a substantial portion of which burned severely during the Woolsey Fire that ultimately destroyed nearly 100,000 acres.

Dr. Ganguli and Dr. Hauswirth, their collaborators and a contingent of 18 students thus far are using a combination of geochemical, geomorphic and geographic information system (GIS) tools to study mercury and PAH cycling. They have collected water and sediment/soil samples from creeks throughout the watershed and the lagoon during multiple storm events and have analyzed the samples for PAHs and different forms of mercury. Additionally, Dr. Tyler Hughes, assistant professor of political science at CSUN, is evaluating policies around the Malibu Lagoon restoration, which was highly controversial, as well as public perception of environmental health risks, such as exposure to mercury. Dr. Hughes and his students have extended the scope of their work to include analysis of policy decisions regarding wildfire suppression and postfire recovery.

Students are leading different aspects of the project: Christian Hoover, a senior undergraduate, is responsible for the PAH component of the project. Hoover is first author on an international conference abstract, and he presented his findings in December 2019. Erin Schmitt, a graduate student, is currently developing the sampling design to investigate contaminant cycling within Malibu Lagoon itself. This within-lagoon study will be conducted over the next two years. As students step into leadership roles, they also gain valuable mentoring experience and confidence by training new students.

Results to date show increases in PAHs, total mercury and methylmercury in Malibu Creek and its tributaries during and immediately after storm events, especially in upper-watershed locations. Significant increases in PAH concentrations were linked with large storm events, likely caused by precipitation-induced erosion and the resulting increase in sediment loads to surface waters.

CSU PROGRAM FOR EDUCATION AND RESEARCH IN BIOTECHNOLOGY

The CSU operates the Program for Education and Research in Biotechnology (CSUPERB) as a community of practice for faculty and students from all 23 CSU campuses. CSUPERB catalyzes collaborative CSU student and faculty research, innovates educational practices and partners with the life sciences industry. CSUPERB's definition of biotechnology is quite broad, intentionally mirroring the highly partnered, multidisciplinary nature of the field. Each year, CSUPERB involves and supports CSU faculty and students in all disciplines related to the current practice of biotechnology, including but not limited to life sciences, physical sciences, clinical sciences, math, computer science, agricultural science, engineering and business.

CREATING FUNDAMENTAL BUILDING BLOCKS TO STUDENT LEARNING AND SUCCESS IN BIOTECHNOLOGY

DNA damage happens continuously in living cells and much of it is unavoidable. In human beings, failure to repair DNA damage results in genetic mutations and can lead to cancer. As an example, more than 90 percent of melanoma skin cancers are due to skin cell damage from ultraviolet radiation from exposure to sunlight. The Centers for Disease Control reports that rates are increasing for melanoma, the deadliest form of skin cancer. In 1982, there were 11.2 cases per 100,000 people; in 2011, that rate increased to 22.7 cases. At this point, scientists and physicians know the cause of most skin cancers and recommend preventative measures, but we still need effective therapies to treat the disease.

To help understand the key molecules and pathways that direct DNA repair, Dr. Paula Fischhaber's group at California State University, Northridge focuses on proteins found in baker's yeast (*S. cerevisiae*). Compared with human cells, yeast cells provide a simple model system for study, but they contain most of the DNA repair mechanisms found in more complicated systems. The group uses microscopy, genetics and other biochemical methods to understand how cells choose the most appropriate DNA repair pathway to avoid burdensome levels of mutations that could otherwise give rise to cancer.

The fundamental studies' importance has been underscored by continual grant support, starting in 2007, from the National Institutes of Health to Dr. Fischhaber's group. Over the years, the NIH funding not only led to nine publications from the 54 undergraduate and 18 master's students trained in the lab, but also a notable source of successful students who moved on to graduate school and biotechnology jobs. Coming full circle, Dr. Armen Mardiros, Fischhaber's first master's student, was invited back to the 31st Annual CSU Biotechnology Symposium as a featured speaker; he's now the director of translational oncology at Allogene in south San Francisco. Several Fischhaber group members have been CSUPERB Award finalists and two students—Justin Karlin and Fred Fregoso—won the Don Eden Graduate Student Research Award in 2010 and 2019, respectively. Dr. Karlin is now practicing as a physician in Los Angeles; Fregoso is in the molecular biochemistry and biophysics doctoral program at the University of Pennsylvania.

Fischhaber has been involved in CSUPERB governance since arriving at CSUN, serving as a Faculty Consensus Group member, and she was elected in 2018 to serve as the deputy chair. Fischhaber recognized that, even with federal grant funding, she was unable to offer apprenticeship-style research experiences to all interested students. She's taken a leadership role advocating and advancing course-based undergraduate research experiences (CUREs) within the CSUPERB community. Piloted in 2018, the CSUPERB CUREs network now involves more than 91 faculty members from 22 campuses in workshops, webinars and an online community. CUREs offers course-based discovery research experiences and experiential learning which, if well-executed, can result in student engagement, learning outcomes and skill-building similar to research apprenticeships. The CSUPERB CUREs network, led by Fischhaber, hopes to see CSU faculty, administrators, departments and campuses design effective ways to incorporate experiential learning for all STEM students across the curriculum. She explains: "Hands-on research experiences provide the deep mentoring that is vitally important to STEM students' personal growth and professional development. The CSU should build on programs and infrastructure that will enable increased faculty mentorship, such as those promoted by CSUPERB."

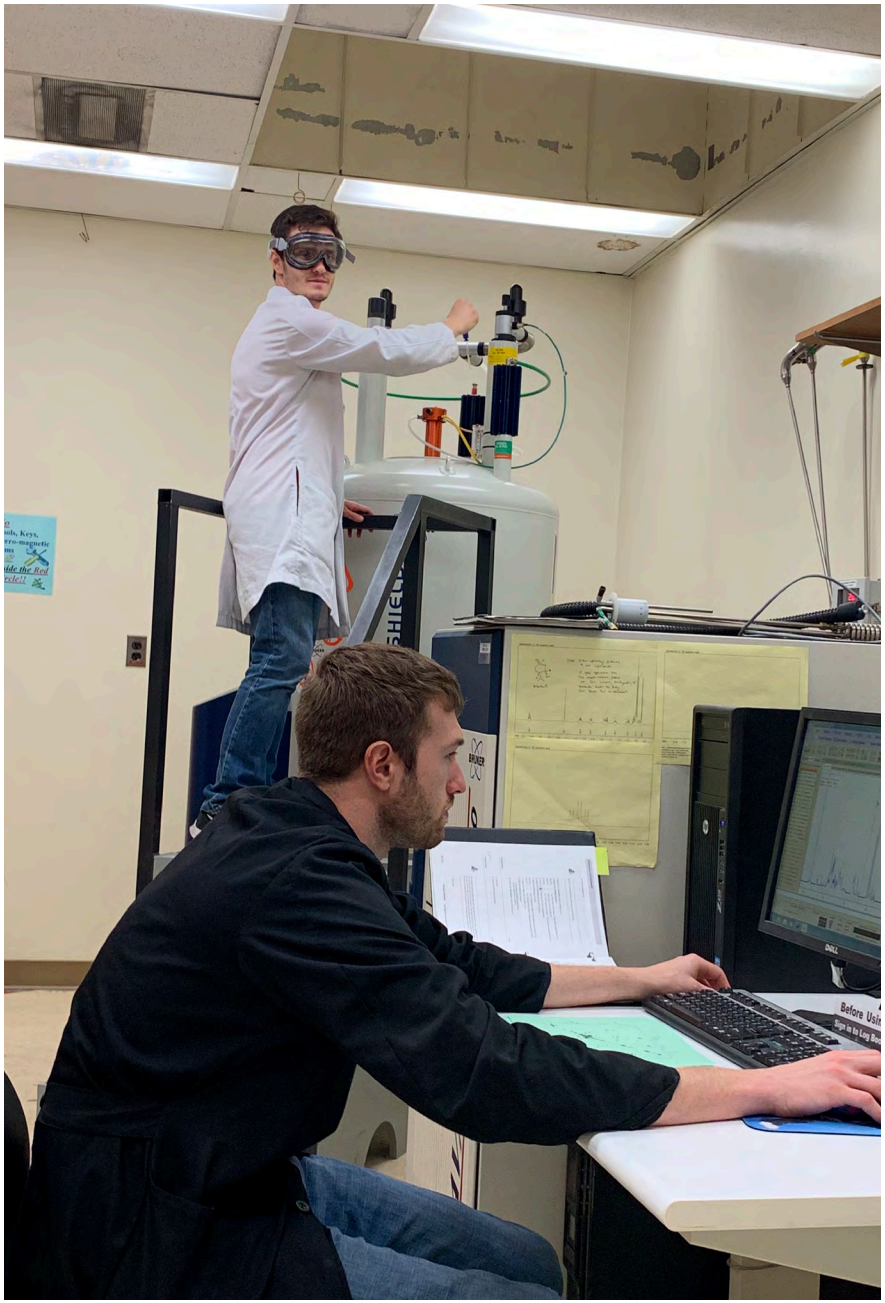
NAVIGATING CHALLENGES OF BECOMING AN IMPACTFUL TEACHER-MENTOR-SCHOLAR

Between 2010 and 2016, the annual number of new HIV diagnoses decreased nine percent in the United States. The Centers for Disease Control estimates that more than one million people in the U.S. had HIV at the end of 2016, but one in seven do not know they have the infection and unknowingly can spread the disease. No cure exists for HIV yet, but drugs are used to slow disease progression in infected patients. Meanwhile, scientists and physicians around the world continue to work on preventive interventions so that the virus never enters a patient's body.

After joining the CSU, Dr. Katherine McReynolds, professor of chemistry at Sacramento State University, won funding from the National Institute of Allergy and Infectious Diseases to work on new HIV prevention strategies. Her research group is expert in making unique carbohydrate (sugar) macromolecules that might prevent the HIV virus from infecting host cells. But in 2011 she faced a gap in funding and turned to the CSUPERB Research Development seed grant program to support lab operations and student research activities. The lab needed to innovate and improve the process used to make the complicated macromolecular structures. Dr. McReynolds also used the time to develop a collaboration with researchers at Duke University who had the capability to test her group's molecules against live HIV virus. Based on advice McReynolds received from NIH-funded researchers within the CSUPERB community and from program officers at NIH, she targeted her new proposal to a National Institute of General Medical Sciences (NIGMS) grant program aimed at funding research groups at regional comprehensive universities like Sacramento State. The strategy was successful; the McReynolds group won the first NIH SCORE grant awarded to the campus.

Today the McReynolds lab is one of the busiest chemistry groups on campus, involving on average 10 undergraduates and three master's students. McReynolds not only involves students in her scholarship, but also elevates them to gain recognition and showcase their contributions to the research enterprise. McReynolds nominates students in her laboratory for the very competitive, university-wide scholarships and awards sponsored by CSUPERB. As a result, her Sacramento State students have won seven Doris A. Howell–CSUPERB Student Research Scholarships; only 11 are awarded each year. Cory Vierra, a master's student in the McReynolds lab, was a 2016 Howell Scholar. The depth of his research expertise in carbohydrate chemistry as well as his work on a real-world problem worth solving, led to a job with a startup biotechnology company, BCD Bioscience, in Sacramento.

McReynolds frequently credits the CSUPERB community with the student mentoring and research track record she's built at Sacramento State. She found collaborators and peer mentors within the CSU who helped her navigate the challenges inherent in becoming an impactful teacher-mentor-scholar. As a result, she became involved in CSUPERB governance councils and was elected chair of the Faculty Consensus Group in 2018. As chair, McReynolds is focused on giving back to the CSU's biotechnology community by developing professional development programs. She inaugurated the Faculty Short Talk series at the annual CSU Biotechnology Symposium to raise the profile of CSUPERB-funded faculty university-wide. She co-organized a 2019 new faculty workshop to help teacher-scholars hit the ground running on CSU campuses, bringing NIGMS Program Director Anissa J. Brown to California to consult one-on-one with faculty interested in writing NIH grant proposals. Most recently, she spearheaded CSUPERB efforts to reconnect with CSU alumni to smooth the path for student researchers as they leave to start biotechnology careers.



INNOVATIVE LEARNING SPACES OPEN OPPORTUNITIES FOR STUDENT SCIENTISTS

Dr. George Vourlitis' research group measures the effects of human activities—including land use and land cover change, atmospheric pollution and climate change—on our terrestrial ecosystems. These issues "are interesting and complicated, and as a result, generate a lifetime of interesting research questions [related to] water quantity and quality, biodiversity, carbon storage and erosion control just to name a few," he said. Dr. Vourlitis received a 2017 Research Development grant to learn new DNA-based, metabolomic research tools and demonstrate their application to his research program. Because the environmental monitoring field is increasingly adopting DNA-based methods, CSUPERB has seen a large increase in grant applications from ecology and environmental sciences faculty and students.

The CSUPERB grant allowed the Vourlitis group to measure how long-term nitrogen addition affected the soil microbial community of local chaparral and coastal sage scrub shrublands. The grant "funded the master's thesis of my graduate student, Tim Grant, and because I am an ecologist with little direct experience in soil metagenomics, I partnered with Dr. [Arun] Sethuraman to help," Vourlitis said. Sethuraman, an assistant professor in biological sciences at CSU San Marcos, runs a population genetics research program and brought next-generation DNA sequencing expertise when he joined the faculty in 2016. Based on their joint project and preliminary data collected by Grant, Vourlitis and Sethuraman wrote a proposal to the United States Department of Agriculture to fund course-based undergraduate research (CURE) in a molecular ecology class.

The new Molecular Ecology CURE is a combination of lecture, field work and lab. Vourlitis and Sethuraman team-teach the class, offered every spring at CSU San Marcos. "Data collected as part of this class were stellar, and Dr. Sethuraman and I feel that there are two to three possible publications," Vourlitis said. CSU San Marcos faculty always have had a tradition of opening their labs to undergraduate students interested in doing independent research, but, he explained, "because we have grown so much over the last decade (we have fewer than 1,000 students and 16 [tenure-track] faculty), there is not enough time or people-power to serve all of the students interested in doing research. So, our idea was to bring the research to them, in the form of an open-ended lab experience where lab/field tools and techniques could be taught in context to an authentic research project. This was not the first biology lab to run a CURE, but the first time that the class was funded by an external source." Their story is a good example of CSUPERB's strategy to seed projects that lead to external support as departments work to pilot and incorporate experiential learning into the curriculum and increase the number of research experiences they can offer CSU students.

MOSS LANDING MARINE LABORATORIES

Moss Landing Marine Laboratories (MLML) is home to San José State University's School of Marine Science, which offers a master's degree and undergraduate courses to students from five CSUs. SJSU faculty and researchers generate millions in research grants. This environment provides students hands-on, field-oriented research utilizing a 60,000-square-foot laboratory, research vessels, an aquaculture facility and a dive program. Faculty from all CSUs can collaborate with MLML faculty and researchers.

ADVANCING OF AQUACULTURE RESEARCH TO MEET EMERGING NEEDS IN CALIFORNIA

Aquaculture is responsible for more than half of all seafood consumed globally. Worldwide aquaculture production increased 176 percent from 2000 to 2018, accounting for 46 percent of global fish production, but production in North America has decreased. Because of perceived environmental impacts, the United States, and California in particular, have not embraced aquaculture.

The San José State University aquaculture facility at MLML is working to change that. It is developing a rigorous foundation in the science and workforce training of sustainable aquaculture. An experiment by a recent MLML aquaculture class found that purple urchins—which currently are devouring large habitat-forming kelps and have been decimating kelp forests in California—could be brought into captivity and fed until they became commercially valuable. Within two months, the urchins produced eggs (or uni), a delicacy in sushi restuarants. This project, which was reported on National Public Radio, demonstrates that aquaculture could attract urchin fishermen to help solve the problem of disappearing kelp forests. Fisheries win, aquaculture practices win, and the kelp forests win.

Two recent projects at MLML highlight aquaculture's restorative capabilities: both white abalone and native Olympia oysters are being cultured so that they can be returned into the wild to bolster failing populations.

About half as many young white abalone are being raised at the MLML facility as there are in the entire wild population of California. In two years, the abalone will be placed into the wild with the hope that they will help the endangered population recover. Olympia oysters from Elkhorn Slough in Monterey Bay are induced to spawn and the young are grown to sufficient size to be placed into the slough to enhance a population affected by poor water quality and habitat issues.

MLML also has been funded by California Sea Grant and the Ocean Protection Council to identify and culture California native seaweeds capable of reducing greenhouse gas production by ruminant livestock. Ruminants, primarily cows, produce nearly 30 percent of methane in the state. By adding just two percent of certain seaweeds to the diet of cows, methane production may drop by up to 80 percent. Working with the U.S. Department of Agriculture, MLML will determine which California native seaweed species best reduce methane in cows and study how best to propagate those seaweeds for large-scale production.

In addition, MLML has funding from the Pacific States Marine Fisheries Commission to develop culture methods for a potential new aquaculture product, rock scallops. Most rock scallops consumed in the U.S. are from Japan and China. The development of farming techniques for native rock scallops would reduce the carbon footprint of shipping those scallops across the oceans and would allow us to buy local. This will involve creating new hatchery and nursery techniques, growing microalgae to feed these filter-feeders and experimenting with environmental conditions to formulate optimum growth.

Aquaculture could solve a number of emerging issues in California but it has to be done responsibly. MLML is developing new techniques and courses to (1) train the next generation of marine farmers to help with healthy food production, (2) reduce harmful greenhouse gases, (3) work with fisheries to improve their industry and (4) to use aquaculture to improve native populations.

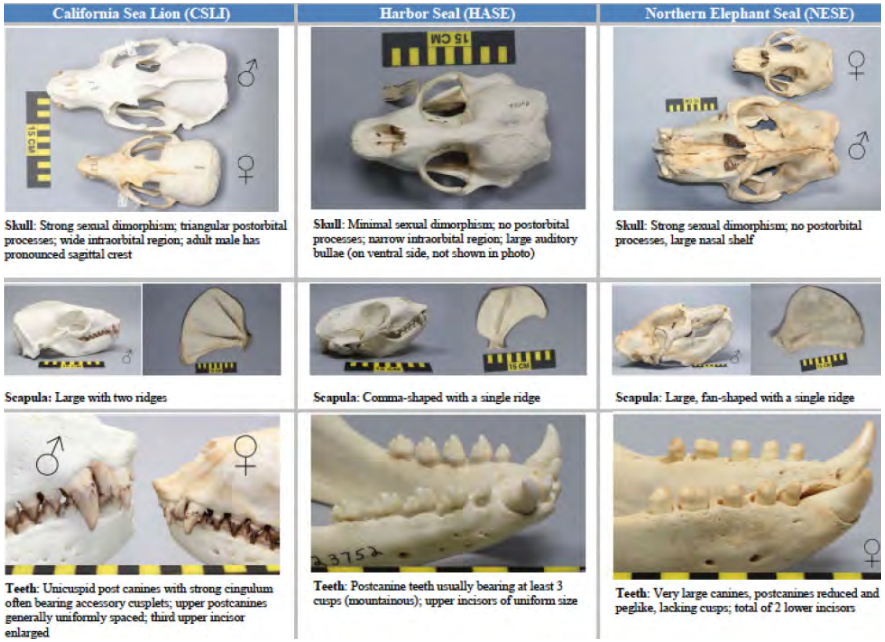
BEACHCOMBERS PROGRAM LEVERAGES VOLUNTEERS TO PROTECT THE ENVIRONMENT

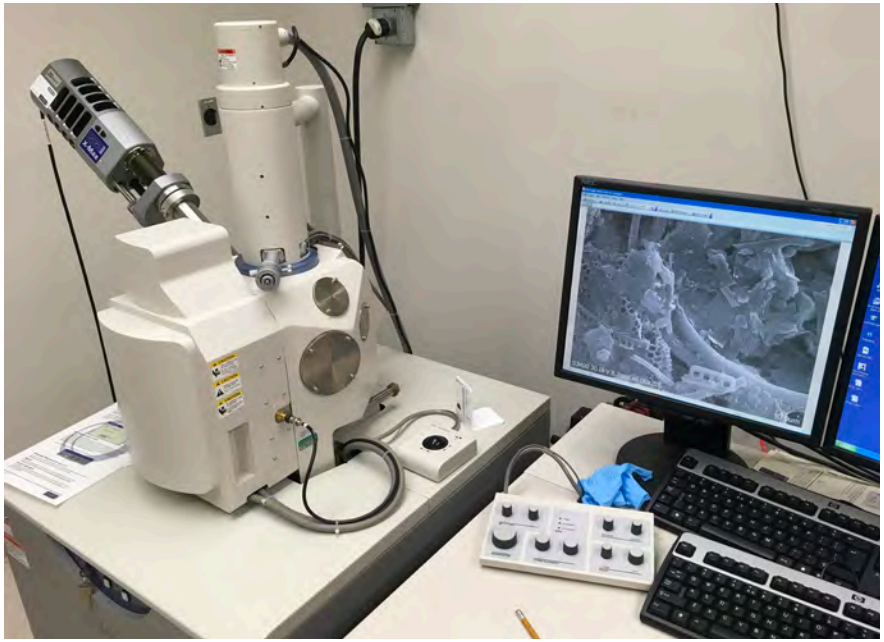
For 22 years, MLML has led a team of volunteers and scientists that monitors the health of coastal California by surveying beaches from Santa Cruz County to Los Angeles County. The Beach Coastal Ocean Mammal and Bird Education and Research Surveys (BeachCOMBERS) began in 1997 with the objective to train citizen scientists to collect standardized scientific data within the Monterey Bay National Marine Sanctuary.

Since then, the program has expanded to Southern California and 150 volunteers who document the deposition of marine birds, mammals and turtles. During the first week of each month, survey teams record the number of deaths, species, cause of death (if known) and effects of oil on beachcast specimens. Cases of oil spills, fishery interactions (entanglements), harmful algal blooms (HABs) and plastic ingestion have been documented.

Resource managers have used the data to change the policies on fishing practices to reduce fishery interactions. This long-term dataset was used to recognize that oil was seeping from the USS Jacob Luckenbach, a vessel shipwrecked off San Francisco in 1953. Winter storms often caused the ship to shift and some oil to escape, leading to the deaths of thousands of seabirds. The source of the oil was identified when the oil on the birds was "fingerprinted," which identified the source of the oil It generated the will and resources to remove the oil from the sunken vessel. Several large die-offs of seabirds occurred throughout the west coast of North America and were attributed to starvation. The migrating birds were mostly juvenile birds that were not finding enough fish. The long-term monitoring also determined that an increase in HABs have affected seabirds and the fish they ate. HABs have been responsible for shutting down the California Dungeness crab fishery, and can have ecosystem impacts from benthic invertebrates to pelagic fishes to higher level predators that are monitored.

BeachCOMBERS is an excellent example of citizen scientists conducting a rigorous science project for years. This project is a collaboration with the Monterey Bay National Marine Sanctuary, California Department of Fish and Wildlife, the U.S. Fish and Wildlife Service and the U.S. Geological Service.





MARINE GEOLOGY: DEEP-SEAFLOOR DRILLING LEADS TO NEW KNOWLEDGE OF EARTH'S PAST

Sediments in the ocean basin provide a record of the earth's climate and tectonic history. Much of the lab research conducted by San José State University Geological Oceanography Professor Dr. Ivano Aiello and his graduate students is focused on analyzing rock outcrops and the deep-sea core sediment record to understand their composition and sources. Dr. Aiello and his marine geology students identify shape, size and composition of the (biogenic) particles that settle through the water column as a result of productivity in the surface waters and the (terrigenous) particles that come from the weathering on the continents. The findings from examining the sediment record collected by international scientific groups such as the Integrated Ocean Discovery Program (IODP) can provide information on terrestrial climate and atmospheric conditions (e.g., rain intensity) as well as tectonic processes such as mountain uplift.

During 2019, Aiello took part in two IODP-NSF (National Science Foundation) deep-seafloor drilling cruises. Both occurred in the Pacific region but in opposite hemispheres.

That summer, he was in the waters off Chile to study the evolution of the Patagonia icefields and the oceanographic and hydrologic change along the northern margin of the Antarctic Circumpolar Current and on the South American continent during the last million years. The Patagonian icefields are an important, yet poorly known component of the global cryosphere. Outside of Antarctica, they are one of the few glaciated regions of the Southern Hemisphere. Previous studies have suggested that the relatively small glaciers that occupy Patagonia are important to global climate because they acted as pacemakers during past episodes of global climate change. This included times when the Gulf Stream was weak or absent (a major oceanic conveyor of heat on our planet). The sediment record collected during the cruise allows, for the first time, the ability to reconstruct the timing and extent of waxing and waning of the ice sheets in Patagonia; the study is currently underway.

In the fall, Aiello sailed on an IODP expedition in the Gulf of California (Guaymas Basin) to investigate the subsurface of this young oceanic basin that is slowly separating the Baja California Peninsula from North America. One of the goals of this deep-sea exploration was to establish the history of precipitation and droughts in the Mesoamerican region for the last two million years, which Aiello's lab will determine by identifying the sources and types of minerals present in the sediment. Another goal of the expedition was to advance understanding of the conditions that limit life in the deep biosphere. The sediments that fill the ocean basins (two-thirds of the earth's surface) are some of the largest habitats for life on earth. Yet they pose extreme chemical and physical conditions that would be lethal for life at the surface of our planet. Aiello's collaboration with an international team of microbiologists aims to shed light on the relationships and interactions between subseafloor sediments and the life they host.

OCEAN STUDIES INSTITUTE

The Ocean Studies Institute (OSI) is a collaboration of nine CSU campuses offering members access to joint research, support vessels and a diving safety program for marine research. OSI is now part of the Southern California Marine Institute, a research and resources partnership of the CSU, University of California, Los Angeles, Occidental College and University of Southern California.

GIANT SEA BASS SPAWNING AND SOUND PRODUCTION STUDY

Dr. Larry Allen's Giant Sea Bass Spawning and Sound Production study is being conducted at the Southern California Marine Institute (SCMI) in San Pedro. The three Giant Sea Bass (GSB) are thriving in the tanks at SCMI and in June 2018, began to court and make sounds. Initially, Dr. Allen and his students completed the acoustic monitoring of the captive Giant Sea Bass through two breeding seasons (partial summer of 2017 and all of 2018). After hundreds of recording sessions with both a handheld TASCAM hydrophone and SoundTrap underwater hydrophones, only "booms" recorded, presumably from the male Giant Sea Bass SOK-3 (known as "Maxie"). In short, these "booms" and concert bass drums have similar acoustic profiles ranging from 30 to 90 Hz in max frequencies.

However, on May 28, 2019, the captive giants began spawning in the tank at SCMI. There have since been seven successful spawns with the fertilized eggs collected and distributed to rearing facilities at both the Aquarium of the Pacific in Long Beach and the Cabrillo Marine Aquarium. The staffs at both of these aquaria have, to date, reared about 700 juvenile Giant Sea Bass through the settlement stage. Rearing baby giants to this size has never been accomplished. A letter of agreement will be signed with the California Department of Fish and Wildlife to release these young-of-year into known nursery areas (e.g., head of Redondo Canyon).

More important to the acoustic study, the fish began producing a new type of sound during spawning events. The male GSB (SOK-3) produced an abrupt "snare drum" sound during the evenings of each spawn. The acoustic frequency characteristics were similar to the known "booms", but was repeated at a very high rate. The information gathered by this study will allow Allen to complete the description of the courtship and mating behaviors of this ecologically and economically important species. Finally, both the "boom" and "snare drum" sounds will aid greatly in the identification of spawning areas for Giant Sea Bass throughout their current range.

CSU SHILEY INSTITUTE FOR PALLIATIVE CARE

The CSU Shiley Institute for Palliative Care is preparing the next generation of palliative care practitioners, educators, advocates and leaders while also educating the community about its benefits in maximizing quality of life, improving patient and family satisfaction with care, and reducing healthcare costs.

FACULTY TOOLKIT: ADDRESSING DISPARITIES IN PALLIATIVE CARE THROUGH CURRICULAR INTEGRATION

Preparing future health care professionals to provide high-quality palliative care for the rapidly growing population of people living with serious illness is one of the core missions of the CSU Shiley Institute for Palliative Care and its consortium of campus partners within the CSU.

To that end, the institute and its partners at California State University San Marcos, California State University, Monterey Bay, and California State University, Fresno, began work in 2018 on a pilot program to develop an online educational toolkit for college and university faculty to assist them in integrating palliative care content into existing curriculum across a range of disciplines and departments.

The first edition of the toolkit, completed in November 2018, included five online modules featuring resources and interactive learning activities that focus on the basics of palliative care as well as health disparities in palliative care. The modules provide cognitive, affective and psychomotor learning resources, including case studies, videos, slide presentations, pretests and posttests.

In January 2019, the three campuses began piloting the toolkit with 11 participating faculty members who teach in a variety of disciplines: psychology, nursing, social work, sociology, human development, gerontology and kinesiology.

The educators used the toolkit in 13 courses during the 2019 spring semester, reaching 684 undergraduate and graduate students. In a follow-up survey, the faculty members overwhelmingly agreed the toolkit met stated objectives and utilized appropriate learning techniques. More than half indicated the toolkit allowed them to introduce palliative care content in courses that previously had none.

The pilot continued in the 2019 fall semester with 13 faculty members participating at the three campuses. Once final data are collected, the results will be incorporated into the toolkit and the project will move forward. The institute is reaching out to secure additional funding that would enable faculty to build out the toolkit and scale access to campuses nationally.

NATIONAL SYMPOSIUM FOR ACADEMIC PALLIATIVE CARE EDUCATION AND RESEARCH

Advancing palliative care education and practice is the aim of the institute's annual National Symposium for Academic Palliative Care Education Research. It is the only conference of its kind in the United States focused solely on the needs of academic faculty whose work is shaping a new generation of palliative care providers.

The hallmarks of the two-day event are intense networking, collaboration and engagement around innovative and emerging academic palliative care teaching and research. Over the past four years, the event has highlighted hundreds of projects in disciplines ranging from medicine to social work to spiritual care and more.

The symposium draws faculty, clinicians and researchers from leading universities across the country, including CSU campuses San Diego State, CSU San Marcos, Cal State Fullerton, Cal State San Bernardino, Sacramento State, San José State and Sonoma State. Many attendees present their work as part the symposium's robust schedule of paper sessions, poster sessions, workshops and plenaries.

"It was so energizing to take the project I worked really hard on for my DNP and share it with a group of people who have similar interests in education," said Kate Murphy, DNP, CRNP, AOCN, ACHPN, of the Fox Chase Cancer Center in Philadelphia, who presented a poster at the 2018 symposium. "The conversations with other educators about their experiences had my mind swirling with ideas for future projects and collaborations."

"Being able to present my poster felt like validation of months of work I put into it," she added.

The 2020 National Symposium has been postponed due to the coronavirus pandemic; however, two virtual events will keep a spotlight on palliative care education and research. The events feature Jessica Zitter, M.D., addressing racial disparities in the pandemic (October 8), and Michael Fratkin, M.D., exploring the expansion of telehealth for palliative care (November 5). A virtual poster session will be accessible through the fall. For details, visit **www.csupalliativecare.org/symposium.**

SUPPORTING NEW ACADEMIC PALLIATIVE CARE RESEARCH

Building the palliative care evidence base is critical to expanding access to palliative care and ensuring that health care professionals are equipped with the most effective strategies to support people with serious illnesses along with their families.

Since 2016, the Institute has awarded more than $105,000 in seed grants funded by the Gary and Mary West Foundation for academic palliative care research that supports the foundation's mission of enabling seniors to successfully age in place with access to high-quality health and support services.

The grants, presented over three years at the National Symposium for Academic Palliative Care Education and Research, have funded studies at universities across the country, three CSU faculty-led projects include:

- A study on "Investigating Communicative Access in Advance Directive Planning for Persons With Aphasia," conducted by Nidhi Mahendra, Ph.D., CCC-SLP, associate professor, communicative disorders and sciences, Spartan Aphasia Research Clinic, San José State. Dr. Mahendra's study found that, among other things, persons with aphasia expressed a strong desire to communicate their health care preferences, benefited from game-oriented approaches to advance-care planning and required an average of five to six interventions to complete the advance directive process.

- Research on "Somatic Movement With Music Protocol Development and Implementation for Seniors in Hospice Care," led by Wendell Hanna, Ph.D., professor of music education, at San Francisco State. Dr. Hanna's project was to develop protocols that combine gentle exercises with music to provide physical and mental stress relief for seniors in hospice care. Her study found the combined interventions were more effective than music or exercise alone, and they were also successful in relieving the stress of hospice staff, families and trained volunteers.

- A project on "Increasing Palliative Care Within the Latino Community," led by Joy Goebel, RN, MN, Ph.D., FPCN, associate professor of nursing at Cal State Long Beach. Dr. Goebel's study focused on holistic palliative care training for promotores de salud—community health workers who educate families and caregivers on topics such as disease-management strategies, prevention and access to health services. In addition to the seed grant, Dr. Goebel's project was funded by a grant of nearly $55,000 from the UniHealth Foundation, awarded through the CSU Shiley Institute for Palliative Care. Over a two-year span, promotores trained through the project went on to train more than 1,950 community members in schools, churches and senior centers in the Los Angeles area.

New funders are being sought to underwrite seed grants for the 2021 symposium.

SOCIAL SCIENCE RESEARCH AND INSTRUCTIONAL COUNCIL

The Social Science Research and Instructional Council (SSRIC) is a collaboration of CSU campuses supported by the CSU Chancellor's Office. SSRIC is the oldest of the CSU affinity groups. The council assists quantitative learning, teaching and research in the social sciences through access to archival database resources as well as an online repository of teaching materials, a student research symposium and workshops for faculty.

FROM UNDERGRADUATE CONFERENCE TO GERRYMANDERING EXPERT

Mike Latner never gave much thought to statistics or quantitative analysis while he was at California State University, Chico, until he was encouraged by a professor to write a paper, using quantitative methods, for SSRIC's annual Social Science Student Symposium (S4) conference. Latner wrote the paper, attended the conference at San Francisco State and won the award for the best paper of the conference.

The experience fundamentally inspired Latner's career choices. Following graduation, he worked for four years at the Field Research Corp., a California public opinion research firm. He attended graduate school to broaden his quantitative skills and to make a career of using data to better understand government and politics. After receiving his doctorate in political science from University of California, Irvine, Dr. Latner accepted an offer at California Polytechnic State University, San Luis Obispo, eventually becoming an associate professor of political science.

He since has become a nationally recognized expert on gerrymandering and legislative redistricting. His book with co-authors Anthony McGann, Charles Anthony Smith and Alex Keena, "Gerrymandering in America: The House of Representatives, the Supreme Court, and the Future of Popular Sovereignty" (Cambridge University Press), demonstrates that partisan gerrymandering became noticeably more common after the 2010 census. He is also the current Kendall Voting Rights Fellow at the Union of Concerned Scientists in Washington, D.C.

STUDENT'S RESEARCH ON CONGRESS LEADS TO JOB AS TWITTER ANALYST

Anna Rulloda majored in political science and minored in both statistics and ethics, public policy, science and technology at Cal Poly San Luis Obispo.

In her paper for SSRIC's annual Social Science Student Symposium (S4) conference, Rulloda presented a paper combining many of those interests.

She undertook a massive data-collection process, scraping web data on 2018 congressional candidates' Twitter activity and then coding the contents of candidates' tweets.

Grouping this data into eight categories based on whether a candidate was female or male, Democrat or Republican, and won or lost, she compared the content of tweets by candidates from each category with respect to a variety of gender civil rights topics.

She found that, controlling for party and whether they won or lost, female candidates tweeted more often than male candidates about family issues and the Brett Kavanaugh Supreme Court nomination, while Democratic candidates tweeted about LGBTQ, health, racial and civil rights issues more often that Republican candidates did.

Rulloda put this experience to good use after graduation—she now works as an analyst for Twitter.

STEM-NET

STEM-NET is a collaboration of 23 campuses supported by the CSU Chancellor's Office. Its vision is to make the CSU a worldwide leader in increasing the pipeline, preparation, graduation and employment of diverse STEM students. The mission is to enable CSU STEM leaders to share expertise and leverage university-wide opportunities to foster the implementation of global best practices for students and faculty in pedagogy, learning and research within the CSU.

SAVING CORAL REEFS BY USING A SEA ANEMONE AS A LABORATORY MODEL FOR STUDYING HOST-MICROBE INTERACTIONS

Coral reefs are among the most diverse ecosystems in the world and are home to a large variety of marine organisms. In addition to their ecological importance, coral reefs have significant economic, aesthetic and medicinal value, including the compounds for biomedical research and therapies. At present, natural and anthropogenic stresses threaten the health of coral reefs worldwide. Global climate change is driving the rise in ocean temperatures, leading to coral bleaching and death. Finding the means for corals to adapt to and survive in higher temperatures requires a more thorough understanding of their physiology as a whole—the corals themselves, and all the microorganisms they associate with.

At California State University, Chico, Dr. Cawa Tran, assistant professor of biological sciences, and her research team of master's and undergraduate students look toward the potential for bacteria to help animals increase their heat tolerance. For the ease of laboratory manipulation, they experiment with a well-established model organism, a sea anemone called Exaiptasia pallida (commonly referred to as "Aiptasia"), that is related to corals. Both are symbiotic cnidarians (a group that also contains jellyfish) that will expel algae in response to stress.

Jamie Sydnor, the most senior graduate student in the Tran laboratory, has examined the community of bacteria that Aiptasia usually associates with (its microbiome) and how that community stochastically changes when the animal experiences heat stress. To better understand how these bacteria are initially integrated into the animal, Dr. Tran and her research team are collaborating with Dr. Joseph Greene, professor of sustainable manufacturing and mechanical engineering at Chico State, and a team of four mechanical engineering undergraduates (Thomas Cunningham, Emily Williams, Alize Hall and Sultan Alharbi). Together, they are designing a novel microfluidics chamber to enclose live anemones with flowing seawater under a microscope that will allow video recording of fluorescently labeled bacteria entering and establishing residence within these anemones in a process known as colonization.

The long-term goal of the Tran laboratory is to identify specific bacteria that can tolerate higher temperatures and, in turn, enable their animal host to endure these higher temperatures and survive in the face of global climate change. These beneficial microbes may serve as marine probiotics to help corals. Caution must be taken before manipulating corals and their microbiomes in nature; therefore, by testing heat-tolerant capabilities in a laboratory model like Aiptasia, Tran and her

students can use this information to explore the potential of improving coral health with the aid of heat-resistant bacteria. This experimental manipulation of microbes, communities and their hosts is referred to as microbiome engineering, which has been used in both agricultural practices and human medicine. The Tran laboratory is attempting to harness the power of microbiome engineering to enable more thermotolerant animals. This research has inspired new training for Chico State students in biology and engineering to use modern biotechnological tools to understand animal-microbe interactions and help save coral reefs.

TRANSFORMATIVE INCLUSION IN POSTSECONDARY STEM: TOWARD JUSTICE

What would it mean for a university STEM department to embody the "serving" in its Hispanic Serving Institution (HSI) designation? Although the HSI label is based on enrollment data, TIPS Towards Justice proposes a definition of Hispanic-serving in terms of culture and outcomes. With partners from other STEM disciplines, it will develop, pilot and test a two-year pathway (the TIPS Pathway) for academic departments to move toward a truly Hispanic-serving vision of a radically inclusive STEM culture, leading to demonstrably equitable outcomes (including graduation and persistence rates).

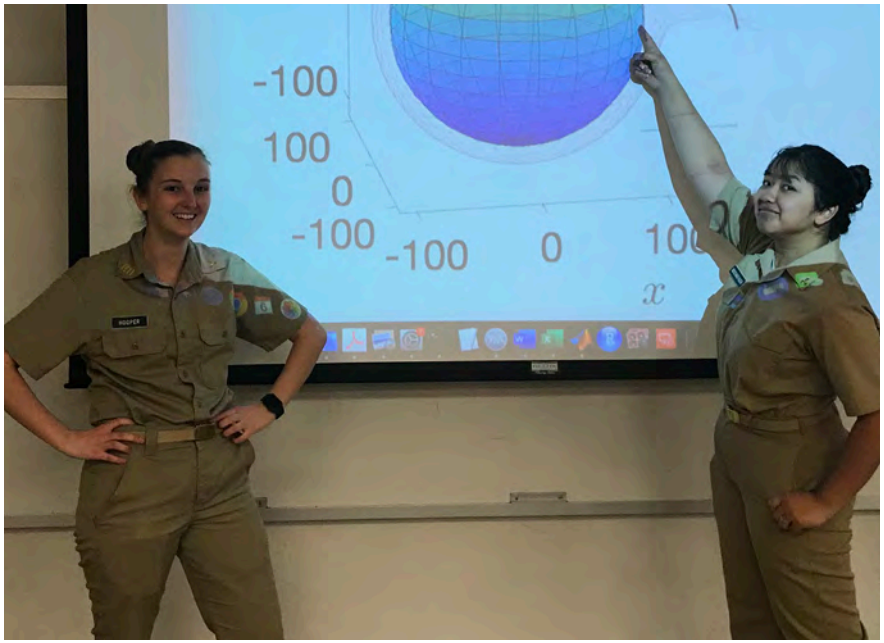
A recently recognized HSI, Sonoma State University enrolls a growing Latinx student population (31.2 percent in the 2018 U.S. Department of Education dataset). The Department of Mathematics and Statistics is committed to embracing its critical role in the realization of a truly equitable STEM community at Sonoma State and to contributing to a transformation of the culture of the mathematical sciences and STEM communities more broadly. Current data clearly show opportunity gaps for Hispanic students in mathematics and statistics at Sonoma State, such as GPA differentials in math major courses and math/stats majors where the enrollment of Hispanic students is 21 percent (compared with 31 percent at Sonoma State, 38 percent in California and 26 percent in Sonoma County).

The obstacles to full, equitable participation and success in STEM pursuits are legion, and mathematics is at the heart of many. Transformation requires math and other STEM departments to confront their:

- Pedagogy that privileges some backgrounds over others.
- Conceptions of mathematics and science that connect with some cultures more than others.
- Prevalent cultural beliefs and messages about who belongs in mathematics and science.
- Assumptions of student preparation that are in fact not widely or equitably available.
- Widely held beliefs that mathematics and science are culture-neutral or even culture-free.
- Lack of conversation and understanding about ways in which identity affects students' engagement in STEM disciplines.
- Reluctance to acknowledge the roles that STEM subjects can play in perpetuating unjust systems, and to address STEM possibilities for confronting and challenging such systems.

During the first two years of the proposed five-year project, the mathematics and statistics department, with partners in all STEM disciplines and local community colleges, will develop a guided pathway for STEM departments to follow in transforming their practice. During the third and fourth years, additional STEM departments at Sonoma State will engage with the pathway to transform their own outcomes and approaches to culture. TIPS leadership will revise the pathway based on feedback and results from both rounds of implementation and will publish results on the web during the fifth year.

TIPS Towards Justice will study effective STEM education reform that embraces "serving" at Hispanic-Serving Institutions, investigating the effects of department-level deep equity work through novel research in two areas: instructional and institutional practices that truly serve Latinx student identities. TIPS Towards Justice will fill a gap in research about students' experiences of marginalization and belonging in university settings, especially about instructional and institutional practices that reduce marginalization and increase students' sense of belonging. Many entrenched STEM teaching practices and institutional procedures, policies and conventions continue to disadvantage students who are historically marginalized in STEM. To finally build equitable opportunity for success in STEM, it is crucial to understand these effects on marginalization and belonging. A second area of focus is the impact of department-level implementation of Culturally Responsive Pedagogies (CRPs) through equity-focused lesson study on students' sense of belonging and their persistence in STEM. TIPS Towards Justice will investigate and advance research on students' sense of belonging when they consistently experience CRPs and identity-affirming episodes across a range of STEM courses and in their broader department experience.



APPLYING MATHEMATICAL MODELS AND COMPUTATIONAL SIMULATIONS TO ADDRESS FERTILITY PROBLEMS

Applied mathematicians see complex problems through the lens of modeling. Keen modelers view intractable problems for laboratory scientists as exciting opportunities of exploration. Such problems are often at the interface of many branches of science and mathematics, providing opportunities for collaboration and working with students from a broad range of backgrounds.

The research group led by mathematician Dr. Julie Simons at California State University Maritime Academy is one such collaborative effort, bringing Cal Maritime students and University of California, Berkeley, scientists together to understand problems in fertility. Gillian Hooper and Alex Rosenberger, juniors in mechanical engineering, are working on developing and running large-scale simulations of sperm swimming in groups near a spherical surface that mimics the surface of the egg.

Sperm motility is a major indicating factor for fertility potential and is driven by undulating flagella. Sperm typically swim in viscous fluids that, to a human, would feel like moving through honey or molasses. Plus, elastic polymers in the fluid are like a maze of connected springs that can both entrap sperm and propel sperm in different directions. A dense matrix of such elastic polymers surrounds the egg that sperm attempt to fertilize.

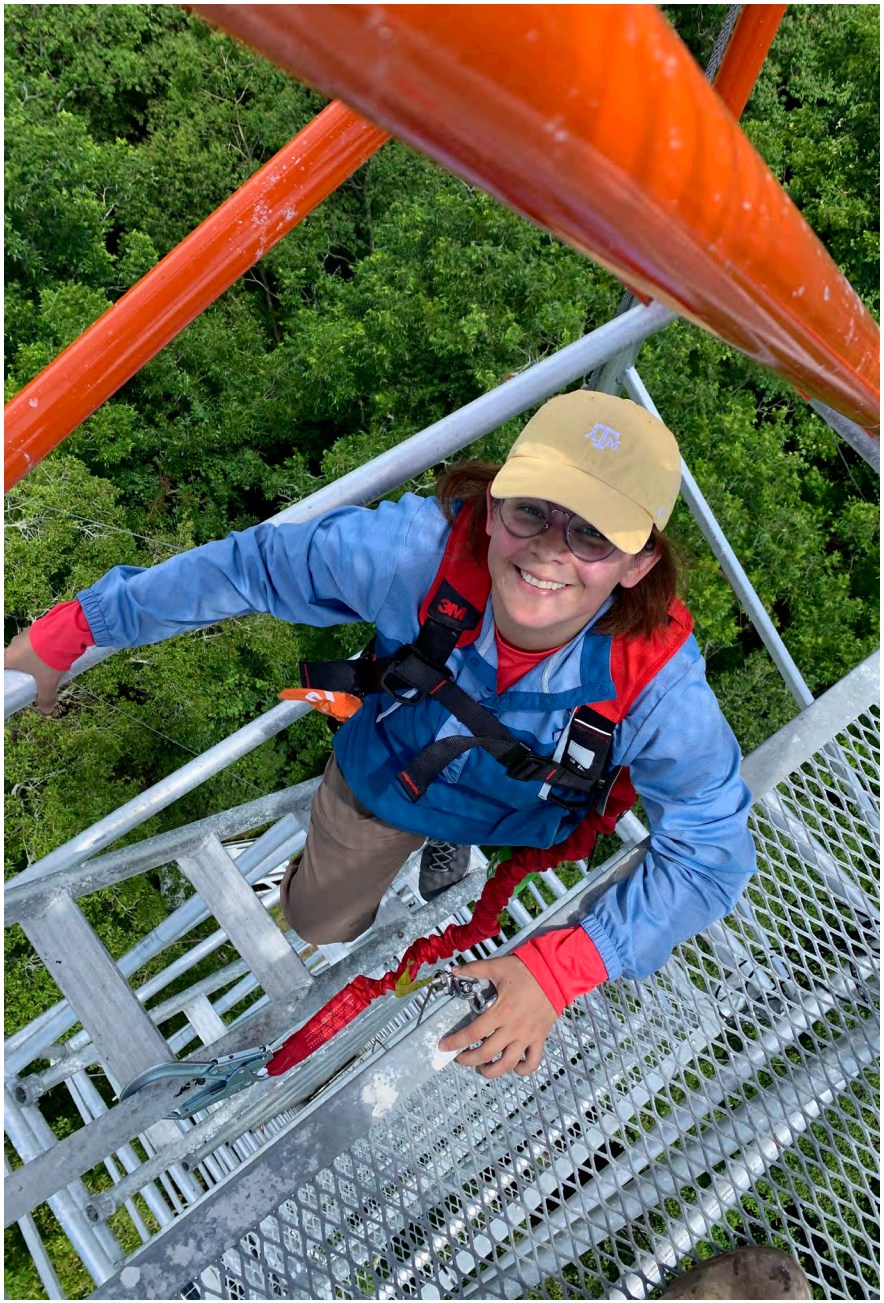
The multibillion-dollar fertility industry has long recognized issues surrounding sperm motility, and most treatments are targeted toward women. A surprising amount of the basic science involved in sperm motility is still unknown. In particular, modeling of viscoelastic fluids is notoriously complicated and until recently, some models were considered intractable because of high computational costs. Yet, fertility costs and infertility problems are becoming increasingly important. With climate change, scientists are facing mounting problems that often require fertility interventions, including food chain security and sustainable agriculture as well as global declines in biodiversity and new conservation approaches.

An interesting aspect of sperm behavior is the sperm of some species swim cooperatively in groups to effectively reach the egg. Studying sperm motility for populations and near surfaces in detail is now experimentally possible through high-resolution imagery. Mathematical and computational models have the potential to measure quantities involving forces, power and efficiency that simply cannot be measured in the laboratory.

The Simons team is trying to explain the fundamental science of how sperm reach the egg by extending computational models previously developed by Dr. Simons and her collaborators at Tulane University to more biologically relevant frameworks. These include investigating the motility of sperm populations and swimming near surfaces to elucidate whether cooperative swimming behavior is advantageous from a fluid mechanics perspective and how fluid elasticity and surfaces affect swimming behavior. This is important for understanding the evolutionary aspect of sperm development across species as well as fertility issues within species. Next summer, Hooper and Rosenberger will be validating and refining their model results by performing new laboratory experiments in the lab of Dr. Polina Lishko at UC Berkeley using human and rodent sperm and high-speed digital cameras.

WATER RESOURCES AND POLICY INITIATIVES

The Water Resources and Policy Initiatives (WRPI) faculty, staff and student researchers and policy experts come from all 23 campuses in the CSU. Through its mission to provide academic preparation, applied research and policy development related to water use, WRPI provides the necessary expertise to support California's need for appropriate and sustainable water resources and policy.



FUNDING A FIRST GENERATION DREAM—FROM PAID INTERNSHIP TO DOCTORAL SCHOLARSHIP

Miriam Morua Catalan is the recipient of a $20,000 Water Resources and Policy Initiatives/USDA (United States Department of Agriculture) Watershed Management Doctoral Scholarship. The scholarship program provides financial assistance to underrepresented students in the natural and social and behavioral sciences to increase their retention and graduation rates. The program also addresses the underrepresented professional workforce in food, agricultural and natural resource systems. To date, approximately $240,000 has been awarded to students pursuing a doctorate.

While attending California State University, Fullerton, Catalan obtained bachelor's and master's degrees in biology with an emphasis in cellular biology and plant ecology. During that time, Catalan worked in the Plants & H2O Lab with Dr. H. Jochen Schenk, where she became interested in understanding how the physiology of plants influenced the environment they survived in and how the availability of water can restrict physiological functions. Her undergraduate and graduate research focused on improving agricultural irrigation strategies and measuring in-situ conductance with plant-based sensing for plants in regions affected by drought and groundwater depletion. She participated in two research-based experience programs, which fostered her interests in working with the United States Department of Agriculture. As an undergraduate, she took part in the U-ACRE project, and as a graduate student, she interned with the CSU's Water Resources and Policy Initiatives USDA program. She also worked on a collaborative project with Dynamax Inc. and the California Avocado Commission as part of the 2016 Innovative Conservation Program to measure sap flow in stems to determine the actual water needs of young Hass avocado trees grown in soil berms.

As a doctoral student, she will continue working with plant-based methods that measure sap flow and water potential. Her current research focuses on comparing two sap flow methods, heat dissipation and heat field deformation. As part of her dissertation, she will work with the Texas Water Observatory, a program whose research efforts are to monitor near real-time data of water, carbon and energy fluxes to understand and model water resources and assess their sustainability in Texas and the southern United States. Catalan will collect data on plant water potential (leaf and stem) and sap flow across various land types to assess changes in water potential to natural regional gradients. She'll also estimate transpiration flow to understand plant water stress thresholds to regions exposed to extreme climatic events and at risk due to water shortages from watershed depletion.

The scholarship will help fund Catalan's research and support her throughout her doctoral program. After receiving her doctorate, Catalan wants to work as a plant physiologist with the Water Management and Systems Research unit in the USDA's Agricultural Research Service.

Catalan hopes to inspire other first-generation and minority students to reach higher and follow their dreams. She is passionate about continuing research that educates the public so as to drive change faster. She dedicates this award to her mentors, friends and family, especially her husband and daughter, for supporting her throughout this journey.

BAKERSFIELD

Located in the southern San Joaquin Valley, California State University, Bakersfield, is home to the Roadrunners—moving forward at lightning speed and championing intellectual progress. CSUB continuously rises in national rankings for its economic value and commitment to student success. Its students are brilliant and increasingly diverse—with the majority of graduates remaining in the Valley to solve the region's complex challenges.

TOMOGRAPHY TOOL ALLOWS CSU BAKERSFIELD TO LOOK WITHIN PLANTS TO SEE HOW THEY THRIVE—OR DON'T

On the hillsides and in the forests of Southern California, the effects of drought are obvious: bone-dry vegetation and trees withered and dying—potential fuel for wildfires. But the real story, at least for scientists, is what's going on within. It is there that these plants tell their stories of resilience or desolation, triumph over nature or surrender to it.

At CSU Bakersfield, that story and scores of others are being told now, thanks to a microcomputer-assisted tomography system, which has opened a world of discovery at the university since its arrival in 2017.

So rare is the micro-scanner that samples from as far away as Spain are sent to CSU Bakersfield for analyses. Teams from research-focused institutions such as University of California, Riverside, Santa Cruz, Davis and Berkeley, to name a few, have come to study at CSU Bakersfield to collaborate using the scanner.

But the most promising research, with real-time application, is happening in the university's backyard, in the fields that grow the nation's crops and industries that power our economy including:

- Nut growers using the scanner to understand drought tolerance.
- U.S. Department of Agriculture researchers sending grapevine samples in the fight against Pierce's Disease, a mysterious bacterial infection that decimates grapes.
- Local industries using the scanner to understand how their products improve crop productivity.

"There are so many applications," said Dr. R. Brandon Pratt, professor of biology at CSU Bakersfield, who led the team that wrote the successful U.S. Department of Defense grant that made purchase of the micro-scanner possible.

"It helps us understand the inner workings of plants, particularly with droughts. Our work is aimed at understanding the mechanisms of what kills plants during drought and getting detailed imaging of how a plant succumbs, or not. Not all plants are withering and dying. There are winners and losers."

Dr. Pratt is working with graduate student Viridiana Castro to research shrublands in the southern Sierra Nevada, a little-studied environment. On a recent afternoon, he demonstrated the incredibly high-resolution scans from the vascular system of a poplar tree, images so detailed that even the Belgium-based maker of the $1 million scanner was astonished. Pointing to small oval-shaped clusters, Pratt explained that gas bubbles prevent the tree from soaking up water.

"That was a pretty exciting scan for us where the resolution was less than one-billionth of an inch, and for the Belgians, too. This is the first sample we are going to print with our new 3D printer to share with our students and visitors to the lab."

GEOLOGY STUDENTS EXPLORE THE SEA FOR FOSSIL RECORDS

A cruise in San Diego sounds like a time for relaxation, but for CSU Bakersfield undergraduates, it has been a research opportunity they likely wouldn't get anywhere else.

Helmed in part by Dr. Anthony Rathburn, department chair of geological sciences at CSU Bakersfield, the oceanography project started in 2018 to attract students to marine sciences, a field that might not immediately come to mind for students in the landlocked Central Valley of California.

"Students are working hand-in-hand and elbow-to-elbow with research scientists," Dr. Rathburn said. "When we're out at sea, students are treated as real scientists, so whether you're a freshman or a senior, you're given responsibilities, you're trained, and you are doing hands-on research."

Plenty of activity takes place at sea, and students are at the heart of it all. Using high-tech equipment, students gather water, rock and seafloor sediment samples from as deep as 6,824 feet. The research, which continues back on campus, looks at ocean and climate changes over time.

Rathburn and his students study foraminifera, microscopic, single-cell organisms that live on the ocean floor. Sensitive to environmental change, they leave a fossil record and generate shell-like skeletons the size of a grain of sand. The research looks at how they are affected by changes in oxygen levels; by studying the living organisms found on the expedition, the scientists can learn more about paleoenvironmental conditions.

"By looking at the fossil record, we can see how the environment, oceans and climate have changed through time based on these tiny organisms," Rathburn observed.

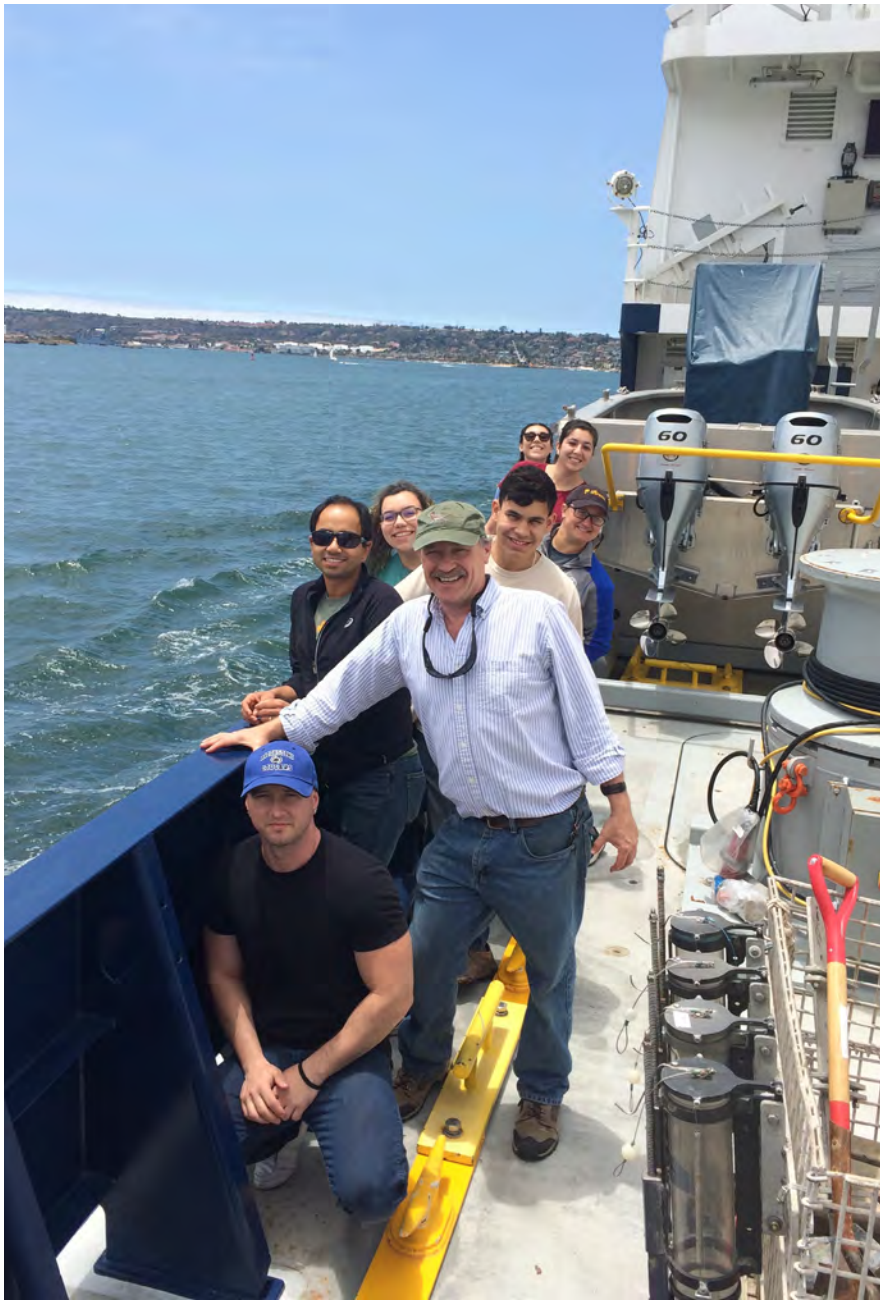
The study of marine science may appear to have little relevance in the Central Valley, but the area was under water about 15 million years ago.

"Marine environments cover 70 percent of the planet so, as geoscientists, that's an important aspect to focus on," Rathburn said. "In addition, most of the economic-oriented geologic deposits in the valley have a marine origin, so students interested in the geology of the valley need to know how marine environments, marine sediments and marine geology work."

For geology major Chris Chavez, the research cruise was a transformative experience. He heard about the trip in his oceanography class.

"I enjoyed oceanography when I took the class, and getting into this research, I think I've found that it's something that I really, really like," Chavez said. "It's kind of decided for me that oceanography is what I want to get into in graduate school."

Natural science major Rebeca Guerrero is in the credential program to become a science teacher and said the expedition has already made its way into her own classroom. She uses her experience on the cruise to expose her students to real-world scientific research.



"Plus, Dr. Rathburn gave me deep-sea sediment to show my class and they were so excited!" she said. "Who would have thought that a group of eighth-graders would be so intrigued and excited about mud! A little bit of deep-sea sediment can plant the seed for my students to pursue a career in science, and that is all thanks to an incredible experience out at sea."

MAKING A DIFFERENCE WITH THE CHICANO MOVEMENT THROUGH MEDIA

What is the lasting impact of the Chicano movement? Cesar Chavez? What do people in Kern County need to know about the grape boycott, which originated in Delano, California, the birthplace of the United Farm Workers?

María Rodríguez asked herself those questions as an undergrad communications student and figured that if she didn't know, chances were good that she was not alone.

It was while taking a class in the Spanish department called the Chicano Experience things began making sense for Rodríguez, a Delano native. From that seed of understanding grew a passion to learn more about the Chicano experience.

"It was an epiphany," Rodríguez said.

When Rodríguez returned to earn her master's degree in Spanish, she decided to do her thesis on the effect of the Chicano movement and what people knew of it. The result is her documentary, "5 Decades Later: The Aftermath of the Grape Strike."

Rodríguez's research consisted of interviews, surveys and archival research. The documentary's running time is 45 minutes and is subtitled in English and Spanish.

"That was my contribution, to kind of teach people, and hopefully by teaching them, they'll gain interest in the topic," Rodríguez said.

The filmmaker explores the lasting impact of the Chicano movement and the legacy is being preserved in classrooms.

"My hope is that public schools will encourage their students to study the Chicano movement and engage with their local histories. Schools can even show the documentary as a teaching resource," said Dr. Dustin Knepp, department chair, Modern Languages and Literatures.

Rodríguez's parents are fieldworkers, who made great sacrifices to come to the United States.

"This project represents hard work that impacts other people who have the same walks of life or who maybe just want to learn something new," Rodríguez said.

Knepp is eager for his student to share her research with the public.

"There's no impact if we're the only ones who engage with that research," he added.

CHANNEL ISLANDS

As the newest and fastest-growing CSU campus, California State University Channel Islands is a novel institution that is reimagining higher education for a new generation and era. Serving a largely first-generation, underserved student population, CSUCI provides an immersive, hands-on education that includes high-impact learning practices such as undergraduate research and creative activities that help instill in its graduates the communication, critical-thinking, problem-solving and mathematical skills needed to thrive in today's innovation economy.

A PIONEERING PROGRAM FOR DUAL-LANGUAGE LEARNERS

CSU Channel Islands associate professor of early childhood studies Carola Oliva-Olson, Ph.D., and early childhood studies lecturer Maria Estrada, Ph.D., are changing the early childhood education landscape in California.

Their project, called "Dual Language Learning Professional Development for the California Early Childhood Workforce," funded by the California Department of Education, focuses on equipping educators throughout the state with the skills needed to teach dual-language learners in preschools, community organizations and other settings. Over 60 percent of children between the ages of newborn to five years old in California live in a household where members speak a language other than English.

Dr. Oliva-Olson and Dr. Estrada designed the professional development model. An undergraduate course offered through CSUCI's Extended University introduces students to current theory, research and policy to support dual-language learners and effective strategies to use in the classroom. The course is offered online and in-person, in English and Spanish.

"We know that what happens in early childhood makes a difference for students in being successful in both school and life," Dr. Oliva-Olson said. "We must respond to a tremendous need in the county, state and nation to prepare our teachers. It's not about teachers becoming proficient in multiple languages, but the learning strategies they can use with their dual-language learners throughout the day."

This past spring, Oliva-Olson and Estrada launched a pilot online course with 20 early childhood educators across California.

"The pilot gave these teachers an opportunity to refine their classroom practices, and we were thrilled with the results," Oliva-Olson said. "We have great momentum to roll out the program across the state."

In the fall, they launched six simultaneous cohorts supported by 10 new instructors. This phase will support more educators in completing the course, and build both trainer and instructor capacity to advance this professional development. The excitement around the pair's work has extended beyond the classroom: Continuing Development Inc./Child Development Centers (CDC), which operates local and statewide early learning experiences, is planning to roll out their strategies across its agency.

"There's a lot of interest in the work we're doing," Estrada said. "It has also provided us with the opportunity to work closely with CSUCI faculty and staff to talk about the language and cultural needs of California's young children. Extended University has been critical in making this happen and has been a great partnership for Early Childhood Studies and the School of Education."

◀ CSUCI EARLY CHILDHOOD STUDIES ASSOCIATE PROFESSOR CAROLA OLIVA-OLSON

ARTFUL CONSERVATION

A 17-foot California condor sculpture created by CSU Channel Islands (CSUCI) art students Isela Munoz, Jenica Zeta and Maria Zuart now soars over Bitter Creek National Wildlife Refuge.

The three students, who affectionately refer to themselves as "the crazy condor ladies," created the project for CSUCI art professor Matt Furmanski's capstone class and worked in partnership with the U.S. Fish and Wildlife Service. In addition to the sculpture, the trio created an array of murals depicting native flora and fauna for the refuge's bunkhouse used by researchers, volunteers, rangers and staff.

"Part of the capstone process is to meet several times with the client, in this case U.S. Fish and Wildlife Service," Furmanski explains. "Maria, Jenica and Isela met with Fish and Wildlife, wrote up a proposal, pitched the ideas and got feedback from the rangers and staff. We conducted a site visit and photographed the potential project sites. The students are the creative power behind the content of the mural and the sculpture; I gave guidance as far as some of the processes and engineering involved, but they are the artists."

The 23,572-acre refuge is located approximately two hours north of CSUCI in the Los Padres National Forest at Dough Flat. In 1985, the U.S. Fish and Wildlife Service began acquiring land in the area to conserve threatened and endangered plants and wildlife. The refuge provides habitat for several listed species, but its primary goal is to preserve essential foraging and roosting habitat for the endangered condor.

"This project has challenged us as artists in the best way possible," the students wrote in their capstone summary. "As a group we have been able to successfully work together in merging our creative ideas as well as tackling bumps in the road along the way. This project also contained a lot of firsts for many of us, such as our first time painting a mural, the first time using a plasma cutter and even seeing snow for the first time, just to name a few. The experiences have not only brought our group closer together but have also made us better artists."

CSUCI STUDENT MARIA ZUART SPREADS HER ARMS ACROSS A DRAWING OF THE CONDOR SCULPTURE. ▶

STUDYING BATS TO ASSESS AN ISLAND'S RECOVERY

CSU Channel Islands' (CSUCI) research station on Santa Rosa Island is a university treasure. The island, about 45 miles off the Ventura County coast, is part of Channel Islands National Park. CSUCI students of all disciplines have the chance to travel to the island to conduct research projects while experiencing its beauty and wonder.

After being used for ranching and hunting for 154 years, the island is now returning to wilderness. Santa Rosa is believed to be home to about eight bat species, though the California bat is the only confirmed species breeding on the island. Bats are an indicator species for ecosystem health, so understanding how the island's bat populations change over time will help shed light on the island's recovery.

Under the direction of CSUCI mathematics professor Jason Miller, biology major Karissa Rico and mathematics major Krista Beck studied the island's California bat population as part of the university's summer undergraduate research program.

"Once upon a time, a biology major could graduate with a bachelor's degree with little or no mathematics on their college transcripts. And a math major could get a job without any knowledge of how math is thoughtfully used in real-world situations. Times have changed," Miller noted. "The study of bats is a natural playground for getting undergraduates to learn in an interdisciplinary way and appreciate the skills each discipline brings to the effort."

Beck said, "When I first applied, I was extremely curious about what math had to do with bats. I was very interested in learning the different applications for math in naturally occurring ways."

She and Rico used modern, nondestructive technology to learn more about this seldom-seen species.

Because bats use ultrasonic echolocation to forage for insects at night, the students used special ultrasonic detectors to locate and identify bats based on their echolocation calls. Two types of ultrasonic bat detectors were used to collect data. Researchers on foot at night used an active detector to identify foraging bats. Once foraging areas were identified, a passive detector was deployed to record activity from sunset to sunrise.

Specialized software measured the animals' chirps. Chirp patterns were then compared to those of various bat species, and the California bats' chirps were singled out for analyses.

The data the students collected will help build a library of Santa Rosa Island bat calls for future use by researchers.

"I did not know much about bats before this research and now I spend my time reading books on bats," Rico said. "I want to become a professor and focus my research on the conservation of bats and show the public how important they are to our ecosystem."

Beck added, "Doing this research has made me discover how truly passionate I am about environmental science and the many ways math is used in the different aspects of it."

CHICO

California State University, Chico faculty and students lead cutting-edge research, training and public service programs. Highlights of its diverse work range from regenerative agriculture and resilient environmental systems, forensic anthropology and blood and immune cell behavior studies to advancing community health through research-based nutrition, pavement materials development and preservation and a rural nursing preceptorship. An environmental studies program also involves hundreds of habitats, plant and animal species at Chico's 3,950-acre outdoor laboratory, the Big Chico Creek Ecological Reserve.

SUSTAINABLE SOLUTIONS FOR HUNGRY COLLEGE STUDENTS AND BEYOND

Even before the COVID-19 pandemic made basic needs a top priority, the Center for Healthy Communities (CHC) at Chico State, was working to feed the most vulnerable low-income students and residents across the state by connecting them with federal food aid. Since 2006, CHC has received several large contracts to promote the Supplemental Nutrition Assistance Program (SNAP), also known as CalFresh, to low-income college students and community members. One of the key priorities of this CalFresh Outreach (CFO) contract is to assist eligible college students and their households to apply for CalFresh and successfully receive benefits to buy food.

Although Chico State's CHC holds the prime CFO contract, the center subcontracts with campuses across the state including campuses within the CSU, University of California (UC) and California Community (CCC) systems. In fact, CHC increased its reach from 10 campuses in 2014 to include more than 40 campuses as of 2020. In addition, CHC partners with basic needs directors in the CSU and CCC offices of the chancellor and committee chair leaders in the UC Office of the President to ensure collaboration, communication and outreach within and among all three higher education systems.

This contract expansion was remarkable considering the degree of effort and coordination it takes to work and contract with different program and fiscal coordinators, sponsored programs, campus leaders and systems. Despite these administrative barriers, CHC has identified critical phases of growth among the subcontracting campuses to ensure that they meet or exceed program goals by the end of the three-year contract cycle. Meeting these contract goals will result in millions of dollars in food aid for disadvantaged college students, helping them offset other bills, work less and, hopefully, learn more.

Additional funds from the California Department of Social Services (CDSS) and the CSU Office of the Chancellor (via SB-85 and AB-74) support the creation of a CalFresh Outreach handbook aimed at a college audience, a Basic Needs Training and Resource Center and research dollars to support the critical impact of this work on student success.

Campus Community Connection

CHC also has a longstanding partnership with five community-based organizations in the far north primarily serving low-income older adults and/or people living with disabilities. With transportation a common barrier for this population, CHC's outreach has been most successful by going to the residents (e.g., apartment complexes, assisted-living facilities, etc.) and by providing one-on-one assistance with the GetCalFresh.org application assistance tool. Through partnerships with local organizations, CHC has helped support the acquisition of broadband services and improve technological literacy among these populations.

In addition, CHC is working to reduce the stigma of receiving CalFresh Food benefits by dispelling myths and using appropriate messaging to encourage high-need residents to apply. For example, many older residents mistakenly believe they will be taking benefits from children if they apply, despite the fact that these federal dollars are for all who are income eligible, without limits, and despite the fact that California has one of the lowest CalFresh participation rates in the country.

Another unique aspect of this contract is the work being done to connect colleges with rural partners. For example, the Siskiyou County Office of Education is working with Shasta Community College to help with the submission of CalFresh Food applications. Of the applications submitted by this subcontractor, 55 percent were from college students. As a result CHC will continue to build relationships between community colleges and community organizations to increase the CalFresh Food benefits among the college population.

CalFresh Supporting Student Success

One of the most promising and exciting aspects of the CFO contract is a pilot study exploring how CalFresh affected student success. Preliminary findings indicate that these CalFresh Food benefits do in fact help students offset bills, allow students to work less outside the classroom, attend class and office hours more regularly, and provide needed nutrition for better learning and classroom comprehension and overall health. This validated research tool will be shared statewide to track the impact of CalFresh on short- and long-term student success in support of the CSU Basic Needs and Graduation 2025 initiatives.

In the aftermath of COVID-19 and the likelihood of even more students losing jobs or experiencing unstable housing, mental health challenges and other obstacles to getting their basic needs met, this CalFresh work is more critical than ever.

WATER QUALITY MONITORING PLATFORM AIDS CAMP FIRE RECOVERY BY MOVING WATER CONTAMINANT TESTING FROM LAB TO FIELD

A collaboration between Chico State and Northwestern University researchers investigates water contamination caused by the 2018 Camp Fire, which nearly destroyed the nearby town of Paradise, California. At Chico State, Dr. Sandrine Matiasek, assistant professor of geological and environmental sciences, and Dr. Jackson Webster, assistant professor of civil engineering, are collecting a benchmark set of water samples and assisting Dr. Julius Lucks, associate professor of chemical and biological engineering at Northwestern University, with implementing a new synthetic biology platform to quickly monitor water quality in the field, as opposed to in the lab.

Natural disasters such as hurricanes, floods, droughts and, most recently, wildfires are increasingly affecting water quality. The Camp Fire released toxic metals and chemicals from burned houses, industrial structures, cars and other infrastructure into the environment, but the impact on water quality remains unknown. Currently, no technologies exist for fast and cost-effective water quality monitoring outside of a controlled lab environment.

To address this issue, Dr. Matiasek and Dr. Webster are working with Dr. Lucks and Dr. Jean-François Gaillard of Northwestern to implement a synthetic biology platform using regulated in vitro transcriptional sensors that can detect toxic compounds such as lead, copper, zinc and cadmium in water samples. The Lucks Laboratory at Northwestern University, along with collaborators from Massachusetts Institute of Technology and Indiana University, developed the low-cost platform for use from the lab to the field for faster and more efficient water-quality monitoring.

The Northwestern research team visited Chico State in June 2019 to test the platform in the field with guidance from Webster and Matiasek, who monitored water quality in creeks affected by the Camp Fire throughout the 2018-19 rainy season. The Chico State team conducted more field testing of the platform over the summer and in October 2019. Each field test involved Chico State undergraduate and graduate students.

The field tests were successful and preliminary results were presented at the American Geophysical Union Fall Meeting in December, 2019.

ALMOND SHELL FIBER RESEARCH LEADS TO DISCOVERY OF MORE SUSTAINABLE CARS AND PLASTIC BAGS

Low-cost natural fibers can help automotive companies looking to produce a more sustainable car. The headliner, usually a composite material that is adhered to the inside roof of a car, is a prime example of a low-cost part that could be made with sustainable materials.

Dr. Joseph Greene, professor of sustainable manufacturing and mechanical engineering at Chico State, conducted studies, funded by the Almond Board of California, to identify low-cost materials made from natural fibers and biodegradable plastics.

Using different recipes of almond shells and recycled polypropylene plastic, he compounded and molded plastic and natural fibers to produce several interior parts for testing. Biodegradable plastics were also made for comparison to recycled plastics. Dr. Greene and his team made 10 tensile bar and impact bar parts of various material combinations. They tested the plastic parts for tensile and impact strengths and quality appearance. They found that the addition of almond shells increased the plastic's tensile and impact strengths.

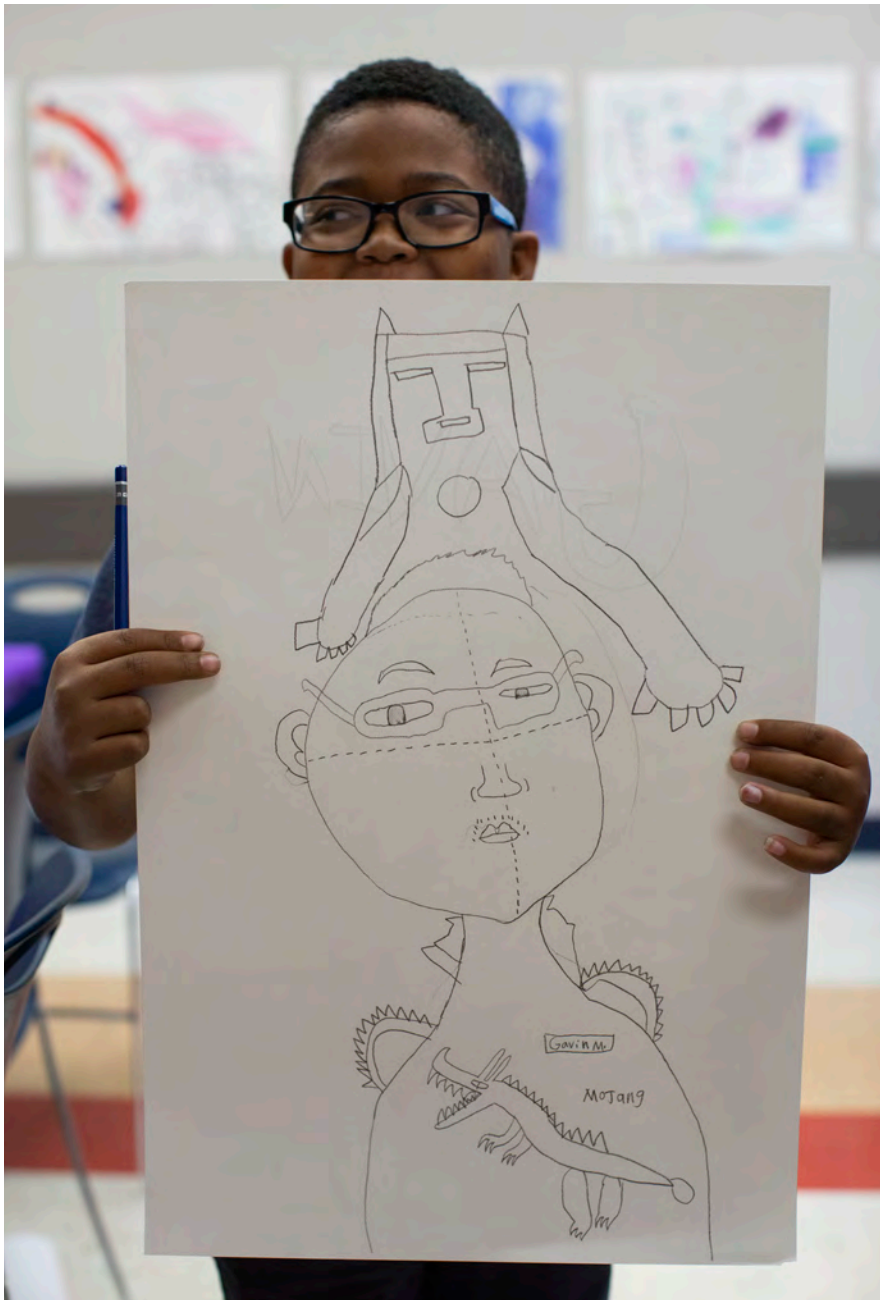
Greene plans to work with Ford Motor Co. to produce interior parts for a new model truck, making parts with recycled polypropylene or biodegradable plastics that contain between 20 percent and 40 percent almond shells. He is developing a manufacturing and engineering process to produce sustainable plastics with almonds shells and recycled or biodegradable plastics.

Almonds, one of the largest food crops in California, leave large amounts of waste product in the form of its shells. Using the shells' natural fibers reduces natural product waste and assists in the discovery of more sustainable solutions for cars at lower costs.

In addition, Greene is working on creating a plastic bag that has an attractive surface and a textured feel for use on the interior of a car. He made plastic bags with the natural fiber by blending almond shells, which contain about 50 percent cellulose, with recycled polyethylene. Plastic bags made with three percent almond shells had increased tear and impact strengths, he discovered that the bags' texture felt similar to leather. Roplast Industries of Oroville, California, which produce reusable plastic bags and garment bags for Nike, is interested in producing the new cellulose polyethylene bag if an appropriate manufacturing process can be developed.

DOMINGUEZ HILLS

As a vital educational and economic resource for California's South Bay, California State University, Dominguez Hills, provides an education that is accessible and transformative. It educates a population of unprecedented diversity for leadership roles in a global society. It actively celebrates and respects diversity in all forms, and its accomplishments are recognized nationally and internationally. CSU Dominguez Hills students graduate with an exemplary education and a genuine commitment to justice and social responsibility.



CALIFORNIA ARTS COUNCIL AWARDS CSUDH $135,000 TO EXPAND PRAXIS CITY ARTS PARKS PROGRAM IN CARSON

The California Arts Council has awarded the PRAXIS City ArtS Parks program at California State University, Dominguez Hills a $135,000 Creative California Communities grant to expand to additional parks throughout the City of Carson to provide art workshops taught by working artists, and to create two public arts projects in the city.

CSUDH's PRAXIS art engagement program launched the PRAXIS City ArtS Parks program in the fall of 2018 to expand narratives of South Los Angeles with afterschool art and mentoring programs. The program provides an artistic outlet for youth and the local community to aspire and dream, while cultivating pride and specificity of place.

The artists working in PRAXIS City ArtS Parks program in Carson will be assisted by paid CSUDH undergraduate students eager to acquire skills in community engagement and youth mentorship. The program's benefits are threefold: it provides opportunities for artists, professional development for undergraduate students and cultural and critical thinking enrichment for K-6 participants.

"With the awarding of the CAC CCC [California Arts Council Creative California Communities] grant, we are excited to solidify our partnership with the City of Carson. The support from Mayor Albert Robles and City Council members has been important for the program's development," said Devon Tsuno, assistant professor in CSUDH's Art and Design Department. He is the creator and co-director of PRAXIS, along with Aandrea Stang, assistant professor and University Art Gallery director.

PRAXIS City ArtS Parks aims to extend beyond studio practice and art history, incorporating social theory, community organizing, storytelling and theories of public space. The cumulative effect of each of these elements—participatory workshops, community-engaged research and the public dialogue—creates a true program of youth-centered arts empowerment.

"Carson has one of the nation's most diverse populations, and serving this diverse cultural heritage is an important value of the city. This partnership with CSUDH is a great step to further integrating the university's arts programming and our community," Mayor Robles said. "The city is committed to building a strong connection between CSUDH and our residents, and doing it for the betterment of the culture and diversity is great."

CSUDH is one of 40 grantees chosen for the CCC program. The award was featured as part of a larger announcement from the CAC, with grant funds totaling a projected $24,508,541 for 2018-19, the largest investment in statewide arts programming since the 2000-01 fiscal year. This is the second CCC award that CSUDH has received. The initial grant received in 2016 served as seed money for PRAXIS, which has evolved into a thriving and dynamic community program.

"Arts and culture are inextricably linked to our humanity," said Nashormeh Lindo, chair of the arts council. "They serve as a universal touchpoint for understanding and addressing our societal issues—dismantling inequity, healing trauma, reframing justice, inspiring truth and shaping futures. The council is humbled to support the vital work of CSUDH's PRAXIS City ArtS Parks program and its passionate efforts to make a better California for us all."

STUDENTS IN CSUDH OCCUPATIONAL THERAPY PROGRAM STUDY SPIRITUALITY IN OCCUPATIONAL THERAPY PRACTICE

Spirituality is often at the crux of the universal human experience, particularly as an important contributor to health, quality of life and well-being. Due to the nature of its holistic approach to health care, occupational therapy (OT) practitioners are well suited to address spirituality within client care. However, it often is not considered. Under the mentorship of Dr. Heather Kitching, coordinator of CSUDH's Master of Occupational Therapy program, a team of CSUDH students examined if and how OT practitioners use spirituality. Utilizing a phenomenological qualitative approach, they recruited via an Occupational Therapy Association of California email and conducted semistructured interviews with 15 participants from various practice backgrounds. Three significant themes emerged from the data.

Losing Spirit: The Inadequacy of Addressing Only Mind and Body

Many would argue that through mankind's eternal search for meaning, purpose and connectedness, we are inherently spiritual beings. The team further promoted the idea that mind, body and spirit are all one and, therefore, should not be separated if humans are to be fully functional, purposeful and harmonious.

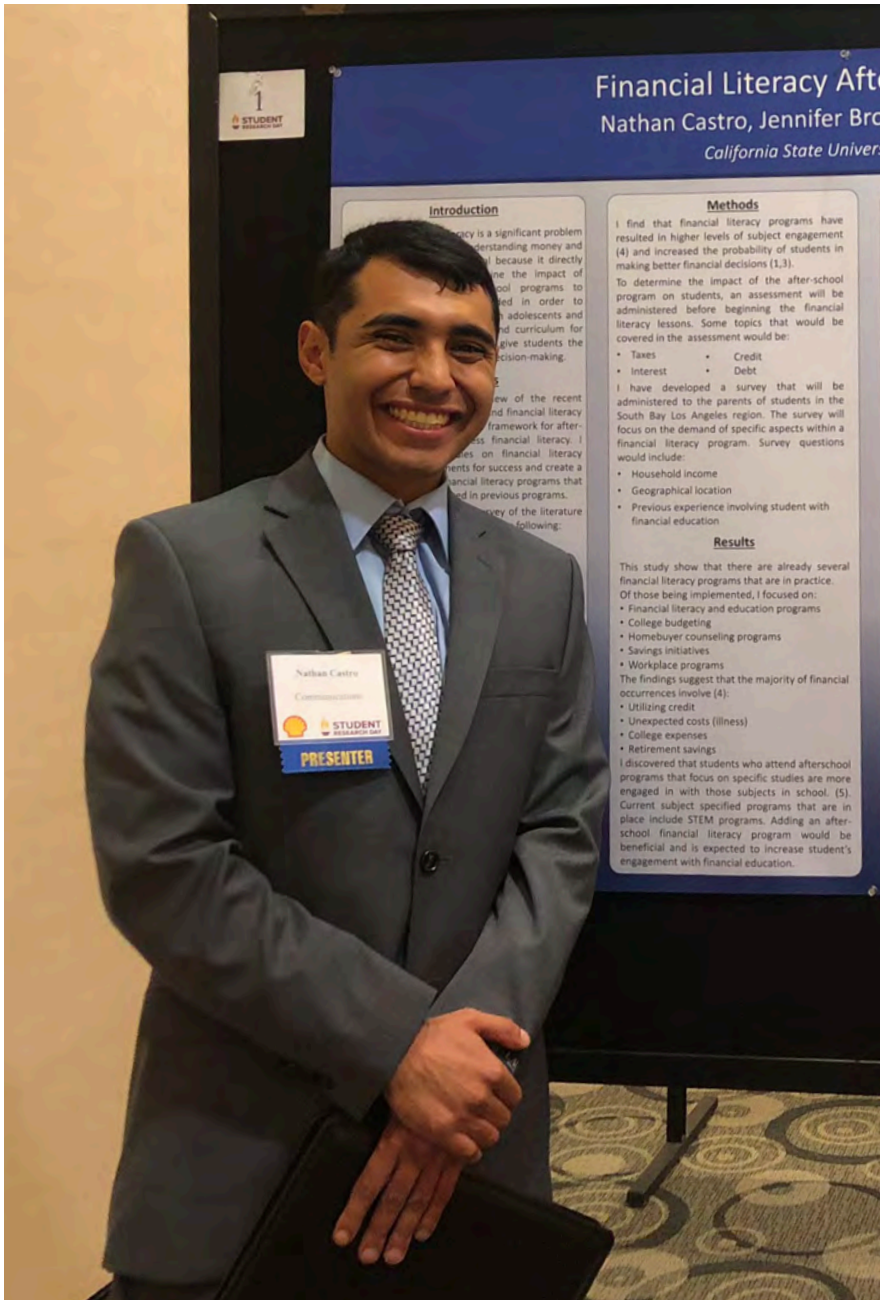
Spirituality as a Vehicle for Reaffirming Purpose in Both Client and Therapist

It is widely known that spirituality plays a critical role in the recovery process for patients across diagnoses, cultures and settings. The study discovered an additional layer, that spirituality can also be an intrinsically motivating factor for the therapist. Spirituality can be both a motivator and/or vehicle for reaffirming purpose in improving recovery outcomes for clients. When client health outcomes improve, OT practitioners derive intrinsic satisfaction, which enforces their professional or life purpose.

Addressing Spirituality Through Functional and Measurable Treatments

Through discussions with the participants, certain barriers, both perceived and real, were often found to be the limiting factor in OTs finding ways to address spirituality with their clients. However, it became evident through participants' experiences that spirituality and the medical model can be compatible and incorporated into practice by thinking outside the box. Examples included praying the rosary, which addresses sequencing and memory, and yoga, which addresses flexibility and range of motion.

The team's findings suggest that OT practitioners do find spirituality a relevant and imperative topic to address. OT practitioners should undertake their own journey of self-reflection and spiritual development to better connect with and address the spiritual needs of their clients. This responsibility does not rely solely on the practitioner. The profession also must acknowledge and nurture spirituality to convey its importance and to provide support to its base. Therefore, despite obstacles, not only is spirituality an approach that can be carried out in a medical model environment, it is a topic that practitioners should not be afraid to address, integrate and maximize.



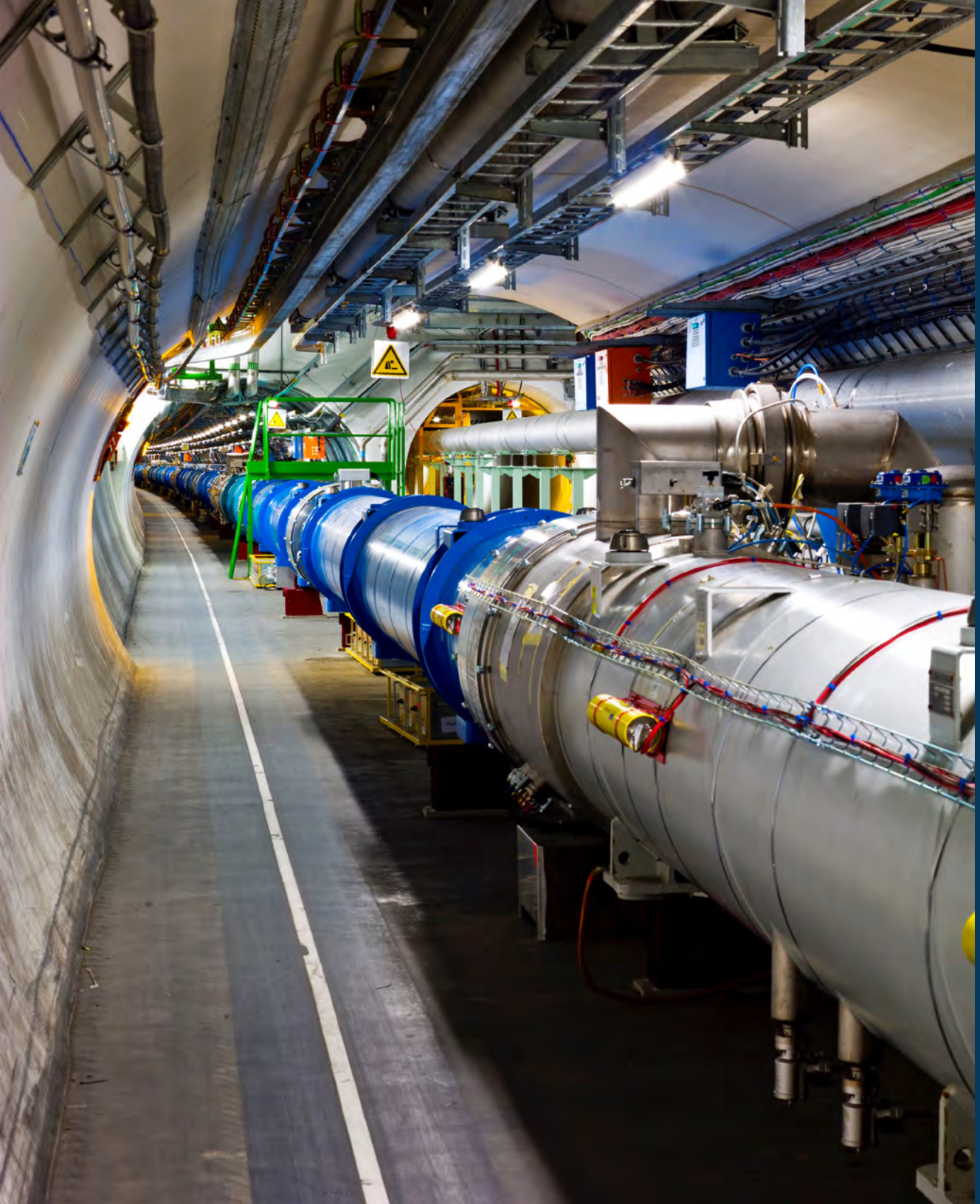
DEVELOPING A CURRICULUM FOR AN AFTER-SCHOOL FINANCIAL LITERACY PROGRAM

Financial literacy is the set of skills that help people navigate personal financial decisions, such as having emergency savings, saving for retirement, and understanding the costs associated with taking on debt. Previous studies find that financial literacy has an effect on wealth. In his senior year, CSU Dominguez Hills student Nathan Castro became interested in financial literacy. Castro started his college experience with classmates who were taking on large amounts of student debt and not graduating. He wanted to find ways of helping people understand how to make better financial decisions and manage their personal finances. Under the mentorship of Dr. Jennifer Brodmann, assistant professor in CSUDH's Department of Accounting, Finance and Economics, Castro studied the impact of financial literacy programs to determine the structure needed to improve financial literacy rates in adolescents and adults through an after-school program that engages both parents and their children.

Their study examined the types of financial literacy programs offered in the United States, their program outcomes and how to increase efficacy. Castro concluded that certain practices may help increase the efficacy of the program, which include adhering to national financial literacy standards from the Council for Economic Education, having students take assessment tests before and after the program, providing financial coaching with specific student goals and periodically evaluating the progress toward those goals, having a targeted list of workshops tailored to the student's needs and offering a range of course instruction (e.g., in-class, small-group and alternative media instruction) according to the student's learning preference.

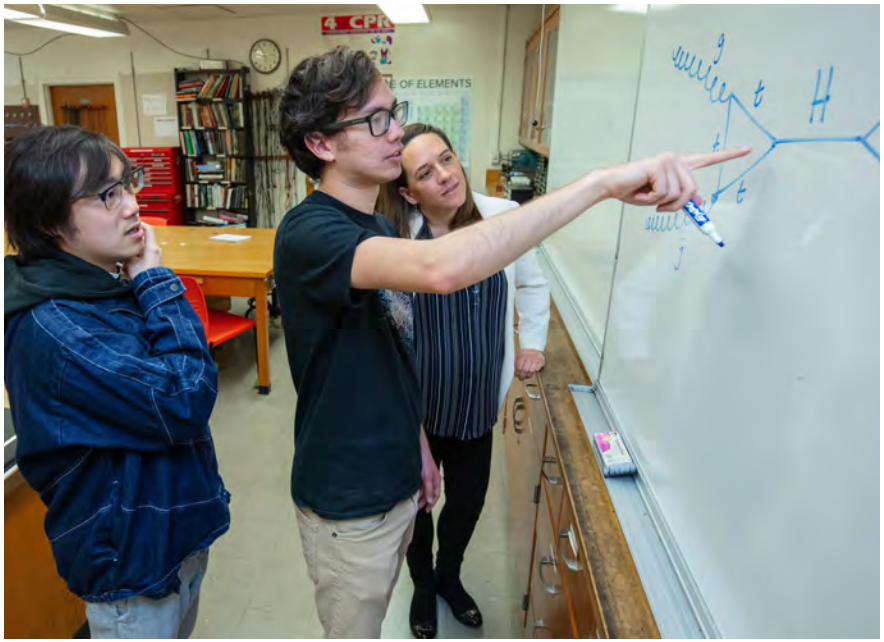
Castro presented the study at the South Bay Economic Forecast in 2018, as well as at CSUDH Student Research Day and the Academy of Economics and Finance Conference in 2019. In conducting this study, he learned research composition and methods, applied critical thinking skills and gained valuable experience in presenting research.

Castro graduated with his Bachelor of Arts degree in communications with a concentration in advertising and public relations in 2019, and he is applying for graduate programs in business and education.



EAST BAY

California State University, East Bay, is home to one of the most diverse student populations in the U.S. With the campus's focus on hands-on learning and small class sizes, students at the university's three campuses engage with faculty-student research from day one. Drawing students primarily from the San Francisco Bay Area, Cal State East Bay finds that the vast majority of graduates stay to work locally, fueling the region's growth.



CAL STATE EAST BAY STUDENTS HEAD TO GENEVA TO STUDY, PARTICIPATE IN RESEARCH AT CERN

Deep underground in an accelerator spanning the border of two countries, protons race toward each other at lightning speed. As the particles collide (nearly 1,000 million times per second), these collisions trigger detectors that measure the momentum of each charged particle and record data about the energy carried by each. The data are then sent back to the lab, where data scientists pore over the numbers, searching for a sign of the invisible forces that have shaped our universe since the beginning of time.

This is CERN, the European Council for Nuclear Research.

Located in Geneva, Switzerland, it is the largest particle physics lab in the world.

And in the summer of 2019, it was home to three Cal State East Bay (CSUEB) students who spent 10 weeks alongside physicists analyzing data and helping to build the next generation of detectors.

CERN began in the 1950s as a small lab for scientists from Europe and North America. Its vision was to stop the "brain drain" to the United States and Canada that was occurring during and after World War II and to "provide a force for unity in postwar Europe."

These days, it serves as a world-class research facility focused on fundamental physics.

"The primary focus is on particle physics … and fundamental research removed from most practical applications," said Dr. Kathryn Grimm, CSUEB assistant physics professor, who selected the East Bay students.

"It's one of those collaborations that in this particular field is a really cool thing to be a part of, it's kind of like saying you work for NASA, it's kind of the particle physics equivalent," said Alex Penaflor, one of the students.

Dr. Grimm, who did postdoc work at CERN, said the California State University has joined 45 other U.S. universities in becoming a member of the ATLAS collaboration.

Each participant must have taken and done well in a particle physics class at Cal State East Bay, and be enrolled in a computer programming class, to learn the data skills needed to work at CERN.

And while the Cal State East Bay students are used to having access to hands-on experiments from virtually day one, at CERN they instead were a small part of a much, much larger research effort.

"It's really cutting edge the work they'll be doing, but the fact is that because it's so big, the part they are doing can feel really small," Grimm said. "They have what we call tabletop experiments at East Bay where they do a large chunk of an experiment or research project, but there they'll be doing just one tiny part."

That cross-disciplinary work is key, she said, for students who may or may not end up working within the particle physics fields.

"A lot of the same tools used for big data are involved in this work, so there's a lot of people who have left particle physics and [gone] to Silicon Valley. So these are really good skills that can take students different directions."

And that's exactly what Penaflor is hoping happens.

"Recently I've been looking into engineering positions, but the experience I gain from the coding may be enough to get into the data science field," he said.

DEPARTMENT OF ENERGY GRANT ALLOWS CAL STATE EAST BAY PROFESSOR, STUDENTS TO RESEARCH NUCLEAR FUEL WASTE STORAGE

If used nuclear fuel waste was stored in a football field, the 80,000 metric tons produced in the last century by the U.S. alone would fill the stadium up to eight yards high. Ninety-six percent of that waste is radioactive uranium. As as result, scientists have a hefty task ahead—figuring out how to safely and effectively dispose of the materials.

Thanks to a three-year $785,000 research grant from the Department of Energy's Nuclear Engineering University Program, Cal State East Bay professor Ruth Tinnacher, Ph.D., and her environmental geochemistry students are helping to find a solution. Or at least a portion of it.

Radioactive waste—a byproduct of nuclear power generation—is currently stored in containers at temporary storage sites or at one of the 80 plants nationwide where it is produced. However, time is running out, because the containers were designed to last approximately 60 years.

"It is science that is directed toward solving a real-world issue," said Nicolas Hall, an undergraduate working with Dr. Tinnacher in the Department of Chemistry and Biochemistry. "It is not too common to see the science being done in labs actually applied to real-world situations and questions, and storage of radioactive contaminants is a huge question."

According to the United States Nuclear Regulatory Commission, the U.S. commercial power industry has generated more waste than any other country, and it is expected to increase to about 140,000 metric tons over the next several decades.

Dr. Tinnacher said when the U.S. storage program was designed in the 1970s and 1980s, the assumption was that the hurdles—political, social and scientific—would be overcome and a long-term, deep geologic nuclear waste repository would be built.

So while politicians are sorting out where to store the waste, Tinnacher and hundreds of other scientists nationwide are working on how to store it.

In the lab at Cal State East Bay, she and her students are focusing on the role of the engineered barrier that would surround a container of radioactive waste and protect the surrounding area from contamination after the canisters erode (a process currently estimated to take about 4,000 years).

The barrier is a layer of material known as bentonite, the same material used on highways and at other waste-disposal sites. Bentonite contains a clay material known as montmorillonite, which is highly effective at binding radioactive contaminants and has low permeability. This means any radioactive contaminants escaping the proposed containers would move incredibly slowly through the barrier layer. The amount of the contaminants moving through this barrier is largely determined by their binding (sorption) to the clay matrix in the bentonite, which again is dependent on the specific chemical form (or species) the contaminants are found in these systems.

How the binding of uranium to the clay is affected by mineral impurities in bentonite and the heat produced by the radioactive decay of spent nuclear fuel is the question that Tinnacher and her students, including graduate student Jonathan Pistorino, are seeking to answer.

"The overall goal of the project is how best to store uranium … we need to find out what species of uranium is in the waste material based on the chemical conditions of that material and how the intended barrier materials might impact the story," Pistorino said. "It's problem-solving; this type of science is about figuring out the puzzle."

CAL STATE EAST BAY STUDENTS, PROFESSOR PART OF TEAM BEHIND REVOLUTIONARY TELESCOPE

Cal State East Bay is helping expand our view of the universe. A first-of-its-kind prototype gamma-ray telescope will change the way astrophysicists see the cosmos—allowing scientists to study the most extreme events in the universe. With the new technology, made possible through the collaboration of more than 100 scientists, astrophysicists have gained a unique perspective of objects in the universe millions of light years away.

Dr. Amy Furniss, Cal State East Bay assistant professor of physics and gamma-ray astrophysicist, helped develop the prototype Schwarzschild-Couder Telescope, contributing the secondary mirrors for the telescope. An East Bay computer science student (now alumnus) contributed to the analysis software. The instrument was completed and unveiled at the Fred Lawrence Whipple Observatory near Tucson, Arizona, in early 2019.

"This represents the next generation of telescope that will lead gamma-ray astronomy, a field of astronomy that is only 50 years old, into the new era of multimessenger astronomy," Dr. Furniss said. "This telescope can see a much larger portion of the sky than previous instruments, and with far greater sensitivity, allowing us to look deeper into the cosmos to answer questions about how the universe behaves."

The telescope, which is said to be 20 times more powerful than current technology and 100 times faster than similar telescopes, will test a novel dual-mirror design to improve image quality.

Cal State East Bay students who work within Furniss' research group will have the opportunity to travel to the Whipple Observatory to help to commission the new instrument. They will participate in data collection, calibration, troubleshooting hardware and software and developing and testing the analysis software pipeline—all critical steps in the smooth transition to full data-taking for the prototype Schwarzschild-Couder's testing phase.

"Finally, and perhaps most excitingly, our students can use the data from the instrument to study extreme astrophysical sources within our universe, like gamma-ray emitting galaxies that have supermassive black holes at the centers of them with huge jets of relativistic particles emerging from the vicinity of the black hole," she said.

"Questions like 'How has the universe changed since it was born?' and 'What is dark matter?' and 'What is the most energetic phenomenon in the universe?' and 'How do black holes work?' are all high-priority questions, and this telescope is poised to help scientists find the answers."

FRESNO

The mission of California State University, Fresno, is to boldly educate and empower students for success. Through high-impact practices, service learning and community collaboration, Fresno State provides a transformative educational experience for its students—more than half of whom are the first in their families to graduate from college—and prepares them to serve and lead in the Central Valley, the state and beyond.

RESEARCHING HIGH-FLYING WAYS TO PRODUCE THE MOST ACCURATE MAPS

In summer 2019, Fresno State graduate student Jacob Lopez sat in a cool, dark engineering lab on campus analyzing digital photos of the Sierra foothills captured by unmanned aerial vehicles (UAVs).

Lopez, a civil engineering major focusing on geomatics, is one of three students working on an aerial mapping research project with the California Department of Transportation. In mid-June 2019, he presented the project at a conference in the Netherlands.

"We've been given these resources to help Caltrans really take the time to understand the many aspects of this new technology," Lopez said. "Everyone's starting to use it now."

Caltrans approached Dr. Riadh Munjy, professor and chair of the Department of Civil and Geomatics Engineering in the Lyles College of Engineering at Fresno State for help researching and determining the best practices using UAVs for high-accuracy mapping. The university's geomatics engineering program is the first four-year, nationally accredited comprehensive program in the nation.

The state agency needs to establish guidelines such as which type of UAV to use—one with a fixed wing or a rotary system—how to fly it, what type of camera to use and ground control placement, Dr. Munjy said. Specifically, how it can be done and what type of equipment needs to be used, he said.

The civil and geomatics engineering department and Caltrans have a long history of working on photogrammetry research together—at least 30 years with Munjy. Photogrammetry is the science of taking measurements from a photograph to create a map, a drawing or model.

The findings from this three-year project will offer instructions on how to use UAVs in surveying and mapping. The findings also can be adopted by any agency producing photogrammetric maps.

Munjy and his team at Fresno State contracted private UAV pilots to perform three test flights over the San Joaquin Environmental Range, 4,462 acres of annual grass and oak-pine woodland off Highway 41 in Madera that serves as an outdoor laboratory for students. In fall 2019, the team planned to conduct more test flights over a Cal Fire yard at the University of California, Davis.

For many years there was a disconnect between technology and its application. Drone manufacturers didn't know how photogrammetry worked, said John Erickson, chief in the Office of Photogrammetry and Preliminary Investigations for the Division of Engineering Services at Caltrans.

Traditionally, survey crews of two to three people are sent out to do topographic surveys of small areas. Planes are used to capture aerial photographs or lidar images using lasers of large areas.

UAV technology takes the process to the next level and can help agencies save money and increase safety practices, Erickson said.

"I haven't heard of any other studies going this deep into UAV use," he said. "There's a lot of interest in the results of this project."

The results so far are positive.

"We're getting accuracies that even Dr. Munjy doesn't believe," Erickson said. "The surveys done on the test ranges are highly accurate."

NSF GRANTS VALLEY CSU CAMPUSES $2.5 MILLION TO IMPROVE STEM EDUCATION

Three California State University campuses in the San Joaquin Valley will work together to develop innovative teaching practices to improve student academic performance and retention in the fields of science, technology, engineering and mathematics (STEM).

Fresno State, CSU Bakersfield and Stanislaus State received a combined $2.5 million grant from the National Science Foundation in September 2019 to form a regional team of science and math experts, including lecturers and social science researchers, to think outside the box when it comes to teaching STEM.

They will participate in intense creative-thinking "Ideas Labs" with nationally recognized math and science mentors to design a more interactive curriculum for lower-division chemistry and mathematics classes. These classes tend to be stumbling blocks for students seeking to graduate with a STEM degree. Then the team will apply the practices to their coursework and center it on research on real-world problems in the San Joaquin Valley, starting with air pollution.

"This is unique and transformative in that it's beyond one campus, serving an entire region," said Dr. Christopher Meyer, dean of Fresno State's College of Science and Mathematics. "It's great to work with our partners in Bakersfield and Stanislaus on collaborative and interdisciplinary approaches to facilitate student success in STEM. We're really excited about this, since it has the potential to benefit thousands of students in chemistry and math at the three CSU campuses."

Each university will focus on a discipline that presents the greatest challenge to its own students. Fresno State will focus on chemistry and math. CSU Bakersfield will concentrate on chemistry, and Stanislaus State will focus on math. Emerging best practices and innovations will be shared across the three campuses.

It's critical to increase the number of STEM graduates given the rapid growth of available, high-paying STEM jobs, Dean Meyer said. It is estimated the United States will have to fill millions of STEM positions by 2025. At the same time, less than 40 percent of students who intend to major in STEM actually graduate with a STEM degree, he notes.

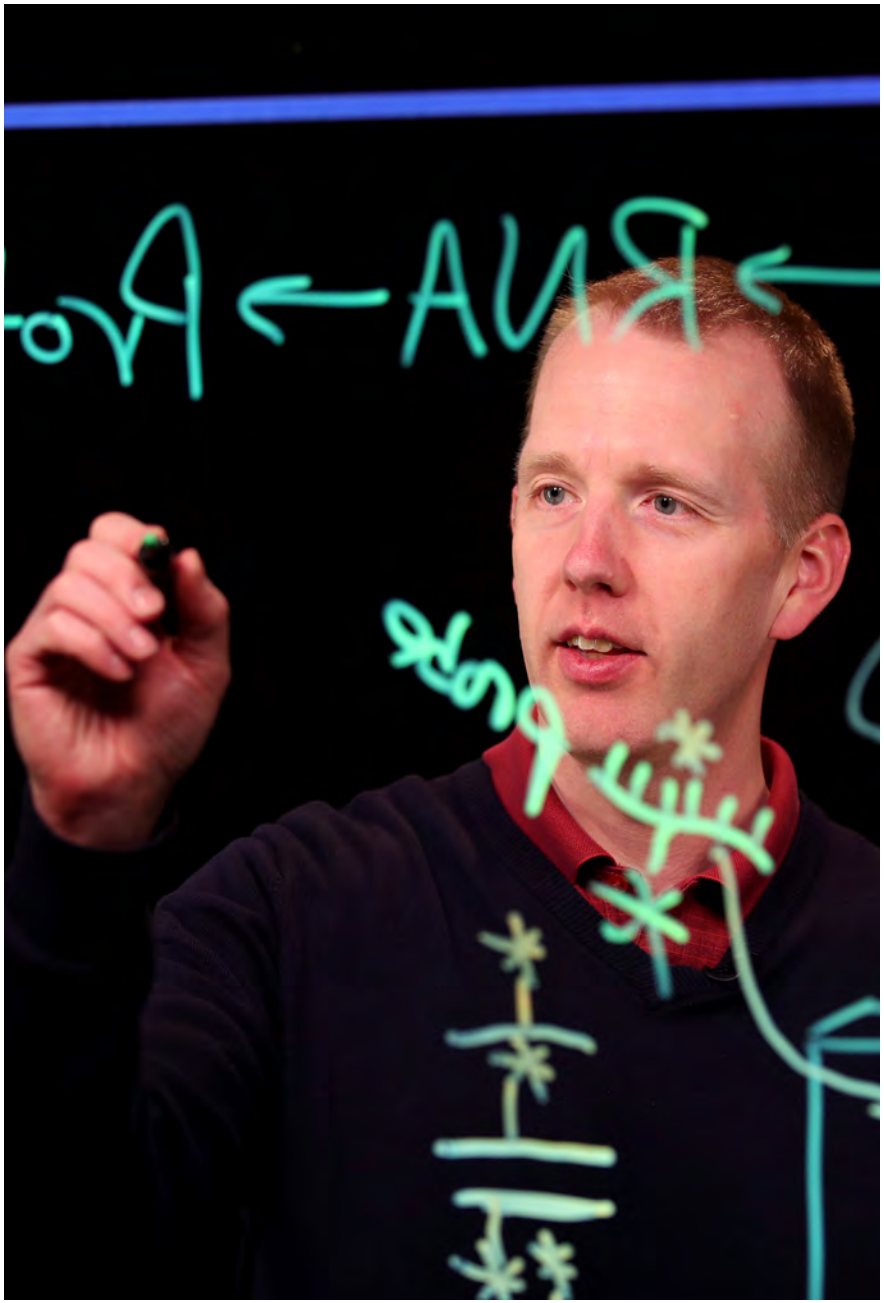
The project hopes to boost the number of Hispanic, first-generation and low-income students with STEM degrees to better reflect the demographics of the region. All three campuses are Hispanic-Serving Institutions, as designated by the U.S. Department of Education. About 60 percent of the students on the three campuses are Pell Grant-eligible, meaning they come from low- and medium-income households, and about 70 percent are the first in their families to attend a four-year university.

Another goal is to promote in chemistry and math students a greater sense of belonging, a stronger sense of self-efficacy and identity and a connection to faculty and their peers.

The work also will engage faculty-learning programs to share the practices developed with all instructors, especially part-time faculty who typically are not included in professional-development opportunities.

"In the CSU, we pride ourselves on great teaching, and this grant will enable our already-innovative teachers to share ideas and work synergistically across campuses," said Kathleen Madden, dean of CSU Bakersfield's School of Natural Sciences, Mathematics and Engineering. "We look forward to the positive effect this collaboration will have on student engagement and success in chemistry and mathematics courses."

The three-year project started in October 2019.



BIOLOGY PROFESSOR LEVERAGES TECHNOLOGY TO ENGAGE AND TEACH STUDENTS

A large television screen on the back wall of Fresno State biology professor Dr. Joseph Ross' office acts as a digital whiteboard ready for a genetics lesson when students visit during office hours.

Using an iPad, Dr. Ross draws diagrams of cellular processes that appear on the big screen to help students understand the week's lesson. He records the tutorial and posts it on YouTube so that other students can watch and learn.

Ross also records his class lectures, makes practice exam videos and uses lightboard technology, a glass "chalkboard" pumped with light that allows instructors to face the camera, to create videos for his students.

"I wanted to be able to create specific videos about things that we were going to talk about in class," Ross said. "That's how this started. Then, I just realized more and more things you can do with videos."

He can track viewership through YouTube analytics, and use timestamps to understand what students are most interested in or need help with.

Ross has long advocated for the use of technology in classrooms. He was an early adopter of Fresno State's DISCOVERe mobile technology program in 2014, and he is one of the nearly 400 faculty members trained to teach courses using tablets, laptops and smartphones.

During the 2018-19 academic year, more than 12,000 Fresno State students enrolled in DISCOVERe courses that make up about half of the classes offered on campus. A campus loaner program provides 1,600 free iPads for students to borrow throughout their college careers as long as they are enrolled in at least one DISCOVERe course.

Ross started creating videos to give his students something more engaging than a traditional textbook to read before attending class.

One of his first techniques, that he still uses, is a mobile PowerPoint display application projected on a big screen to his class. He uses his finger to write on his iPad and it shows up on top of the presentation for all to see. The application records his voice and the action on the tablet, which he later posts to YouTube.

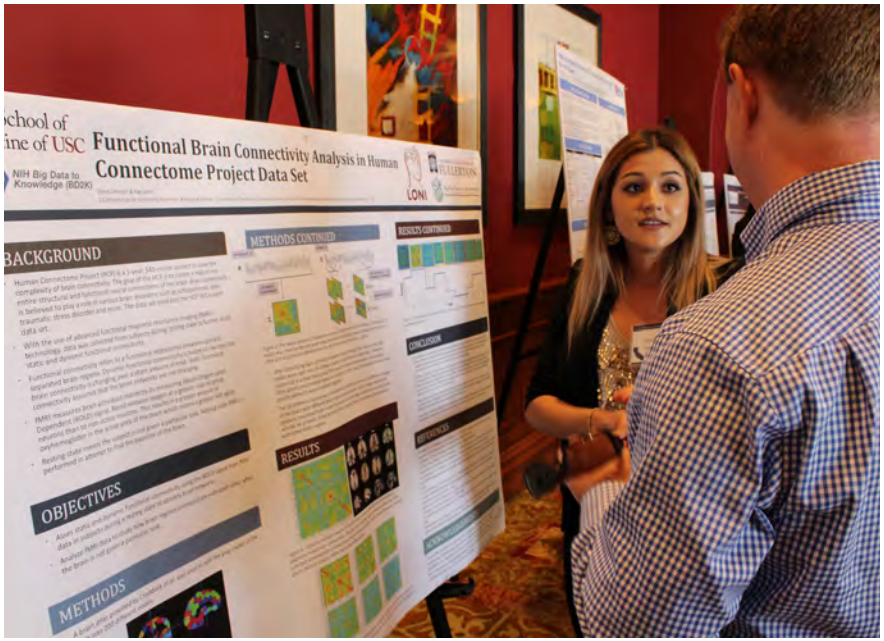
"I've always wanted to 'flip' my classroom," said Ross, who has been teaching for six years. "It's this blended learning approach of how to get students to access content first outside of class, then in class in a way that is active and engaging."

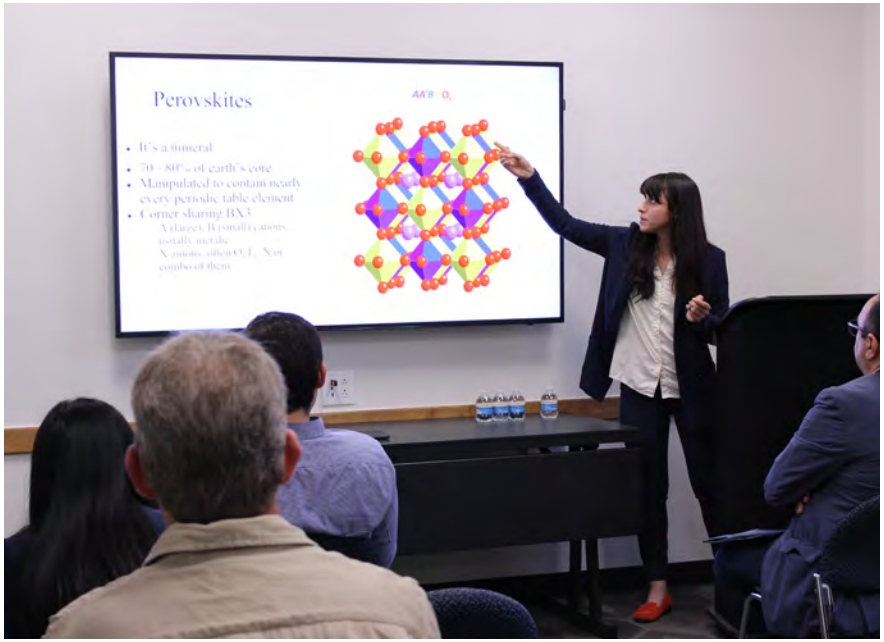
Senior biology major Arturo Aguilar has taken several DISCOVERe courses, but none like Ross'. "In a lot of the DISCOVERe classes, you use your tablets to take notes, but the way Dr. Ross does it, he uses tablets and computers to interact in the classroom," Aguilar said.

"I wish there were more teachers who teach like that because it makes everything easier," he said.

FULLERTON

A first-choice institution known for its national rankings in both academic rigor and lowest net cost, California State University, Fullerton blends cutting-edge research with an immersive student learning experience amid a rich diversity of perspectives and backgrounds. Dedicated to the principle that teaching and research are intricately woven, CSUF has made undergraduate research an integral part of its educational practice while strategically promoting faculty research, scholarship and creative inquiries.





STUDENTS GAIN BIG DATA SCIENCE (BDS) SKILLS TO EXPLORE EPIDEMIOLOGIC AND NEUROIMAGING DATA FOR DISEASE PREVENTION

Virtually 90 percent of data available has been generated in the last few years alone! Technological, medical, diagnostic and other scientific advances have contributed to generating enormous amounts, varieties and sources of complex big data that have vast potential for the creation of new knowledge, particularly in disease prevention and control. However, the newly emerging field of big data science (BDs) has inherent challenges of utilization and value.

Cal State Fullerton is working collaboratively to address these issues. Its Big Data Discovery and Diversity through Research Education Advancement and Partnerships (BD3-REAP) program has partnered with four campus colleges, external institutions and key faculty, including Dr. Archana McEligot, epidemiologist and professor of public health; Dr. Sam Behseta, mathematics professor; Dr. Math Cuajungco, biological sciences professor; and other faculty. They are providing comprehensive didactic and research opportunities in BDs for CSUF undergraduates, improving student research exposure, training and attitudes toward BDs. BD3 scholars have gained skills in computation—including Python, R and MATLAB—as well as an understanding of modern statistical techniques such as principle components analyses, and ridge and lasso regression. Importantly, BD3 scholars applied BDs skills to tackle large epidemiologic and neuroimaging data to address vital biomedical questions.

Of the 18 BD3 scholars, Alysia Bright, Stephen Gonzalez, Gwen Lind, Mimi Ngo, Cydney Parker, Galilea Patricio and Shaina St. Cruz explored the large publicly available National Health and Nutrition Examination survey data, investigating research questions such as the role of folate in depression in diverse populations, and links between physical activity and sedentary behavior to blood pressure and obesity. Also, BD3 scholars gained appreciation for handling complex, large datasets, including understanding population sampling surveys, weighting, cleaning, merging and identifying appropriate variables. St. Cruz and Gonzalez examined dietary folate intakes in non-Hispanic whites, Asians and Hispanics and found that dietary folate intake is inversely associated with depression, particularly in the Hispanic population, suggesting increased folate consumption for Hispanics.

Also, in partnership with USC, students utilized MATLAB and wrote scripts for functional magnetic resonance imaging (fMRI) datasets, identified potential biomarkers for post-traumatic epilepsy, explored Alzheimer's risk factors among Mexican Americans, conducted brain imaging with biomarkers in neurodegenerative disorders in Mexican Americans and predicted brain age by combining brain MRI data with deep-learning neural network algorithms.

Of the initial 12 scholars trained (the first two cohorts), all co-authored a peer-reviewed manuscript and/or presented at national or regional meetings. Further, of the six BD3 scholars who applied to graduate school, all were accepted into graduate programs at universities such as University of California, Los Angeles; USC; Dartmouth; Emory; and University of Chicago. In evaluations, two BD3 scholars indicated that the program changed their lives.

SUPPORTING EARLY IDENTIFICATION OF CHILDREN AT RISK OF AUTISM IN VIETNAMESE CHILDREN

HyeKyeung Seung, Ph.D., CCC-SLP, professor in communication sciences and disorders at Cal State Fullerton, researches autism screening and early identification of children at risk of autism. Dr. Seung conducted an autism screening study in 2012, screening more than 2,000 children across South Korea. This study resulted in "Examination of the Korean Modified Checklist of Autism in Toddlers: Item Response Theory" published in the Journal of Autism and Developmental Disorders.

In 2017, Dr. Seung conducted an autism screening study of Vietnamese children with Vietnamese American students in Fullerton's communication sciences and disorders department. She used the same autism screening test—Modified Autism Checklist in Toddlers-Revision—used in the Korean autism screening study. (The test is available in many languages, including Vietnamese.) In this study, they experienced challenges in recruiting participants, which led to follow-up research that examined Vietnamese families' cultural attitudes toward autism in general and seeking services for children. The findings were presented in 2018 at the American Speech-Language-Hearing Association annual convention in Boston, Massachusetts, and the RiteCare national conference in Los Angeles.

Dr. Seung and colleagues executed another study with speech-language pathologists who work with children with autism. In this survey study, they found challenges working with Vietnamese families related to language barriers and parents' perspectives about having their child diagnosed with autism, handling the diagnosis and providing necessary interventions for their child. This study resulted in the following presentations:

- "A Cross-Cultural Examination of SLPs' Perspectives on Working With the Vietnamese ASD Population" at the American Speech-Language-Hearing Association annual convention in Orlando, Florida.
- "Autism: A Look Into Vietnamese Culture" at the California Speech-Language-Hearing Association annual convention in Pasadena, California.

PREPARING FOR THE BIG ONE: SURFACE RUPTURE MAPPING AND PHYSICAL DISPLACEMENT MODELING OF CENTRAL CALIFORNIA FAULT SYSTEMS

Dr. Sinan Akciz is an assistant professor of geology at Cal State Fullerton whose research interests are in structural geology and paleoseismology. He conducts field-based research to understand the evolution of fault systems, with particular focus on the dates and magnitudes of past surface rupturing earthquakes along the numerous faults that form the San Andreas fault system. He has received funding from U.S. Geological Survey (USGS) and Southern California Earthquake Center to better constrain the ages of prehistoric southern San Andreas Fault earthquakes. Along with his CSUF colleague, Dr. Matt Kirby, Dr. Akciz investigate the influence of climate-change-driven heavy-precipitation events in preserving the timing and magnitude records of past earthquakes.

When Southern California's largest earthquake in nearly two decades occurred in Ridgecrest—at a magnitude 7.1—on July 5, 2019, Akciz put aside his research and joined his colleagues from USGS, California Geological Survey and other academic institutions to rapidly map the surface rupture and make detailed surface offset measurements before they deteriorated. Surface trace complexity and slip magnitude data are essential for scientists to create and ground-check their three-dimensional models of the ground's physical displacement. This information is also crucial for engineers and emergency responders to plan their response to infrastructure damage and plan for future earthquakes.

"Most of the Ridgecrest earthquake rupture occurred on previously unmapped faults, so we would not have expected to have an earthquake where it occurred," said Akciz, who mapped the southern 15-kilometer portion of the ruptured fault trace. "With each earthquake, we learn a bit more about the complicated process of earthquake occurrence and its surficial effects. These will ultimately help us build more earthquake-resilient structures and communities. While we get excited about such an event as a scientist, nonaffected residents of California need to remind themselves that they are living in an earthquake country, and the next one might be a lot closer to where they live."

HUMBOLDT

Surrounded by redwood forests and near the Pacific Ocean, Humboldt State University is a residential campus that prides itself on being a unique place to live and learn. A Hispanic Serving Institution, HSU provides an affordable, high-quality educational experience. Programs grounded in hands-on learning and community-building emphasize a commitment to tackling social and environmental issues and prepare students to become leaders who make a positive difference in the world.

MICROGRID PROVIDES CRITICAL SERVICES DURING OUTAGE

A groundbreaking microgrid developed to provide renewable power and energy resiliency for the Blue Lake Rancheria was put to the test during the 2019 statewide outage.

The Blue Lake Rancheria Tribe's main campus remained up and running when Humboldt County went dark, thanks to its fully integrated solar+storage microgrid developed by the Schatz Energy Research Center at Humboldt State. The Rancheria's gas station also stayed operational, running on a backup diesel generator that has now been replaced by a second solar+ microgrid. Schatz played a leading role in the design and development of both microgrids, working in collaboration with the Rancheria and other project partners.

The microgrid provided a safe, warm environment for local families to study and play, charge cell phones and access the internet; it supported a mobile office for Humboldt's daily newspaper, the Times-Standard; it charged electric vehicles; and it gave an electrical boost to municipal water and sewage systems. The gas station delivered fuel and other services for emergency response vehicles, government agencies, the Mad River Fish Hatchery and thousands of community members.

One of the greatest concerns during power outages is providing continuous access to electricity to people whose medical conditions require it. During the power shutoff, the Rancheria also housed eight people with acute medical needs in its hotel, by request of the county Department of Health and Human Services (DHHS). DHHS credited the Rancheria with saving these individuals' lives. Emergency diesel was also provided to United Indian Health Services to power the backup generators that keep perishable medicines cold.

The Schatz Center's current microgrid projects include installation of final components, testing and commissioning of the solar+ system at the Blue Lake Rancheria's gas station and development of the Redwood Coast Airport microgrid for deployment in 2021.

"As we prepare to deploy new microgrids currently under development for the North Coast and beyond, it's good to see our first commissioned microgrid successfully delivering critical services for our region," said Maia Cheli, Schatz outreach coordinator.

EXPLORING INDIGENOUS AND WESTERN APPROACHES TO NATURAL RESOURCES RESEARCH

In the Wiyot language, "rroulou'sik" means "rising up." The word is an emblematic name for a Humboldt State internship program for Indigenous undergraduates nationwide to participate in experiential research in natural sciences at HSU. Throughout Northern California, many Indigenous tribes are actively engaged in managing their tribal resources, utilizing both Western and Indigenous science.

Funded by a grant from the National Science Foundation, the program operated from 2016 to 2018. Each summer intensive was facilitated by Dr. Matt Johnson, wildlife professor, and Seafha Ramos, research associate, Indigenous scholar and National Science Foundation postdoctoral fellow in biology. Ramos' current research project on elk habitat and Traditional Ecological Knowledge (TEK) is the first formal study to address elk diet and habitat, as well as Indigenous science and the cultural value of elk, to take place on the Yurok reservation.

Designed to provide Indigenous students an opportunity to participate in natural resources research, Rroulou'sik projects focused on a range of topics, including an analysis of sea-level rise on Humboldt Bay waterfront infrastructure, an assessment of ecosystem health in the Eel River watershed and strategies for supporting and empowering Karuk tribal youth in natural resources restoration and food security.

"The Rroulou'sik program had tremendous value because it allowed students to work collaboratively with HSU faculty members and tribal collaborators to do research that's relevant to tribal communities," Dr. Johnson said. Rroulou'sik helped to advance the conversation at HSU about integrating TEK and conventional science, he explained.

Ramos, who is Yurok and Karuk, joined HSU after graduate school to serve as the Rroulou'sik coordinator. She continues her work in the integration of TEK and conventional (western) wildlife management approaches. In the course of her education, professional experience and cultural involvement, Ramos has observed discrepancies between Indigenous and Western worldviews.

Today, she is the lead researcher of a collaborative project with Redwood National Park and the Yurok Tribe to explore Yurok TEK as related to "meweehl," the Yurok word for elk, and to study elk habitat and diet via genetic analysis of fecal pellets.

Donald Moore, who is Yurok and Hupa is a junior at Fort Lewis College in Durango, Colorado. During Rroulou'sik at HSU, Moore analyzed different aquaponics systems for bok choy production.

"My project related to TEK and tribal land use by the way we used and took care of our resources," explained Moore, who used the health of sturgeon to measure water quality. He entered the Rroulou'sik program as a history major but switched to environmental studies after the program.

"I think Indigenous students might feel more supported when exposed to topics, worldviews and science they can relate to," Ramos said. Although not every Rroulou'sik project involved TEK, each undergraduate who participated in the summer program self-identified as Native American, American Indian, Alaska Native, Pacific Islander or Hawaiian, she said.

As an Indigenous scholar and scientist, Ramos has observed that the absence of diverse perspectives is not limited to undergraduates, but systemic throughout the sciences in higher education. In her research approach, aspects of both Indigenous and Western science have a role in answering important questions.

HSU RESEARCHERS JOIN STATEWIDE EFFORTS TO MONITOR MARINE PROTECTED AREAS

Researchers from Humboldt State University will continue studying marine life in protected areas on the North Coast, thanks to $9.5 million in total funding.

The new awards—administered by California Sea Grant in partnership with the California Ocean Protection Council and the California Department of Fish and Wildlife—will support up to three years of research for the state's network of 124 marine protected areas (MPAs).

One of the Golden State's most treasured resources for tourism, industry and recreation, California's 840 miles of coastline is also home to a diverse abundance of marine life. To protect the thousands of marine species who depend on coastal habitats, the California Legislature passed the Marine Life Protection Act in 1999. After years of lobbying by scientists and environmentalists, the state finalized the current network of MPAs in 2012.

The law established a statewide network of MPAs, areas designed to safeguard the biological diversity of coastal habitats while supporting scientific research.

In 2019, the Ocean Protection Council approved $9.5 million to fund seven projects through the MPA Monitoring Program. Several Humboldt State faculty will continue to conduct research in five ongoing MPA research projects:

- California Collaborative Fisheries Research Program, fisheries biology professor Dr. Tim Mulligan and biology instructor and California Sea Grant Extension specialist Dr. Joe Tyburczy
- Socioeconomic monitoring program for consumptive human uses, environmental science and management professor Dr. Laurie Richmond
- Evaluating sandy beach and surf zone ecosystems, emeritus faculty of fisheries biology Dr. Tim Mulligan and fisheries biology professor Dr. Jose Marin Jarrin

- Monitoring and evaluation of kelp forest ecosystems, biology professors Dr. Brian Tissot and Dr. Sean Craig

- Monitoring and evaluation of mid-depth rocky reef ecosystems with Dr. Brian Tissot

Researchers began collecting data in several MPAs in 2007, though baseline monitoring only began on the North Coast in 2014, said Tissot, who is also director of the Humboldt Marine and Coastal Science Institute and HSU's Marine Lab. At a 2017 Marine Lab symposium, data and reports were presented on baseline monitoring in MPAs along the North Coast. With the new funding, HSU faculty and students will join researchers to conduct long-term monitoring throughout the California coast. They will also provide scientific reference points to protect marine habitats, fishing communities and coastal ecosystems for generations to come.

"With this new grant, we can evaluate statewide data and make recommendations to the state on its MPA Monitoring Action Plan," Tissot said.

For his research projects on kelp forests and mid-depth rocky reef ecosystems, the grant allows researchers to keep collecting data to document changes throughout California's MPAs.

Dr. Richmond will be collaborating with a team of researchers to conduct socioeconomic monitoring related to consumptive human uses within MPAs. Her research focuses on commercial and charter (or commercial passenger fishing vessel) fishermen to examine potential impacts from MPAs as well as to monitor the health and well-being of California's fishing communities in the context of MPAs.

"With long-term socioeconomic monitoring that includes an analysis of landings data and conversations with fishermen, we may better be able to understand how fishing communities have been affected by MPAs and how they have adapted to MPA implementation," Richmond said.

As the public eye turns west toward the ocean with the increasing threat of climate change, continuing MPA research will be critical in shaping policy on California's famous coastline. "We need to spend significant effort in understanding the changes in marine ecosystems everywhere along the coast so we can adapt our resource management strategies to a rapidly changing ocean due to climate change," Tissot added.

LONG BEACH

California State University, Long Beach is committed to being an outstanding teaching-intensive, research-driven university that enriches students' lives and emphasizes student engagement, scholarly and creative achievement, civic participation and global perspectives for the public good. It is committed to the education, development and success of underrepresented racial and ethnic minority, first-generation, low-income and other underserved students. These are vital components to Cal State Long Beach's student-centered mission to help students succeed.

FILM AND TELEVISION CREATIVE ILLUSTRATES THE ART OF STORYBOARDING AND COSTUMES

When Forrest Gump decided his running days were over, he turned to a group of unexpected followers and told them he was tired and wanted to go home. The stunned crowd then stepped aside to allow the curiously bearded man to walk away.

In the highly popular "Forrest Gump" movie, Gump seemed to be something of a prophet during his three-year trek, a man who attracted disciples to an unknown cause. He looked the part, too. He had long hair, a scraggly beard and a gray-and-yellow poncho that resembled a biblical tunic.

What Gump wore in that defining theatrical moment was the idea of Cal State Long Beach professor Robin Richesson. She served as costume illustrator for the movie, and the producer asked her to draw something that would make Gump look like a religious leader.

"They gave me a picture out of a children's Bible story of John the Baptist, and he was wearing a fur loincloth," Professor Richesson said. "Nothing anyone would be wearing now or running around in across the country, but we knew what he meant."

She sketched a free-flowing rain poncho, a garment modern enough to make sense within the film's setting, but also evocative of the world that existed 2,000 years ago. It's just one of several of the movie's costumes she had input on.

Richesson, a professor of illustration and animation in the School of Art, has collaborated with costume designers to help visualize their designs on other films through extensive research of time periods and styles.

Her costume illustrations include Steven Spielberg's "War of the Worlds," "Polar Express," "The Curious Case of Benjamin Button" and the Academy Award-nominated "If Beale Street Could Talk."

Her talents aren't solely defined by sketches of stitches and seams. She also has worked as a storyboard illustrator on numerous movies and television shows. Among her storyboard credits are "American Beauty," "Jack Reacher," "MadMen," "Grace and Frankie" and "GLOW."

The bulk of her film and television work can be found in storyboards, sketches of scenes from which the director, producer and actors take their cues. Depending on the movie or television show, Richesson will research time periods, animal behavior and special effects, such as explosions.

She starts the storyboard process by sitting with the director and talking through scenes. Instead of taking notes, she does rough sketches of what she perceives will happen, giving them a creative blueprint.

"Others feel nervous drawing on the spot, but I don't," she said. "I sketch these little drawings; visual ways of taking notes. They [directors, producers] look over and see what I'm doing and they say, 'Yeah, that's right.'"

The task can be challenging, because every shot changes. As she explains, one shot can be several panels of drawings or many little sketches, but in the end, they help everyone involved communicate.

"Showing them a picture is faster than telling them," she said.

Richesson graduated from Cal State Long Beach in 1982 with a Bachelor of Fine Arts and in 1995 with a Master of Fine Arts.

She worked in television for 12 years, helping produce commercials for such brands as 7-Up and Duracell, as well as shows for NBC, CBS and Fox Television. Getting into the film industry, however, proved more difficult because of the exclusivity of unions.

Richesson's work is well-known internationally, since she was recognized 20 years ago as one of the "100 Most Creative People in Hollywood" by Entertainment Weekly.

HEART STENTS AND LANDFILL GASES RESEARCH IMPROVE LIVES ONE MOLECULE AT A TIME

As a child growing up in a small city in China, Dr. Fangyuan Tian spent most of her summers in rural areas fishing and camping with her father. Rocks and the smell of wildflowers fascinated her.

"We are not creating new things to change the world," Dr. Tian said, quoting her father. "Instead, we are always discovering and learning from nature." That was her first science lesson.

That casual conversation piqued her interest in biochemistry, but she didn't foresee a career in designing functional materials inspired by the natural world. Her love of nature and fanciful thoughts of becoming a nature explorer have led Tian to explore two areas of bio-inspired research that have the potential to improve the lives of thousands.

"You want to do more research that impacts more people," said Tian, an assistant professor of chemistry in Cal State Long Beach's chemistry and biochemistry department.

One of her passions is developing a safe, effective and affordable material that could help more than half a million heart patients each year. Inspired by a natural iron supplement, she has researched for the past four years a biodegradable coating for stents that would slowly release medicine into the patient following surgery without flaking.

A $278,000 award from the National Science Foundation and a $15,000 award from the California State University Program for Education and Research in Biotechnology (CSUPERB) have supported her research.

Stents are mesh tubes that permanently prop open a clogged artery, reducing the chance of heart attacks. Biodegradable stents were developed in the 1990s with polymeric, metallic or combination scaffolding, possibly coated with an anti-proliferative drug or gene, all of which degrade over time.

Tian discovered, though, that some initial drug-eluting stents were covered in a polymer that could flake off, create inflammation and possibly trigger a blockage in other parts of the body.

Her work aims to create a biodegradable coating that will release anti-proliferative and cholesterol-fighting drugs to prevent cholesterol buildup for people battling heart disease.

About 647,000 people die of heart disease in the United States every year, and about 805,000 Americans have a heart attack, according to the Centers for Disease Control.

"We have developed an iron-containing porous thin film, which can be potentially used as a degradable polymer-free stent coating for a controlled drug release," she said. "This material is different from other drug-eluting stent coatings, which are polymer based."

Tian's other research interest centers on solving environmental and energy-related issues. These two disparate research areas may seem unrelated to each other, but she sees it differently.

She is exploring effective and more efficient new biodegradable materials—similar to the materials used in stents—to benefit the landfill industry. Landfills are the third-largest source (14.1 percent) of human-related methane emissions in the country. Researchers see this as a lost opportunity to capture a significant energy resource.

In 2017, Tian received a $100,000 grant from the Environmental Research and Education Foundation to support her proposal titled, "Renewable Energy From Waste: A Study of Landfill Gas Purification by Hybrid Porous Materials."

In this project, Tian discovered a hybrid porous material that can absorb carbon dioxide, separating it from methane. In doing so, she found a way to more effectively and affordably filter gases that are released as the landfill waste decomposes. The gas (methane) could be burned to generate electricity and then be provided to local power grids.

FUEL REWARDS: EXPLORING PROPERTIES OF SOLID ROCKET PROPELLANTS

For Dr. Joseph Kalman and his students, the pursuit of knowledge is a mission to better understand energetic materials—the hot-burning stuff of solid rocket propellants, explosives and pyrotechnics.

Dr. Kalman, an assistant professor of mechanical and aerospace engineering at Cal State Long Beach, is leading the establishment of an on-campus Solid Propulsion and Combustion (SPC) Laboratory. There, he and other researchers study the physical and chemical properties of solid propellants—or to put things more simply—what happens inside the rocket motor during the moments after ignition.

Kalman comes from the Naval Air Warfare Center Weapons Division at China Lake in California's Mojave Desert. His current appointment allows him to introduce students to the world of propulsion engineering.

The SPC lab enables researchers to take a close look at what happens at the micro-level when energetic materials ignite, blazing to temperatures that he said can approach 3,000 degrees Kelvin, which is close to 5,000 degrees Fahrenheit.

The Office of Naval Research provided a grant of nearly $400,000 to help the lab acquire equipment, so Kalman has the lab fully equipped with such features as:

- CO_2 laser, a device that also is used to cut or weld metal, for controlled ignitions.
- Resonant acoustic mixer, an increasingly popular device in the propellants industry that uses sound to mix thick, batter-like propellant ingredients use.
- High-speed camera and optical devices to record, at minute resolutions and very high speeds, which help researchers understand how propellants react in a flame front and flame combustion process.

"It is crucial to have this lab on campus," Kalman said. "If it is not on campus, our aerospace engineering students, and others, will not benefit from this equipment. We are in a hotbed of the aerospace and propulsion industry, and having students exposed to this work and equipment, with hands-on experiences, will give them a leg up from their peers at other schools."

Alumnus Alek Nilsen, along with graduate student Christian Rodriguez and others, has worked with Kalman designing a slab burner to study how hot air interacts with solid fuel. Students are excited about the lab's research possibilities.

One of their objectives is to better understand the functioning of a ramjet, a variant of an air-breathing jet engine. This kind of propulsion system allows a flying missile to channel surrounding environmental air into a combustion chamber. Missiles incorporating ramjets can have greater thrust and, thus, longer ranges than their more traditional counterparts, Kalman said.

The typical method of producing solid rocket propellants is similar to baking a cake, he noted. Here, however, the main ingredients are an oxidizer (needed to begin/sustain combustion), metal particles (for energy density) and a rubbery polymer binding agent that holds everything together. The ingredients are mixed together and molded into the shape of a rocket engine.

That's a basic description of the process, but part of the mission for the new laboratory is to explore the potential for more sophisticated fuel or propellant geometries. David Ramirez, an undergraduate student, is researching the science of 3D-printed rocket propellants at the lab.

A missile powered by 3D-printed solid propellant, for example, could be designed to accelerate rapidly after being fired before slowing to a cruising speed and accelerating again before striking its target, Kalman said.

If such a fuel is employed to power a rocket with a human passenger, the propellant could be designed to slow to a more comfortable rate of acceleration after escaping the earth's gravity, Nilsen said.

LOS ANGELES

California State University, Los Angeles is the premier comprehensive public university in the heart of Los Angeles. Having achieved top ranking in the United States for the upward mobility of its students, Cal State LA is dedicated to engagement, service and the public good. The university has provided ladders of opportunity for first-generation college students, veterans, immigrants and families throughout Los Angeles in pursuit of better lives.

RELIVING HISTORY THROUGH 'THE MINUTES' (FORMERLY THE WALKOUTS)

"The Minutes" was improvisational theatre experimentation at the Arena Theatre at Cal State LA that centered on the East Los Angeles 1968 walkouts, and the dismissal and reinstatement of legendary educator Sal Castro. All shows sold out days before opening night, and the performances were received with great enthusiasm.

"The Minutes" took the minutes of the LAUSD Board of Education meetings from August 29 to September 12, 1968, as a starting point to investigate and reveal power structures inherent in space and social structure. Based on these minutes, as well as film archive footage, 10 acting students, musicians, a stage crew and a camera team, created a live improvisation of history.

At the same time, five computer sciences students worked—and still work—on a video game called "Race Against the Machine" implemented in spring 2020. This steampunk game combines social criticism with humor and gameplay. The game is set in a surreal version of the world of the civil rights movement of 1968. The game design team aims to develop an AI bot based on the language games derived from the improvisational theatre. During the live performances, all improvised language and historic speech were transcribed in real time. A simple algorithm called "Markov Chain" was used to filter keywords to comprise the core of the played scenes. One of these "Markov Chains" sounds like this:

"we're not happy I was great political opposition and so tell me what demand at work have you? expecting you know Mexican teach how about that I was aware they were doing the right think the school did you were not home what myself tell I'll go something beautiful you know my house you work have a felon you can't be a freshman I wasn't know about us this school disrespecting your school? already broken you kind of education we want that myself tell I'm trying to work have you? know Julian Nava he color of the students and I wasn't know the feel like if I wasn't like sweat it smelled like OK I'll he doesn't suppose we give to drag us out feet first yeah the police car on our wife and so late I just like it smelled by a system that it smelled them they dug into our wrists the feeling of the your house I see and so telling there as much a criminal system what doing is more important than you look good yes?"

The algorithm language was played back during the performance so that it could be used as a feedback loop. This way and by means of spatial story design, the performers explored the narrative determinations of space and (historic) situations. They were looking into what are the driving forces and underlying power structures of society and how does personal memory and group dynamics feed into our collective experience and consciousness.

The project produced an abundance of interdisciplinary research in the field of digital humanities. Already more than 40 student papers have analyzed and discussed a variety of aspects such as linguistics and power, Chicanx history, politics of knowledge production, issues of human-machine interaction, interactive storytelling and game design.

The students were able to develop and deepen their improvisational skills as a collaborative framework to explore teamwork and collective investigations of social relations. They currently examine the impact of institutional language patterns with artificial intelligence and evaluate the efficiency of model-making as a means of learning and representation.

MATERIALS SCIENCE AND MANUFACTURING RESEARCH AT CAL STATE LA HAS THE RIGHT MOVES

At his Advanced Materials and Manufacturing Laboratory (AM^2L), Dr. Mohsen Eshraghi has the right moves for materials science and manufacturing. The associate professor's broad base of research spans from computational materials science to 3D printing.

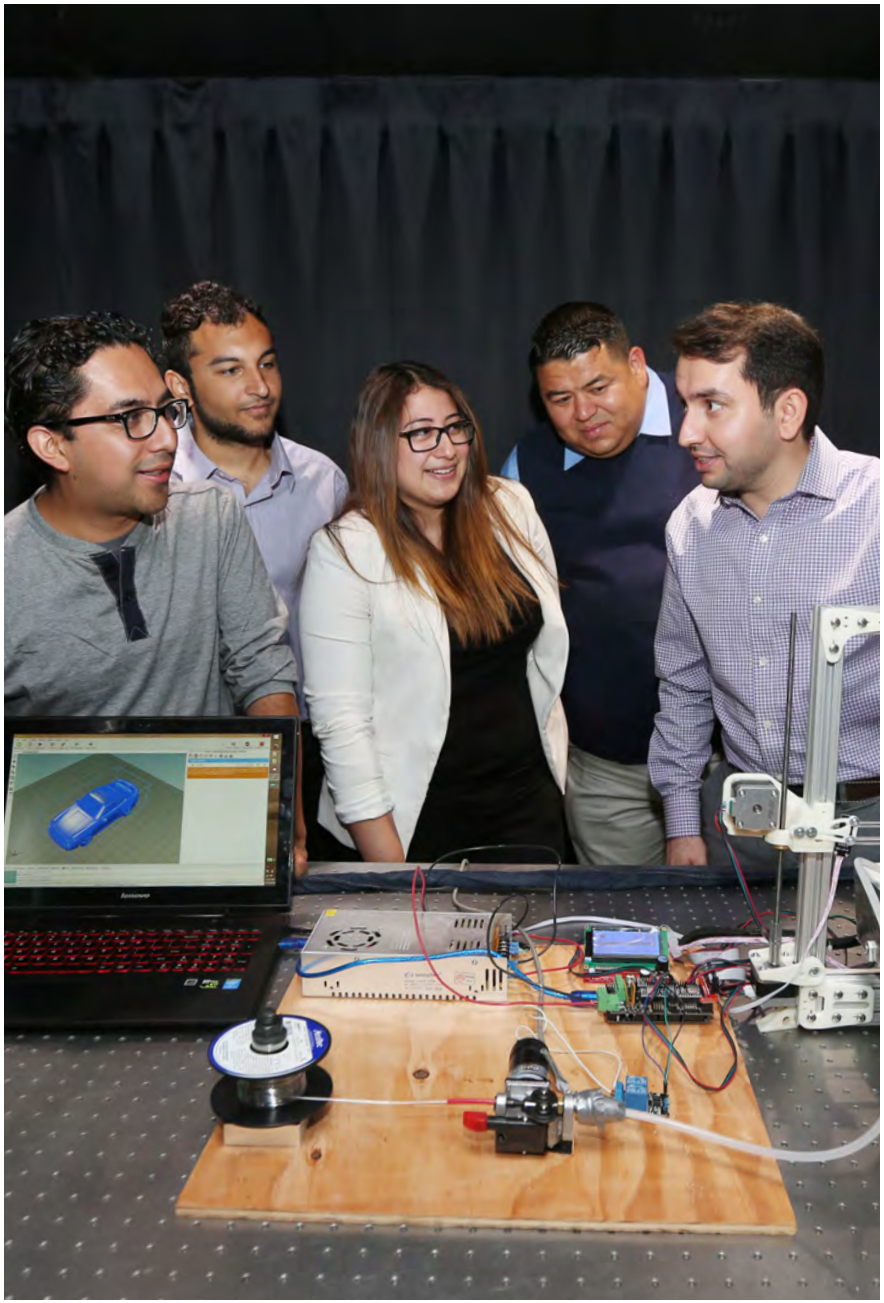
Cutting-edge cameras can zoom in to capture the details of jet engines, but they don't have the capability to see the microstructure of the metallic components. A team of researchers at Cal State LA is using computer models to simulate how microstructures evolve in materials during manufacturing processes. The team has obtained two competitive grants from NASA to work with Marshall Space Flight Center and the International Space Station on simulation of microstructure formation during solidification of alloys.

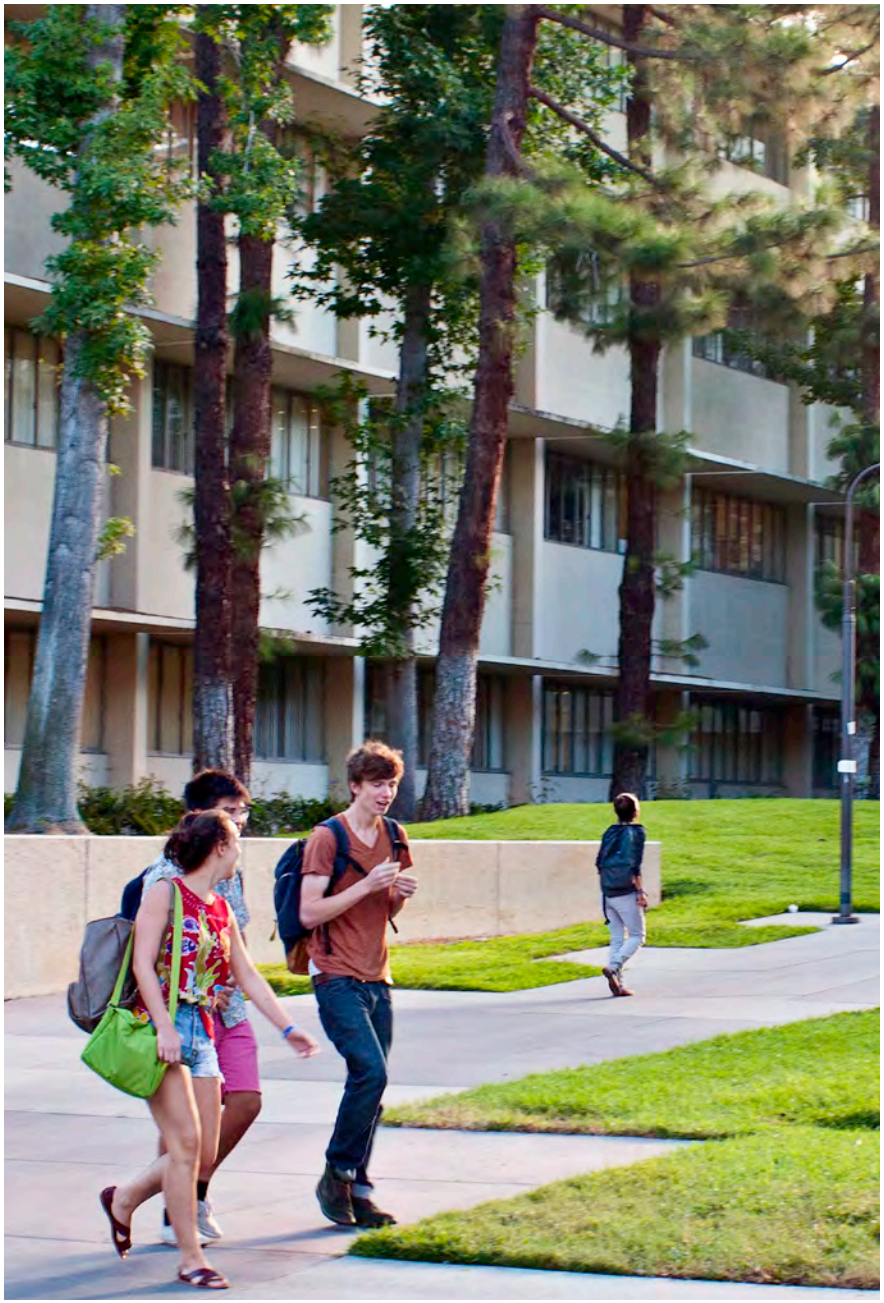
Solidification is a critical step of all manufacturing processes. Understanding solidification phenomena will help to produce parts with superior properties. This research studies solidification microstructure in space where gravity is absent and compares it with solidification on earth in the presence of gravity. This would be useful for in-space fabrication as well as manufacturing processes on earth. Whether the alloys are made by casting, welding or 3D printing, this research work will apply to all industrial manufacturing processes that involve solidification.

Additive Manufacturing (AM) technologies, aka 3D printing, provide new opportunities for materials customization, improvements in product performance, multifunctionality and lower overall manufacturing costs because of their unique capabilities. Students at AM^2L have designed and built a Wire Arc Metal AM system from scratch. Two graduate students are now developing processing parameters for high-temperature alloys using that system. They have also developed in-house systems for selective laser sintering (SLS) and AM process monitoring. A team of undergraduate senior design students is now developing a large-scale system for concrete 3D printing. In addition, another team is working on multiscale modeling of metal 3D printing processes. This research will provide a better understanding of how changing process parameters affect the microstructure formation and properties of 3D printed materials. Currently, six undergraduate students, five graduate students and a visiting scientist are working on a variety of projects at AM^2L.

AM^2L is a unique facility occupying a standalone building next to the Engineering and Technology building at Cal State LA, with two areas for Additive Manufacturing (AM) and Integrated Computational Materials Engineering (ICME) research activities. The AM lab is equipped with AM technologies (including SLS and Wire Arc AM systems) and is used for AM research and education. The other area houses the ICME lab, which houses powerful workstations for Dr. Eshraghi's ICME research activities and also computers equipped with CAD software for AM design applications. It also includes a virtual reality station to promote the AM^2L's research projects with NASA and the International Space Station.

Eshraghi is also serving as the director of the newly established materials science and engineering program at Cal State LA. The MS Program in Materials Science and Engineering (MSE) is designed to be an interdisciplinary program providing a rigorous education in materials science and engineering. The curriculum includes a core of materials science courses covering the structure, properties, processing and performance of materials. The program prepares students to practice as engineers and scientists and build a better tomorrow through innovations in materials science and engineering.





CAL STATE LA'S 2019 OUTSTANDING PROFESSOR AWARD WINNER IS A CHAMPION OF STUDENT PARTICIPATION IN RESEARCH

Dr. Heidi Riggio has worked with more than 30 undergraduate students and 35 graduate students on psychology research projects since 2005. As a social psychologist, Dr. Riggio's research focuses on attitudes, personal relationships and social identity. Students collaborate on various research projects, using mainly survey research and experimentation. Current projects in the lab include:

- Political party, strength of identification and knowledge of and attitudes toward U.S. Presidents.
- Religious group, strength of identification and knowledge of and attitudes toward the Bible.
- Religiosity, benevolent and hostile sexism, and self-esteem among Christian adults.
- Self-efficacy in romantic relationships and sexual outcomes.
- Sexual shame: measurement and links with sexual and relationship outcomes.
- Religiosity and sexual outcomes for heterosexual and LGBTQ individuals.

Most of Riggio's graduate students worked with her on research projects as Cal State LA undergraduate students. The master's program is mentor-based, meaning that faculty choose whether they will work with graduate students, and with whom. Undergraduate students' work in a research lab develops their research skills and establishes relationships with Cal State LA faculty key to mentoring students entering the graduate program.

Riggio's students present their research at the Cal State LA Student Research Symposium, at professional meetings of the Western Psychological Association, the Association for Psychological Science and the American Psychological Association. Riggio and her students have made more than 85 paper and poster presentations and published 13 empirical journal articles. Several of her students have pursued doctorates in various areas of psychology (clinical, social, counseling, organizational behavior). Several former students are now teaching, including in Cal State LA's psychology department. Other students hold managerial positions in professional and government organizations and yet others have attained master's in other areas, including counseling. Students' research experiences with faculty are highly valued in graduate programs. Master of arts programs commonly have an empirical thesis requirement, essential for evaluation of MA degrees and admission into doctoral programs in psychology.

MARITIME ACADEMY

California State University Maritime Academy faculty and students engage in an exceptional breadth of vibrant basic and applied research. The university's research efforts include novel approaches to expanding the fields of chemical material engineering, oceanographic research equipment, eradication of invasive marine organisms, complex computer modeling of human anatomic functions, physical oceanography, cybersecurity, air quality analysis, water quality analysis, drone technology, zero emissions technology including hydrogen power, wind power technology, energy storage and much more.

ENERGY TRANSFER STUDIES ACROSS THE AIR-SEA INTERFACE

Dr. Alejandro Cifuentes-Lorenzen, assistant professor of oceanography at CSU Maritime Academy, currently leads a National Science Foundation collaborative research award. The collaborative effort includes University of Connecticut, Woods Hole Oceanographic Institution, University of Rhode Island and Lamont-Doherty Earth Observatory at Columbia University.

The experiment focuses on the mechanical energy transfer across the air-sea interface and the role of surface gravity waves at the boundary by dynamically linking the atmosphere and ocean through a unique set of turbulent kinetic energy (TKE) dissipation rate measurements and measurements of breaking wave statistics. To elucidate air-sea wave-driven turbulence, the project team measured the vertical structure of the TKE dissipation rate across the air-sea interface from the Air Sea Interaction Tower at Martha's Vineyard Coastal Observatory (atmospheric side) complemented with simultaneous measurements of subsurface TKE dissipation rates (ocean side). Indirect and direct observations of the energy flux divergence (wave-induced transport) on the atmospheric side will be used to constrain the magnitude of the air-sea TKE transfer rate and to provide an upper bound to the TKE injection by wave breaking (i.e., the breaker work). Direct estimates of active breaking and the resulting foam (i.e., whitecaps) on the ocean surface will be used to study the connection between the surface manifestation of breaking waves and the expected enhancement of the TKE dissipation rate. On the ocean side, measurements of TKE dissipation rate and the TKE production and transport terms throughout the water column will be made using several complementary techniques. Using these measurements, the team will explore the expected TKE dissipation rate deficit/surplus at the interface relative to a rigid-wall and assess the role of surface gravity waves in the [expected] deviations from it.

The field campaign hosts a wide range of atmospheric and subsurface instrumentation with an experienced, diverse team of experts in different areas behind it.

Together, the proposed measurements of turbulence across the air-sea interface will enhance the understanding of coupled boundary layer dynamics and will improve existing and future air-sea interaction parameterizations in an effort to improve ocean-atmosphere circulation and climate models. Undergraduate research experiences are being provided through an existing NSF-REU program (URI) and a new NSF-REU supported student at Cal Maritime.

CAL MARITIME'S TESTING OF BALLAST WATER MANAGEMENT SYSTEMS DEVELOPS FUTURE MARINERS TO ADDRESS ENVIRONMENTAL ISSUES

California State University Maritime Academy's Golden Bear Research Center (GBRC) is a globally recognized research, development, testing and evaluation facility focused on type-approval testing of ballast water management systems (BWMS) and other developing technologies in the maritime industry. Although GBRC focuses on testing BWMS to federal and international standards, the

center is involved in educating the public, maritime industry governmental agencies, the scientific community and other stakeholders on the importance of these technologies and promoting the science of BWMS testing.

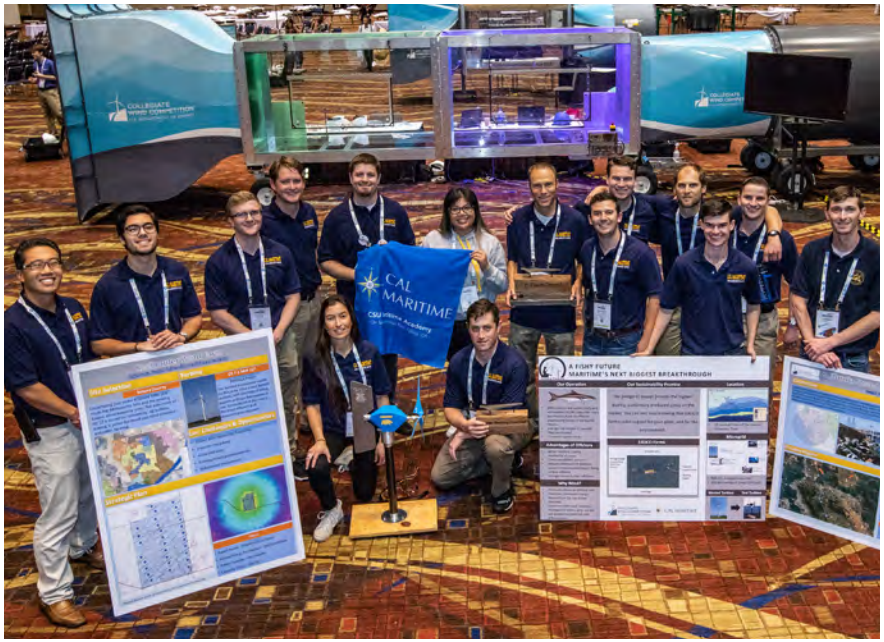
Cal Maritime and GBRC are located in Vallejo, California, on the Carquinez Strait, which separates the San Francisco Bay estuary complex and the Sacramento/San Joaquin river delta. Aquatic invasive species (AIS) have deeply affected the San Francisco Estuary complex, frequently referred to as the most heavily invaded estuary in the world. Many of the AIS are transported around the world in ships' ballast water. As cargo is being loaded, ships typically discharge ballast water into the port to maintain stability, trim and structural integrity. Aquatic life from distant ports is often discharged with the water, potentially introducing AIS into the local ecosystem.

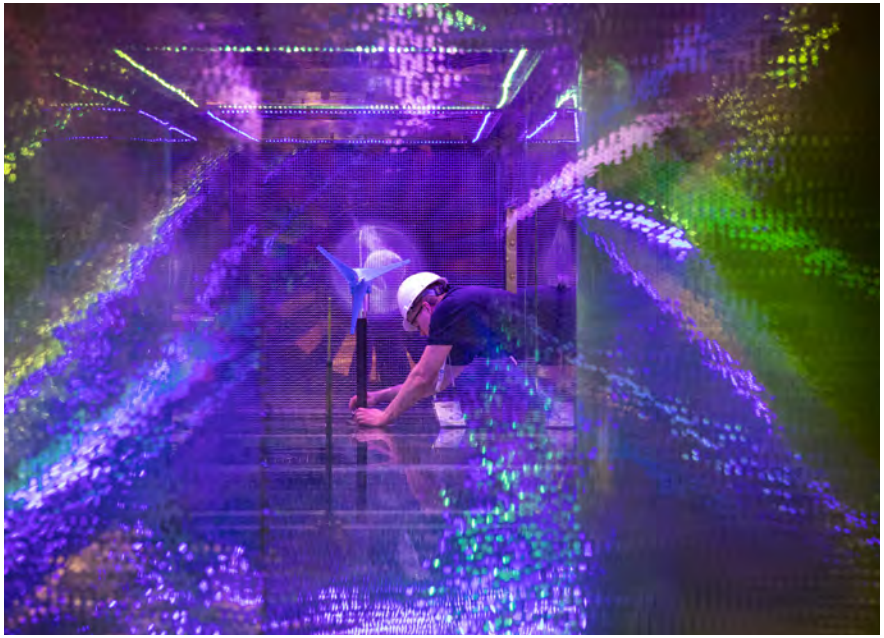
These AIS can be microscopic or larger organisms that attach themselves to the ships' hulls below the waterline or can enter through the uptake of water into the ships' ballast tanks. These organisms are then transported to foreign ports, where they can reproduce, proliferate and displace native species. AIS can harm ecological, economic and human health and may ultimately cost billions of dollars a year to manage. Beginning in the early 2000s, state, federal and international governments established regulations for the commercial shipping industry to mitigate the transmission of potentially invasive species.

During the past few years, the adoption of Ballast Water Discharge Standards by the United States Coast Guard (USCG) and the International Maritime Organization (IMO) placed limits on the number of organisms that can be in discharged ballast water. Technologies to kill or reduce organisms in biofouling and ballast water range from specialized paints that deter the settlement of fouling organisms on the outside of ships' hulls to BWMSes that treat ballast water, primarily through the use of ultraviolet (UV) light or chemical treatment.

Using Cal Maritime's United States training ship Golden Bear as a platform, GBRC has been approved by the Coast Guard and IMO to act as a third-party independent laboratory to test BWMSes and other technologies intended to stop aquatic invasive species from spreading across the world's oceans and ports.

The Golden Bear Research Center consists of a multidisciplinary team of scientists, engineers and Cal Maritime cadets who evaluate the performance of these novel environmental technologies and ensure they are working effectively through a rigorous testing program. To date, GBRC has worked with several domestic and international companies to aid in the research, development, testing and regulatory type-approval of these technologies before they go to market. With Cal Maritime's recent addition of an oceanography degree program, GBRC looks forward to continuing to develop the next generation of mariners and oceanographers to tackle emerging environmental issues.





U.S. DEPARTMENT OF ENERGY COLLEGIATE WIND COMPETITION

Cal Maritime has been participating in the U.S. Department of Energy's Collegiate Wind Competition annually since the program's inception in 2013. This program, designed to develop workforce for the fast-growing U.S. wind energy industry, challenges teams of undergraduate students from 12 selected U.S. universities to complete two tasks. The first task—Turbine Design—is to design and build a fully functional, fully automated, small-scale wind turbine to be tested for power production, control and safety under real-world wind conditions in a wind tunnel. The second—Project Development—is to design a large-scale wind project (also known as a "wind farm") in a real location, including technical planning (turbine selection and siting, electrical connections, roads, etc.), financial planning (financing, land purchasing or leasing, tax incentives, fixed costs, revenue from power purchase agreements, etc.) and consideration of environmental issues (wildlife protection, noise, etc.), permitting, and other policy incentives and challenges. The U.S. Department of Energy selects and funds the 12 teams based on a competitive proposal submission process that occurs on an annual basis.

Dr. Thomas Nordenholz, a mechanical engineering professor, has been the principal investigator and lead faculty adviser every year since 2013. He also advises the turbine design team. Ryan Storz, an assistant professor of engineering Technology, advises the project development team. The team currently involves about 30 students across five majors (mechanical engineering, marine engineering technology, facilities engineering technology, international business and logistics, and global studies and maritime affairs). Faculty members Evan Chang-Siu (engineering technology), Christine Isakson (international business and logistics), and Katherine Sammler (global studies and maritime affairs) also advise the students in specific areas.

The solutions that the students develop are different every year, in part to respond to changing requirements. For example, this year, the turbine design is building a wind turbine that will control itself by turning (pitching) its blades into or out of the wind according to wind conditions. In addition, they are designing and building their own electric generator specifically to meet the competition needs. Meanwhile, the project team is choosing a site in southeastern Colorado where the winds are strong, land is potentially available for leasing from ranchers, and a new high-voltage transmission line has been installed. As part of the competition, teams are required to submit reports that are judged by wind energy experts, and these reports are available to the public. The teams also make presentations to the panel of judges.

The competition is held every year at the American Wind Energy Association Windpower Conference and Exhibition. The Cal Maritime team finished first in 2018, second in 2015, third in 2019 and fourth in 2017. In 2020, the competition was held virtually and Cal Maritime placed first in turbine design and third in project development. More than 50 Cal Maritime students have participated in this program over the past seven years, and several now work in the renewable energy industries.

MONTEREY BAY

California State University, Monterey Bay, provides extraordinary opportunity for students just one mile from the beach. CSUMB serves the community and powers the region's economy, while improving higher education accessibility to traditionally underserved and low-income populations. CSUMB is committed to inclusive excellence, sustainability and innovation. The university offers one of the best online computer science programs in the nation, as well as online master's degrees in business administration and instructional technology.

CAMPUS PROVIDES PROFESSIONAL-LEVEL OPPORTUNITIES IN MUSIC INDUSTRY

When Associate Professor Jeffrey Jones received an invitation in summer 2019 to perform on an exciting music extended play project, he knew where he wanted to record his tracks.

"The call came just a couple of weeks before I moved from the East Coast," said Jones, the new chair of CSU Monterey Bay's Music and Performing Arts Department. "I knew I didn't have time to prepare the music and record before I moved to California, so I scheduled the session for the recording studio in the Music Hall at CSUMB."

He had toured the facility when he interviewed for the job and knew CSUMB had a strong program in recording technology.

"I thought it would be a fun way to introduce myself to the community," he said.

The finished project, "Mindstate Music," is a new EP by global fusion artist Jonathan Scales. Ropeadope Records released it in September 2019.

It features a six-movement concerto composed by Scales for a steel band and his global fusion group. Jones played tenor steel pan on all of the tracks.

His colleague, Lanier Sammons, composer, recordist and MPA assistant professor served as the engineer for Jones' tracks.

"Recording a great player for an exciting project is always a pleasure, and working with an instrument I haven't had in the studio before makes it all even more fun," Sammons said. "Jonathan Scales' fusion of steel pan and jazz is a fascinating sound, and it was a treat watching Jeff pull off some really complex playing for his contributions."

CSUMB students have plentiful opportunities in the region to work in the performing arts, ranging from live recording projects to arts management opportunities with community partners. These partners include Pebble Beach Co., Cannery Row Co., California Rodeo Salinas, Monterey Jazz Festival, Monterey Symphony and the Carmel Bach Festival, Jones said.

"I love that we have the capability at CSUMB, in terms of facilities and expertise, for our faculty and students to participate in the music industry at a professional level," he said.

"I'm hoping this project will contribute to the rich, ongoing dialogue about such opportunities and how CSUMB can help students prepare for and successfully engage with them."

▲ **CSUMB STUDENTS AND FACULTY HAVE ACCESS TO PROFESSIONAL RECORDING FACILITIES ON CAMPUS AND A MULTITUDE OF MUSIC AND PERFORMING ARTS OPPORTUNITIES IN THE REGION.**

◀ **UROC SCHOLAR SELENA VELASQUEZ IS A 2019 RECIPIENT OF THE CSU TRUSTEES' AWARD FOR OUTSTANDING ACHIEVEMENT.**

UNDERGRADUATE RESEARCH OPPORTUNITIES CENTER: SUPPORTING UNDERGRADUATE RESEARCH, SCHOLARSHIP, CREATIVE ACTIVITY FOR 10 YEARS

CSU Monterey Bay's Undergraduate Research Opportunities Center (UROC) began in 2009 as the first centralized undergraduate research office in the CSU. More than a decade later, UROC has grown into a robust center with nine full-time staff that brings opportunities for research, scholarship and creative activity to students from across majors and colleges.

The center offers first- and second-year research engagement programs, individually mentored research experiences for undergraduates at all levels at CSUMB and partner institutions, an international research expedition program in Costa Rica and a wide range of course-based research opportunities.

UROC is also a campus resource center, providing information about student research opportunities, conferences, scholarships and fellowships, and graduate school preparation. The center hosts research, scholarship and creative activity showcases on campus three times per year.

UROC student research, scholarship and creative activities span the disciplines, as demonstrated by the work of Erin Mansel, Selena Velasquez and Sonia Olmos, all UROC and Ronald E. McNair scholars.

A senior in cinematic arts and technology, Mansel spent a summer at Columbia University in New York as a researcher for the award-winning Fox/NBC television comedy "Brooklyn Nine-Nine." She worked in Los Angeles on outreach for a film about Robin Williams and Lewy body dementia, and a documentary on the transgender experience in America under the Trump administration.

Mansel also studied in London as a Gilman Scholar. At CSUMB, Mansel produced an award-winning film, "Screaming in Silence." The Monterey Film Commission recognized her for outstanding academic achievement and commitment to showcasing diversity in film. Forbes magazine honored her as a "2019 Under 30 Scholar."

Velasquez, a senior psychology major, is a 2019 recipient of the CSU Trustees' Award for Outstanding Achievement as well as a Sally Casanova Pre-Doctoral Scholarship. She is a first-generation college student, and her research examines access and equity in higher education, with a focus on success for underrepresented students.

Velasquez worked with the Student Success Equity Research Center (SSERC) at University of California, Santa Cruz, to evaluate the needs of underrepresented students in engineering, with the goal of launching new support services. As a future doctoral student dedicated to diversity, Velasquez aims to explore how universities can better understand and holistically support underrepresented students' academic and personal journey through college.

Olmos, a senior majoring in Chicanx studies, is the first recipient of the UROC Arts and Humanities Research Grant. Her upbringing as a first-generation student in a Salvadoran/Mexican household informs and empowers her research at the intersections of gender, sexuality, mythology and storytelling.

The stories told by the women in her family inspired Olmos' journey into research. The women would share the myths and legends of El Salvador, such as the one of La Sigüanaba, a phantom that appears to be a beautiful woman and lures men to their deaths.

The stories sparked a curiosity about how such myths shape Salvadoran women's understanding of their bodies and sexuality. Olmos explored this in her first research paper and later transformed it into a grant-funded, creative mixed-media project.

Her two UROC-supported summer research experiences in oral history deepened her understanding of Chicana/Latina feminism. This led her to apply for and receive a second grant to create her own digital oral history collection.

This growing collection, the first to document the experience of Latinx muxeres at CSUMB, includes the stories of 15 Latinx muxeres engaged in student leadership at CSUMB. By utilizing Digital Commons to preserve and share these stories, Olmos hopes to demonstrate how the campus vision statement is alive in their service, social justice, activism and academic excellence.

ACHIEVING SUSTAINABILITY, DIVERSITY GOALS IN STEM

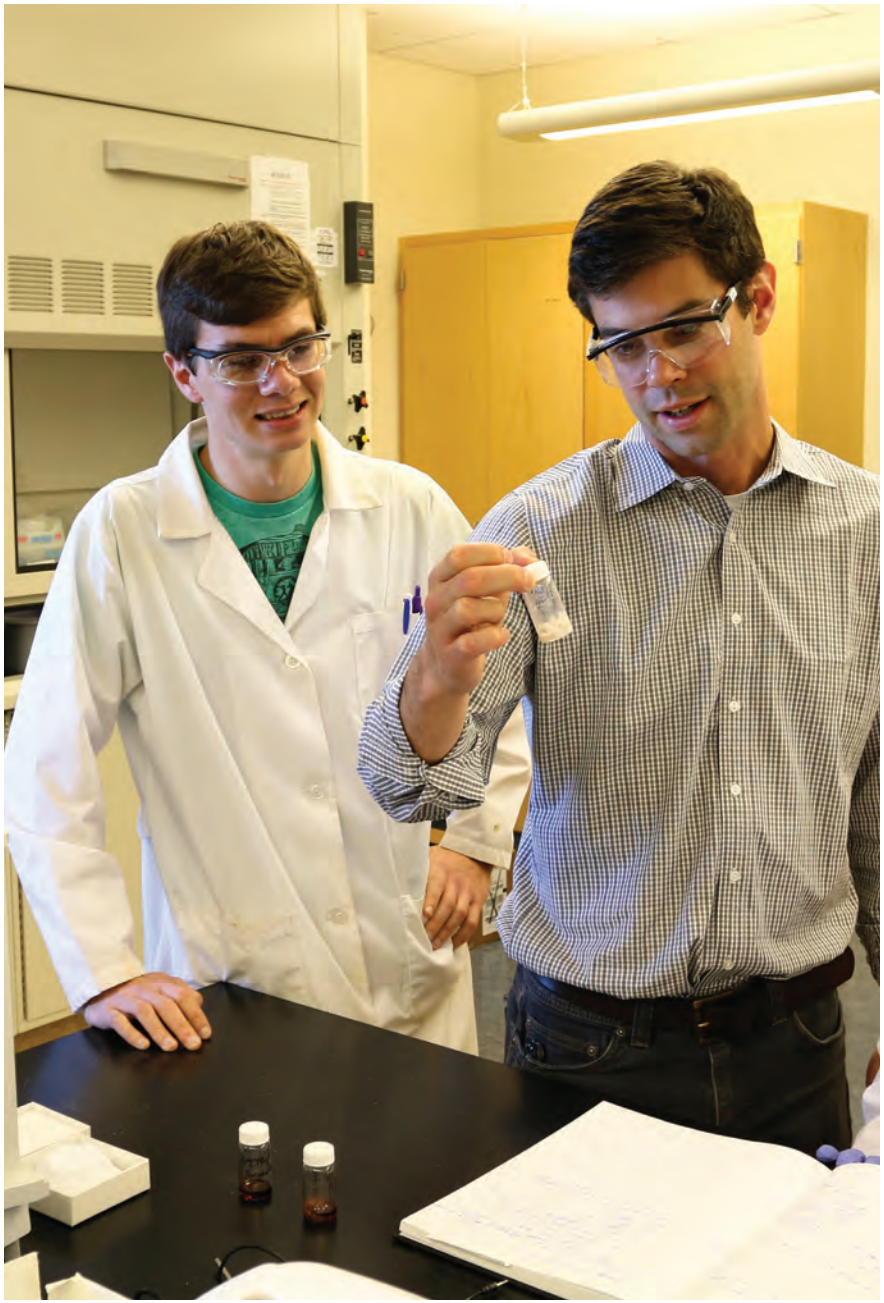
John Goeltz, assistant professor in the Department of Biology and Chemistry has built the Laboratory for Applied Electrochemistry at CSUMB as a pipeline for talented undergraduates to pursue competitive graduate programs and STEM careers in the physical sciences. His resourceful leadership and contributions toward preparing students for success embody CSUMB's vision to serve the diverse people of California.

"The opportunity to train a diverse group of talented young scientists in electrochemistry while working toward improved energy technologies has been, to be frank, a whole lot of fun," Dr. Goeltz said.

"Every morning, I come in to work thinking I've found new challenges to spur my undergraduate researchers to grow as scientists and as people, but every evening I go home thinking that's what they've given me."

Dr. Goeltz joined CSUMB's School of Natural Sciences in 2015. The following year, he received from the California State University a faculty incentive grant to support the applied electrochemistry research in his lab. The research aims to enable faster battery-charging capabilities and overcharge protection. The findings led to a nonprovisional patent application for a hydroxide selective electrode in 2017.

In addition to research success, his team developed a three-hour, hands-on training module that takes undergraduate scientists beyond the scope of electrochemistry taught in general chemistry.



The module was first offered by Goeltz and CSUMB undergraduate Parker Smith during the summer of 2017. It trained eight Research Experience for Undergraduate (REU) students who were conducting summer research at CSUMB.

The training program was so successful that Sonoma State's chemistry department requested it for spring of 2018. The team also presented the program at the American Chemical Society Fall National Meeting in San Diego in 2019.

Goeltz has mentored more than 20 CSUMB undergraduate researchers and secured funding from the National Science Foundation (NSF) to support up to three students at a time in his lab through August 2021.

The grant will also support the expansion of his general chemistry workshops and allow CSUMB student researchers access to cutting-edge nuclear magnetic resonance (NMR) technology at UC Santa Cruz. It's a significant opportunity because CSUMB does not currently have access to NMR scientific instrumentation.

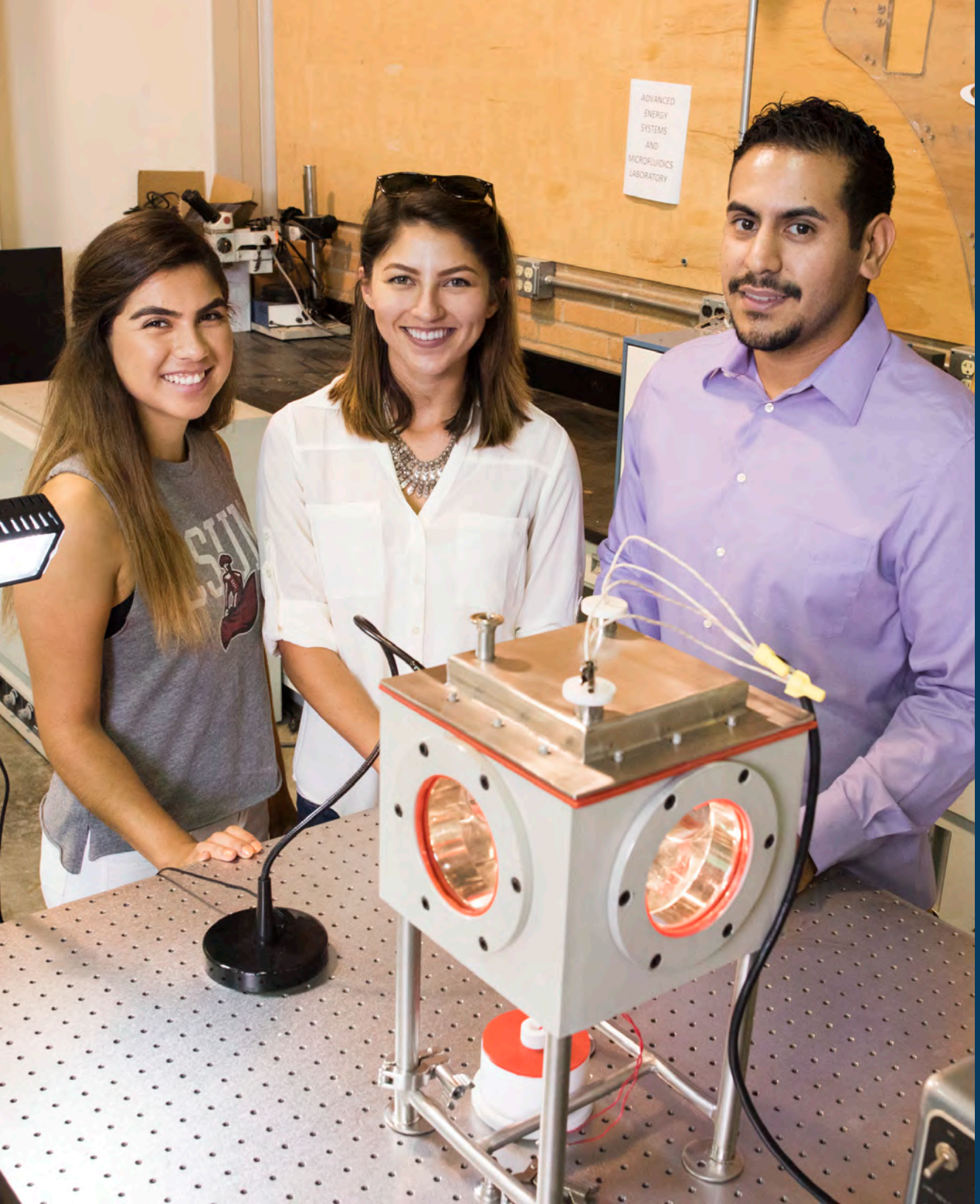
In developing his lab, Goeltz has encountered some challenges and increased needs for support that he understands he cannot fill alone. He has turned to campus resources such as the Undergraduate Research Opportunity Center (UROC) to fill some of the lab's needs.

"Training young scientists to practice communicating their work effectively is a critical piece of broadening the STEM pipeline with respect to underrepresented groups and first-generation college students," he said.

"By engaging with CSUMB's Office of Inclusive Excellence, I have ensured that my recruiting has been inclusive while I also work toward the ultimate goal of increasing underrepresented populations in STEM."

"Of the undergraduates I have mentored up to this point, 60 percent have been female and 50 percent have been from traditionally underrepresented groups, and both of those numbers are a strong representation of CSUMB's overall population. It is essential that I facilitate training of whole scientists in a way that is inclusive to all backgrounds," he added.

◀ **ASSISTANT PROFESSOR JOHN GOELTZ (RIGHT) AND STUDENT IN HIS LAB AT CSUMB'S SCHOOL OF NATURAL SCIENCES. DR. GOELTZ HAS DEVELOPED A FORMULA FOR STEM STUDENT SUCCESS.**



NORTHRIDGE

California State University, Northridge is a vibrant, diverse university community in the heart of Los Angeles' San Fernando Valley. Over the past two decades, CSUN has evolved from a primarily teaching institution to a significantly research-active environment. Through its commitment to the educational and professional goals of students and its extensive service to the community, CSUN remains dedicated to transformative educational opportunity.

INNOVATIVE BIOMEDICAL RESEARCH TRAINING MODEL EQUIPS STUDENTS TO ADDRESS HEALTH DISPARITIES, INCREASING DIVERSITY OF SCIENTIFIC WORKFORCE

California State University, Northridge, is one of 10 universities throughout the country that successfully competed to be a part of the National Institutes of Health's (NIH) Diversity Program Consortium (DPC). The DPC represents a 10-year experiment in undergraduate biomedical research training—Building Infrastructure Leading to Diversity (BUILD)—to bring underrepresented students into biomedical research.

Along with Cal State Long Beach and San Francisco State, CSUN has formed a CSU BUILD Alliance with the Office of the Chancellor to disseminate best practices. Now in its sixth year, CSUN's BUILD PODER (Promoting Opportunities for Diversity in Education and Research) program has engaged more than 250 students and 120 faculty mentors in biomedical research methods training and discipline-specific skills grounded in critical race theory. BUILD PODER's framework examines racism and emphasizes the wisdom of oppressed communities in bringing about societal transformation, laying the foundation for a socially-informed training model. Its research training approach is methodologically rigorous and involves hands-on training experiences and multiple layers of mentoring. BUILD PODER students have been found to have a stronger sense of belonging, stronger science identity, and a better sense of the social justice implications of biomedical research compared to students outside the program—even those with outside mentors.

BUILD PODER's "BUILD effect" on campus as a whole has a long reach in supporting the campus community through curriculum, public events and infrastructure. This includes a new Health Equity Research and Education (HERE) Center and four new faculty in health equity from psychology and health sciences, sustaining CSUN's collective strengths in biomedical research training through research education and community-academic partnerships. This extensive research training environment is yielding real-world opportunities for learning about research in our community while addressing health disparities in the San Fernando Valley.

NEW NASA-FUNDED CONVERGENCE RESEARCH CENTER LEVERAGES CROSS DISCIPLINE EXPERTISE TO DEVELOP AUTONOMOUS SYSTEMS AND STUDY SOCIETAL IMPACT

The Autonomy Research Center for STEAHM (ARCS) at CSUN is forging research collaborations in current and emerging challenges of increasingly autonomous (IA) systems. With a vision to be a global leader in education, research and commercialization of IA systems, ARCS is activating a convergence research model—one of the National Science Foundation's 10 Big Ideas—to train 21st century leaders to solve our most pressing technological and social challenges.

STEAHM is an expansion of the traditional STEM fields, in a growing recognition of the deep interdisciplinary expertise needed to solve challenges that are simultaneously technological, social, ethical and more. STEAHM represents S: physical, social, and behavioral science; T: technology and engineering; E: entrepreneurship and business; A: arts, media and communication; H: humanities; and M: mathematics.

Currently, participating professors represent six of nine CSUN colleges: College of Engineering and Computer Science; College of Social and Behavioral Sciences; College of Science and Mathematics; Mike Curb College of Arts, Media and Communication; David Nazarian College of Business and Economics; and College of Humanities.

Launched with support from a $3 million grant from NASA's MIRO program, ARCS's first cohort of student fellows will tackle 12 projects that fall into three synergistic thrusts:

- Developing assured and trusted IA systems.
- Human autonomy teaming with explainable AI.
- Societal and organizational impact, barriers and acceptance of IA systems.

These thrusts are being explored in partnership with NASA Armstrong Flight Research Center (AFRC) and Jet Propulsion Laboratory (JPL) in the context of two NASA concepts of operations: Urban Air Mobility and space construction. At NASA, ARCS' efforts will help assure real-time trustworthiness of IA systems, produce methods and technologies that support human-IA teaming and develop models and guidelines for sociocultural factors on public acceptance of IA systems.

At CSUN, the launch of ARCS substantially expands institutional research capacity, creating innovative pathways toward developing a workforce of 21st century leaders. With 12 professors committed to intellectually diverse teams that will guide these student-led projects, ARCS increases CSUN's historic faculty engagement with NASA sixfold and aims to engage 150-plus undergraduate/graduate students per year in NASA research, a 750 percent jump from CSUN's historic student engagement.

To support these goals and the convergence research model, ARCS is also launching the following initiatives and innovations:

- Establish a one-of-a-kind integrated research space to support live and virtual IA unmanned vehicle operations and a cloud-based virtual research collaboration environment that can connect with and be replicated at other universities and NASA.
- Partner with the CSUN Innovation Incubator and NSF-funded I-Corps program to connect research products to markets and explore commercial viability.
- Nurture a thriving ecosystem of multicollaborator strategic partnerships, including NASA, DoD labs, industry partners, research universities, community colleges and the CSU system.
- Execute a sustainability plan that will launch ARCS into national leadership in autonomy research.

ARCS welcomes all who are interested in creating a new trajectory for engaging students, faculty and other pioneers in IA research. For latest updates and to learn more, visit ARCS at **www.arcs.center**.

PUBLIC HISTORY PROJECT CHALLENGES ASSUMPTIONS ABOUT IMMIGRANTS AND THE ENVIRONMENT

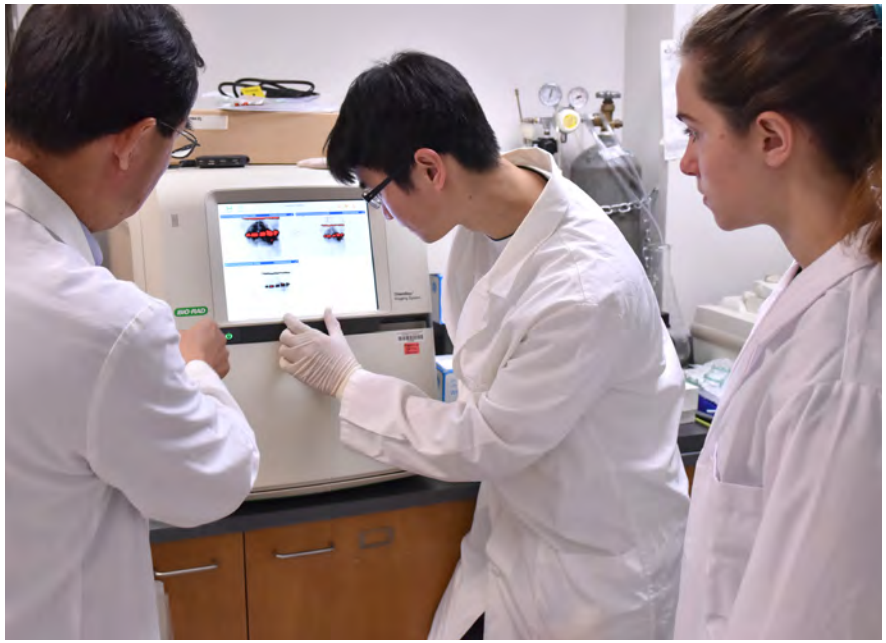
Students and faculty from CSUN's Department of Chicana and Chicano Studies and University of California, Santa Barbara's Asian American Studies have partnered with local environmental justice organizations in a public history project to explore how environmental justice affects Southern California immigrants. Funded by California Humanities, oral histories and other research products are being shared through public programs and a community-created exhibit at the Los Angeles County Museum of Natural History. The museum exhibit will coincide with the arrival of a traveling exhibit curated by the Humanities Action Lab—an international coalition of universities, issue organizations and public spaces in 40 cities—of which CSUN is a core partner. The exhibits provide platforms for civic engagement that challenge our understanding of how migrants and the larger social condition of immigration are intertwined with environmental concerns.

CSUN Chicana/o studies professor Stevie Ruiz and students held workshops across Los Angeles last summer to teach participants, mostly high-school and college-age young adults, environmental justice research and methods to advocate for the environmental health of their communities. These skills help them to conduct oral histories with local leaders, family members and teachers about local environmental issues. The oral histories, which will inform the museum exhibits, give them an understanding of the environmental issues, connect generations and inspire solutions to address climate change.

In spring 2022, the Humanities Action Lab traveling exhibit will be housed at museums, public libraries, cultural centers and other spaces in the communities that co-created them. Southern California chapter community partners include Padres Pioneros, Los Angeles County Museum of Natural History, Southern California chapter community partners include Padres Pioneros, Los Angeles County Museum of Natural History, Japanese American National Museum and the National Park Service.

POMONA

California State Polytechnic University, Pomona is a Hispanic Serving Institution. It offers degrees in a broad spectrum of majors in engineering, sciences, humanities, liberal arts, business, agriculture, hospitality management, landscape architecture and education. The campus emphasizes inclusive polytechnic educational experience.



ADVANCING WATER CONSERVATION THROUGH DECENTRALIZED RENEWABLE OFF-GRID WATER TREATMENT

The Decentralized Renewable Off-Grid Wastewater Treatment (DROWT) team—led by Dr. Reza Baghaei Lakeh, mechanical engineering professor, and Dr. Ali Sharbat, associate professor of civil engineering—developed an off-grid solar-powered graywater treatment system for nonpotable use, such as for washing dishes and clothes, in single households. Water drained from bathroom sinks, laundry machines, dishwashers and showers are captured for treatment.

A three-stage process treats the water through microfiltration, solar-driven reverse osmosis and ultraviolet disinfection. The developed system is capable of reclaiming 90 to 100 gallons of water per day, equating to 60 percent of residential graywater waste, with a recovery rate of 62 percent.

Sponsors are Craig Netwig ('71, chemical engineering), the grandfather of the reverse osmosis water filtration process, and Metropolitan Water District of Southern California. In 2018, Netwig donated $145,000 to the College of Engineering at Cal Poly Pomona (CPP) for research into water reuse systems.

Awards:

Engineering students won second place at the Metropolitan Water District's 10th annual Spring Green Expo for DROWT.

DROWT placed second at the 2018 Bronco Startup Challenge at Cal Poly Pomona. Many of the judges, innovators and entrepreneurs present expressed interest and admiration of the DROWT concept and functional prototype showcased.

In addition, DROWT won first place at the College of Engineering's 2019 Project Showcase, where each CPP engineering department presented their best projects to alumni, industry, faculty, staff and students.

STUDENTS CONDUCT BREAST CANCER RESEARCH THANKS TO NIH GRANT

Cal Poly Pomona's College of Science has received a National Institutes of Health (NIH) grant to study how Usp16-mediated histone deubiquitination regulates breast cancer cell invasion. Professor Junjun Liu, biological sciences, is the principal investigator. He's mentoring three graduate students and one undergraduate.

Graduate student Jade Lolarga said, "I've been working with breast cancer research in Professor Liu's lab for 3½ years and I've been working on different types of cancer research for six years. Dr. Liu has been a great mentor in school, lab and life. He has given me so many opportunities and even helped me get my first job in industry!"

"Students learn about molecular biology and how the cell cycle works in the context of cancer," Dr. Liu said. "The breast cancer research is a continuation of work that we've done. In the previous NIH-funded work, we discovered the importance of a novel PLK1 substrate called Usp 16 and its role in mitosis and published a paper about it in the Journal of Cell Biology."

The current work builds on that and a collaboration with City of Hope. "They found that certain proteins promote breast cancer invasion, which is the first step to metastasis. We're looking at the other side of the equation, which is identifying proteins that inhibit cancer cell invasion."

The goal is to study whether posttranslational modification of histone H2A, a protein found in chromatin that plays a role in gene expression, inhibits epithelial-mesenchymal transition (EMT) and cancer cell invasion.

Liu writes in his project narrative: "The study is expected to reveal a new mechanism of metastasis regulation and may contribute to the development of novel approaches in the prevention and treatment of metastatic breast cancer."

Lab research is extremely valuable to students. "It helps them understand classroom concepts a lot better. They learn about cancer cell biology, cellular and molecular biology and protein biochemistry," Liu said. "Many of my graduate students become upper-division teaching assistants. Those upper-division classes are very specialized but the experience that students gain in the lab allows them to assist with classes such as Tissue Culture Laboratory and Recombinant DNA and Protein Laboratory."

Graduate student Lolarga noted: "I have the opportunity to study the cellular and molecular aspects of cancer research. My research at Dr. Liu's lab challenged me to learn more about protein interactions and pathways. It's definitely a challenge, but Dr. Liu was always there to help me understand and answer my questions."

Undergraduate student Alana Schonbrun said: "I'm learning the lab skills I need to do research. I find cellular biology and cancer research interesting. I want to learn how to do my own experiments. I graduate in 2021 and after graduation will work on a master's degree in biology."

Lolarga added: "Working with tissue culture requires you to be in lab almost every other day of the week. There are times where I have to come back every few hours just to observe results, but when your experiment works, then it pays off!"

In Professor Liu's lab, the NIH grant is already paying off in supporting learning and student success. It may one day contribute to the prevention and treatment of breast cancer.

CAL POLY POMONA AUTONOMOUS TOURING EXPERIENCE PROTOTYPES DRIVERLESS VEHICLES

Graduate student Xianmei Lei watches the yellow four-wheeled vehicle make its way along the walkway outside Building 8. It looks like a robot and runs on a robot operating system but it's more than that. It's a prototype for an autonomous vehicle. CATE—Cal Poly Pomona Autonomous Touring Experience—is different from other driverless vehicles in that the finished product will be an electric cart designed to drive on college campus walkways. The project is a collaboration of Pomona's computer science department in the College of Science, the College of Engineering and the College of Business.

Engineering is providing the low-level controls on the project. "The low-level controls activate all the systems such as motor, steering and braking. There are sensors that acquire data about what's happening. That data is processed and then sent to the high-level controls, which is what computer science is handling," Dr. Scott Boskovich, assistant professor of engineering, explained.

Lei, a graduate student in computer science, is the software lead. "In this project," she said, "the software we're writing deals with four areas: First there is localization, which tells the vehicle where it is. Second, there's mapping, which tells it where it's going. Third is low-level control that tells it how to get there. And fourth is exploration, which the vehicle needs in order to understand its environment."

The prototype vehicle is built on an unmanned ground vehicle (UGV) called a Husky. It uses multiple sensors that include two cameras, a GPS, an inertial measurement unit (IMU) and a light detection and ranging (lidar) sensor.

"This research is very different from other programming in that the way to get there isn't clear. It requires a lot of research," Lei said. One of the biggest challenges is compensating for noise. "Noise is the error that's introduced into the system by the sensors," she explained. "These errors can add up very fast, creating major problems. For example, with the encoder that counts wheel rotations, a slight error will keep compounding and throw off localization so that the vehicle won't have an accurate idea of where it is."

"GPS can be affected by atmospheric conditions but even without that interference, GPS has a 10-meter error range, which is too large a margin of error."

Once all sensor noise or errors are considered, that data then needs to be combined to guide the vehicle. The team uses an unscented Kalman filter, an algorithm to combine the data from multiple sensors to gain a more accurate picture of where the vehicle is.

Donors help make research like this possible. In this case, the donor, who also funded several other projects, wishes to remain anonymous. The College of Science has an initiative called Discovery Through Research that raises money to provide more research opportunities for students. With increased funding, the College of Science is able to offer more research projects to students. The opportunity for students to conduct research, acquire and analyze data and communicate their findings can be transformational in their development as scientists.

Dr. Amar Raheja, computer science professor, said: "As faculty adviser to Lei, I help in assessing her research goals and I'm there as a resource, but this is very much a student-led, student-driven project that prepares students to conduct research and solve problems just like they will need to do when they leave here and are working in the field."

Professor and Computer Science Department Chair Daisy Tang said: "The prototype is built on the Husky platform but the final product will be an electric cart. We now have the cart and we've started purchasing the sensors for it, which we expect to install next year."

In addition to leading the software portion of the CATE project, Lei is interning at the Jet Propulsion Laboratory. She's working on a Defense Advanced Research Projects Agency (DARPA) Subterranean Challenge. Her work focuses on object detection for underground exploration and rescue. "My work uses neural network or deep learning with thermal and clothes detection data to aid in identifying survivors," Lei said.

The research will make it easier for rescue crews to find survivors in cave or mine disasters.

SACRAMENTO

Sacramento State University has established itself as an indispensable part of California's capital region, contributing to the educational, intellectual, social and economic well-being of Sacramento and beyond. Sac State is an inclusive campus, one of the most diverse universities in the West, a leader in sustainable practices and an engaged partner that provides a significant portion of the region's workforce. The university is committed to the ideals of social justice and access.

OCEAN HEALTH AND CLIMATE CHANGE

The ocean speaks volumes to scientists like Sacramento State's Amy Wagner.

At its surface, it offers information about the health of our planet. On its floor, it reveals glimpses of the distant past.

Layer by layer, it tells a story about the impact of climate change, a topic of great interest to Wagner, an assistant professor of geology, and scientists around the world.

Aboard a 274-foot research vessel named the R/V Thomas G. Thompson, she and 21 other researchers spent weeks in remote locations on the Indian Ocean collecting water and sediment from the depths. The international research team, led by chief scientist Elisabeth Sikes of Rutgers University, returned with samples to be analyzed in an effort to reconstruct past ocean conditions and forecast the future.

Studies already suggest that climate change, likely spurred by human activity, is affecting the world's oceans. A study in the journal Science found that ocean warming is accelerating faster than previously thought, with dire implications such as the killing of marine ecosystems, raising sea levels, and making hurricanes more destructive.

Wagner and her collaborators are seeking to build on such research. Her primary focus is paleoceanography, the study of the history and evolution of oceans through the lenses of water circulation, chemistry, biology and sediment patterns.

Aboard ship, the scientists worked in shifts round the clock to document climate conditions since the last ice age. They gathered material by "coring"—using giant pipes lowered by heavy machinery to the ocean floor to capture samples there—bringing up sediment and skeletons of tiny creatures called foraminifera—forams, for short.

"These samples will keep scientists and students very busy for a long time," Wagner said in an interview. "Many years of research will come out of this cruise."

The mission was just the latest in a series of exotic adventures for Wagner, a former "desert rat" from Phoenix who discovered early in life her passion for the ocean and its inhabitants.

"When I was a kid, my older brother had a sailboat in Oceanside," she said. "I fell in love with being out on the water."

She studied marine science and oceanography at Texas A&M University, earning bachelor's, master's and doctoral degrees before joining Sac State's faculty in 2013. Her career has taken her on research missions around the world, including all seven continents.

Aboard the Thompson, Wagner helped oversee collection and preservation of samples from different ocean depths across a range of latitudes. Each layer of water, she said, has its own chemical properties that offer insights into the ocean's health at various times.

Information gathered from the Thompson mission, dubbed CROCCA-2s for "Coring to Reconstruct Ocean Circulation and Carbon Dioxide Across 2 Seas," has groundbreaking potential, Wagner said.

"We have no data for this part of the Indian Ocean," she said. "This will give us a baseline that will help us put modern information into context" and help guide other scientists and policymakers working to stave off the potentially disastrous effects of climate change.

The cruise and subsequent research is funded by the National Science Foundation.

Wagner said she would incorporate some of what she learned into her oceanography and marine geology courses at Sac State, and ultimately publish a scientific paper on the team's findings.

"I think the mission was very successful," Wagner said. "I'm so grateful that my department and college supported this work, and I'm excited to bring it back to the students."

PROFESSOR EARNS HONOR FOR WILDFIRE RESEARCH

For thousands of years, Native Americans living in the Sierra Nevada routinely set small, controlled fires to tame the forest, increase visibility and herd wild game.

Is it time to embrace the old strategy anew? Should forest managers turn back to those techniques, ramping up prescribed burns to decrease forest density and the threat of catastrophic wildfires?

New research by Dr. Anna Klimaszewski-Patterson, Sacramento State assistant professor of geography, suggests yes.

"We should be taking Native American practices into account," said Dr. Klimaszewski-Patterson, whose dissertation on the subject won the prestigious J. Warren Nystrom Award from the American Association of Geographers (AAG) in 2019.

"After all, they are stakeholders who have been here a heck of a lot longer than we have," she noted. "We should probably be looking at their traditions and incorporating them" into forest management.

Klimaszewski-Patterson uses paleoecology—the study of past ecosystems—as well as environmental archaeology and predictive landscape modeling in her current work, which is funded by the National Science Foundation.

Using computer models and pollen and charcoal records to track changes in the forest over time, she has found that forest composition dating back 1,500 years likely was the result of deliberate burning by Native Americans, rather than natural phenomena such as lightning strikes. Those forests featured open spaces, resembling parks. Today, the same landscape is thick, dense and prone to catastrophic fires that have caused widespread devastation in California in recent years.

For decades, federal forest managers have aggressively used firefighting aircraft, fire lines and other tactics to extinguish wildfires and protect the natural landscape. That approach has resulted in too many trees, which have been weakened by drought. As a result, forests have turned into tinderboxes.

Land managers around the country are increasing the use of prescribed fires to tame the forest. But the approach is controversial, particularly in California, Klimaszewski-Patterson said.

Smoke and flames are "scary" for members of the public, she said, and can drastically affect air quality. Timing of prescribed burns is critical; high winds can turn deliberate burns into runaway disasters.

But the Sac State geography professor's research suggests that, done purposefully and carefully, fighting fire with fire makes sense.

"It's an argument for prescribed burns that are done with intention, with careful consideration of the timing and quantity and the resources that you are managing," Klimaszewski-Patterson said.

SAC STATE MICROBIOME STUDIES GET SIGNIFICANT FINANCIAL BOOST

The microbiome is the complex universe that exists in all of us.It is the genetic material of the trillions of bacteria, fungi, protozoa and viruses that live on and within the human body, helping us digest our food, regulating our immune systems and protecting us against disease, among other functions.

Sacramento State biology professor Robert Crawford is an expert in these microscopic inhabitants of our organs and skin. He helps oversee more than a dozen research projects focusing on microbiomes and their impact on human health.

Dr. Crawford and his collaborators, including Raja Sivamani, a UC Davis dermatologist and biology professor, received a $500,000 gift from Microbiome Labs. The Florida company studies these genetic materials and funds research that might lead to more effective treatments for deadly infections, obesity, heart disease and other maladies.

“Most of what happens to us is dictated by our microbiome, and it is different in every person,” said Kiran Krishnan, chief scientific officer of Microbiome Labs. “It’s the most unique thing about us.”

Microbiome studies are in their early stages. Scientists around the world are trying to create a microbiological road map for tissues, including the gastrointestinal tract, skin, airways and urogenital tract. They want to identify changes in the microbiome that are associated with disease, then find ways to correct those problems in affected tissues.

Crawford and his students have researched, among other things, how microbiomes affect wound healing, with an emphasis on diabetic ulcers that can be difficult to treat. They also study bacterial species that affect the gut.

The Microbiome Labs gift, Crawford said, allows students to conduct meaningful research that could lead to clinical trials and treatment breakthroughs. It increases the number of students working in his lab, provides funds for students and faculty to present research findings at academic conferences, purchase new equipment and conduct public workshops.

“There is a huge gap in biological sciences between basic research and clinical work,” said Crawford, whose lab is housed in the newly opened Science Complex. “This brings those factors together and allows students to have meaningful experiences related to their research.”

Sac State and Crawford have been on Microbiome Lab’s radar, Krishnan said.

“We were looking for a relationship with an academic institution, one that was just on the verge of increasing the growth of its biological sciences department,” he said. “Dr. Crawford’s work is very well known among scientists who study microbiomes. We were very inclined to support his work.”

◀ **FROM LEFT TO RIGHT: LISA CARDOZA (ADVANCEMENT); YINFA MA (NSM); SHEELTA KUMAR (SAC STATE STUDENT); JENNIFER TRAN (SAC STATE STUDENT); KIRAN KRISHNAN (MICROBIOME LABS); AICACIA YOUNG (MICROBIOME LABS); PRESIDENT NELSEN; TOM BAYNE (MICROBIOME LABS); RAJA SIVAMANI (UC DAVIS); ROB CRAWFORD (BIOLOGY); LISA HAMMERSLEY (NSM); KELLY HAAS (SAC STATE POSTDOCTORAL FELLOW)**

SAN BERNARDINO

At California State University, San Bernardino we define the future. A preeminent center of intellectual and cultural activity in inland Southern California with two campuses—one set along the foothills of the beautiful San Bernardino Mountains, the other located in the vibrant Coachella Valley—CSUSB's diverse enrollment mirrors the region it serves and attracts many first-generation students. Dedicated to student success, CSUSB provides an outstanding educational and collegiate experience.

WHEN THE GROUND SHAKES, CSUSB ALUMNUS SEEKS TO FIND OUT WHY

After the largest temblor in 20 years hit the Golden State last July, Bryan Castillo (MS, Earth and Environmental Sciences, '19) spent two days in the desert.

The Cal State San Bernardino (CSUSB) department of geological sciences alumnus has studied earthquakes for years—his master's thesis was on a portion of the San Andreas Fault—but the big shake-ups were his first chance to study the aftermath of one in the field. Castillo was among several geologists, students, researchers, and others from across the nation who investigated the damage caused by the 2019 quakes and collected data near two desert communities along Highway 178.

The July 4 and July 5 earthquakes were centered near Ridgecrest and the nearby town of Trona. The quakes' magnitudes were measured at 6.4 and 7.1, respectively. The quakes cracked walls, damaged structures, and interrupted services such as water and electricity.

Castillo's interest in geological sciences was sparked after the 2008 Chino Hills earthquake (magnitude 5.4) struck. He was a high school student in Los Angeles at the time.

"To get a chance to see the surface rupture of an earthquake is beyond exciting for me," Castillo said. "I had to take advantage of it."

While at Highway 178, Castillo and others took measurements, mapped the area, and took photos to gather valuable information. The data is shared with the California Earthquake Clearinghouse, a volunteer-run effort to "coordinate earthquake field investigations and share observations and knowledge among emergency responders, engineers and scientists," according to the clearinghouse's website.

The researchers saw ruptures along the surface of the ground and highway, small fissures, sand blows—formed from the eruption of water and sand to the ground surface—and other characteristic aftereffects. They also saw a displaced fence near the Naval Air Weapons Station China Lake, a military installation and a set of railroad tracks that had been warped.

Castillo also worked with world-renowned geophysicist Dr. Roger Bilham of the University of Colorado Boulder to study the area. He helped set up creepmeters (instruments that measure the slow movement of fault lines) along the earthquake rupture and other nearby faults and repeatedly returned to the area to collect the data. Castillo and Dr. Bilham subsequently published their findings—Castillo's first-co-authored paper—this past January in Seismological Research Letters.

"Bryan has taken advantage of every opportunity to further his education and career, including graduate thesis grants from the Office of Student Research, presenting his work at local, regional and national meetings, assisting with the field work of other graduate students, and volunteering to tell his story at outreach events," said Dr. Sally McGill, a geologist and the associate dean for the College of Natural Sciences. "His recent work with Dr. Roger Bilham measuring fault creep after the Ridgecrest earthquakes is further expanding his research experience and connections to the scientific community."

Castillo has continued to distinguish his academic credentials. His M.S. thesis on the timing of prehistoric earthquakes on the Banning strand of the San Andreas fault is in the final stages of peer review for publication in the journal Geosphere. Last year, he began serving as a part-time lecturer for the department of geological sciences, and is currently a part-time instructor at Crafton Hills College. Last November, Castillo was named the 2018-2019 recipient of a CSUSB Office of Graduate Studies Outstanding Thesis Award for research documenting eight prehistoric earthquakes in the past 7,000 years that "broke new ground in the field of earthquake geology." He also recently launched, with a partner, an earthquake consulting business to apply his scientific training to help educate and prepare consumers for temblors.

CSUSB ALUMNA PURSUES HER FUTURE IN NEUROSCIENCE

Janelle Doyle (BS, Biology, '18) exemplifies what undergraduates can achieve at Cal State San Bernardino.

For the biology alumna and recent recipient of the Professor Richard Fehn Memorial Scholarship, her record of achievement at CSUSB started before she event set foot on campus. Doyle was the recipient of a President's Academic Excellence Scholarship, which is awarded to San Bernardino County high school seniors who graduate in the top one percent of their class. She later studied in the lab of Tomasz Owerkowicz, an associate professor in the department of biology who researches vertebrate physiology. Doyle started working on small research projects in Dr. Owerkowicz's lab before taking the lead role of a project that she later presented at the 2017 "Meeting of the Minds" Student Research Colloquium. This opportunity shaped her career interests.

But it wasn't until she met Dr. Owerkowicz that she realized just how passionate she was about biology.

"It wasn't until I joined his lab that I think I fell in love with biology in general," Doyle said. "Because before that, it was more of a means to an end for me. I got into his lab, and I discovered what you could do with research, and just how much independence and how much creativity you can have in research, and then within that, I found the specific niche of biology that I was interested in: neuroscience."

She conducted research at the University of Virginia in 2016, and obtained an internship at Stanford University in 2017 through CSUSB's Maximizing Access to Research Careers program. That same year, Doyle presented with a group of students at the Society for Integrative and Comparative Biology annual meeting in New Orleans. She eventually became the laboratory-animal facility manager for Owerkowicz, where Doyle was in charge of 12 undergraduate volunteers. She coordinated animal-ethics training that ensures the humane care and use of animals for research, scheduled weekly husbandry duties and monitored animal care.

Doyle's first project with the American alligator occurred in 2015 through the Office of Student Research, where she studied musculoskeletal development in the species after the eggshell was removed during incubation. Then, in 2016, for an undergraduate research project, she studied the effects of tenotomy (a surgical procedure performed on tendons) of the caudofemoralis longus (an integral muscle in the hindlimb of all non-erect terrestrial vertebrates) on the terrestrial locomotion in the American alligator.

In April 2018, Doyle was honored as the recipient of the Fehn scholarship, which recognizes CSUSB biology students who have demonstrated a commitment to biological research.

She credits Owerkowicz with igniting her passion for research. "He was the first person to give me the opportunity to start research. I would absolutely not be where I am without his guidance, his encouragement, his knowledge," Doyle said.

As a CSUSB undergraduate, she further continued her research experiences at the University of California, Irvine, working on stem cells through the California Institute for Regenerative Medicine (CIRM) program. After obtaining her bachelor's degree Doyle joined the Neurosciences PhD Program at Stanford University, where she is working on her doctoral degree studying the biology of glial cells, specialized brain cells that support neurons.

"I've had a lot of really amazing opportunities just by being here [at CSUSB]," Doyle said, "and by having such easy access to the faculty and being able to form really close relationships with them … I couldn't have done any of this without the support of the faculty members here."

DIGGING INTO EGYPT'S PAST TEACHES STUDENTS THE INTERSECTION BETWEEN ARCHAEOLOGY, TECHNOLOGY, SCIENCE, AND RESEARCH

The Wadi el-Hudi Expedition in Egypt, directed by Kate Liszka, the Benson and Pamela Harer fellow at Cal State San Bernardino and assistant professor of history, was awarded the Ellen and Charles Steinmetz Endowment Fund for Archaeology, the Archaeological Institute of America (AIA) announced in March 2019.

"Liszka was awarded a grant for the Wadi el-Hudi Expedition that has been surveying and excavating ancient fortified settlements and mines in Egypt's Eastern Desert since 2014," the AIA said in announcing the $5,500 grant award. "The imminent destruction of the archaeology of the area by new gold mines has forced the project to accelerate the pace of their research. Liszka and her team have developed a technique for ground-based photogrammetric surveys using multiple cameras mounted on poles to rapidly finish surveying the standing architecture, rock inscriptions and other archaeological remains in the area."

"The Steinmetz grant will make an important contribution to enhancing the work at Wadi el-Hudi," Liszka said. "It supported our recent work in Egypt, where we took 146,000 photos to make the 3D models, and it will also help to support turning this raw data into a virtual interface so that everyone can explore Wadi el-Hudi from their homes. I also look forward to my students at CSUSB learning from these models."

Since the awarding of the Steinmetz grant, CSUSB students working with the Wadi el-Hudi Expedition have been processing the photos to be modelled in Agisoft Photoscan. With the help of CSUSB's Academic Technologies and Innovation (ATI), they are now building the first 3D models with the help of Amazon Web Services supercomputing power.

The expedition was launched in 2014 to record and conserve the monuments at Wadi el-Hudi, located in the Eastern Desert of Egypt. In ancient times, the expedition website says, "it was a center for mining because of its unique geology. It contains dozens of archaeological sites that stand like time capsules in the desert, which date from the Paleolithic Period (about 200,000 years ago) to the Islamic Period (about 1,000 years ago).

"Prior work there published only half of the surviving inscriptions and did not investigate the greatest part of the archaeology," the website continues. "Nevertheless, Wadi el-Hudi has historically significant information for the history of Egypt and the organization of the Ancient Egyptian government. Indeed, far beyond its importance for the study of mining expeditions, Wadi el-Hudi has the potential to change much of what we know about the political and social history of all of Ancient Egypt."

The CSUSB team hopes to return to Egypt in the coming year to train more students in the intersection between archaeology, technology, science and research.

SAN DIEGO

San Diego State University, located near the U.S.-Mexico border, is the top California State University campus recipient of federal research support and is an active research public university. Students participate in transformational research, international experiences, sustainability and entrepreneurship initiatives, internships and mentoring, and have access to a diverse range of student life opportunities. SDSU, a Hispanic Serving Institution residing on Kumeyaay land, is known for its long-standing efforts advancing diversity and inclusion.

EMPOWERING WOMEN AND COMMUNITIES TO BRIDGE HEALTH DISPARITIES GAP

When her mother was diagnosed with breast cancer in the 1990s in Amman, Jordan, Hala Madanat's family was devastated to discover they hadn't caught it early enough to save her. Mammograms were not as common as they are now, and awareness about the importance of prevention and screening for cancer were not well known in the community.

Madanat was 19 and a student majoring in biology when her mother died. This led to an abiding interest in public health and the impact it can have, so she switched fields for her master's.

"I realized that when you empower the woman, you empower the whole family," said Madanat, director of the San Diego State University School of Public Health. "As public health professionals we can develop community engagement programs that empower families and entire communities."

Her research focuses on addressing health disparities through community engagement. Madanat was selected for the 2020 Albert W. Johnson distinguished faculty award for her work on obesity prevention in underserved communities.

"I believe strongly in social justice and bridging the gap in health disparities," Madanat said. "We need to look at how to translate scientific discoveries into impactful population health programs. Take the community health worker model—we know it works, but how do we execute it on a large scale to actually help change people's behaviors?"

Madanat heads the evaluation of several National Institutes of Health funded grants, and is the lead principal investigator of the $12 million NCI-funded SDSU/UCSD Cancer Center Partnership.

It serves several purposes: advancing discovery in cancer research, reducing cancer health disparities in the region, and providing research opportunities for underrepresented minority students, with the aim of developing a pipeline of future researchers from diverse backgrounds.

Madanat also leads Communities Fighting COVID!, a $3 million contact tracing program funded by the San Diego County Health & Human Services Agency. The project focuses on underserved communities, with Black and Spanish-, Arabic- and Tagalog-speaking health workers trained to help stop the spread of COVID-19.

"What's exciting about my work is that you're building community relationships over the long term," Madanat said. "We started out studying trends, then applied that to intervention programs, initially for obesity and cancer, and now for contact tracing. So it's not 'one and done.' We continue to work with our communities on many aspects of their health and to address their immediate needs as they come up."

San Diego's Latinx community has been a major focus of the School of Public Health's efforts for the past many years. Researchers will build on that experience and expand it to include the Black, Arab American, and Asian Pacific Islander communities in addressing health disparities.

"Our projects will keep shifting based on community identified needs, but our focus will always remain the same—reducing health disparities," Madanat said.

THIRD PLANET IN KEPLER-47 SYSTEM DISCOVERED

San Diego State astronomers discovered a third planet in the Kepler-47 system, securing the system's title as the most interesting of the binary-star worlds.

Using data from NASA's Kepler space telescope, a team of researchers led by astronomers at San Diego State detected in April 2019, the new Neptune-to-Saturn-size planet, dubbed Kepler-47d, orbiting between two previously known planets.

With its three planets orbiting two suns, Kepler-47 is the only known multiplanet circumbinary system. Circumbinary planets are those that orbit two stars.

The planets in the Kepler-47 system were detected via the "transit method." If the orbital plane of the planet is aligned edge-on as seen from Earth, the planet can pass in front of the host stars, leading to a measurable decrease in the observed brightness. The new planet, dubbed Kepler-47d, was not detected earlier because of weak transit signals.

As is common with circumbinary planets, the alignment of the orbital planes of the planets change with time. In this case, the middle planet's orbit has become more aligned, leading to a stronger transit signal. The transit depth went from undetectable at the beginning of the Kepler Mission to the deepest of the three planets over the span of just four years.

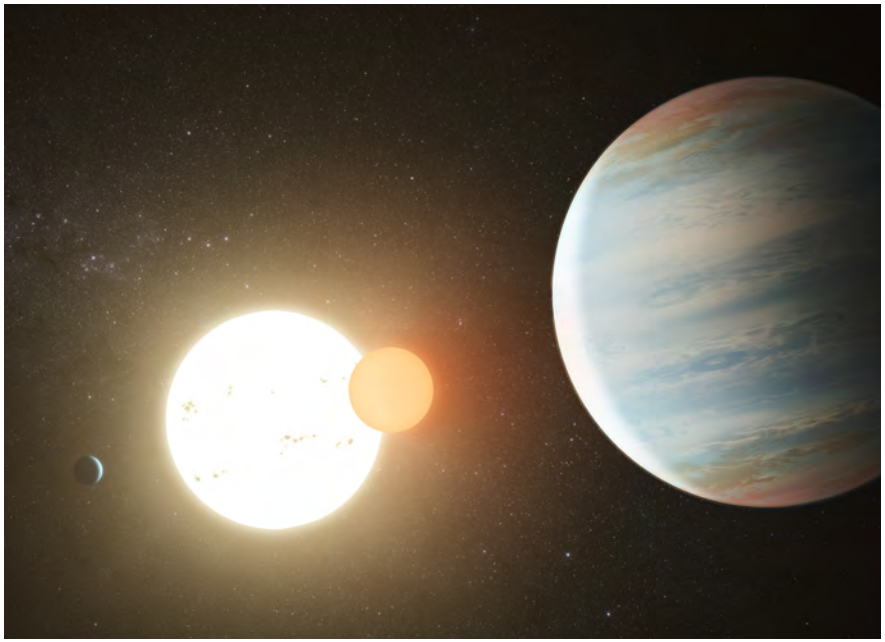
The SDSU researchers were surprised by both the size and location of the new planet. Kepler-47d is the largest of the three planets in the Kepler-47 system.

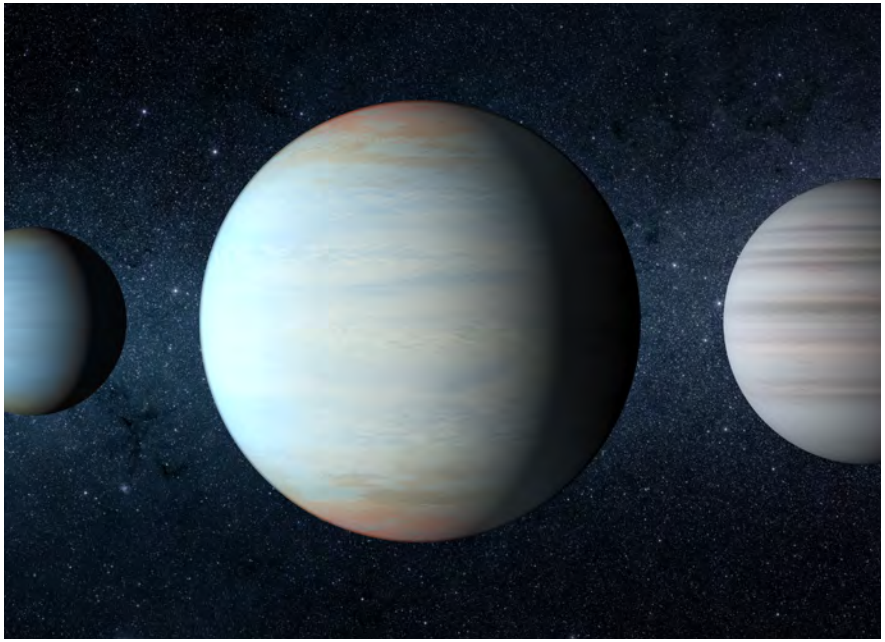
"We saw a hint of a third planet back in 2012, but with only one transit we needed more data to be sure," said SDSU astronomer Jerome Orosz. His team's research was recently published in the Astronomical Journal. "With an additional transit, the planet's orbital period could be determined, and we were then able to uncover more transits that were hidden in the noise in the earlier data."

Dr. William Welsh, SDSU astronomer and the study's co-author, said he and Dr. Orosz expected any additional planets in the Kepler-47 system to be orbiting exterior to the previously known planets. "We certainly didn't expect it to be the largest planet in the system. This was almost shocking," Dr. Welsh said.

With the discovery of the new planet, a much better understanding of the system is possible. For example, researchers now know the planets in this circumbinary system are very low density—less than even that of Saturn, the solar system planet with the lowest density.

This work was supported in part by grants from NASA and the National Science Foundation.





SDSU VOLCANOLOGIST'S DISCOVERY OF SPREADING SOURCE ROCK MAY SHED LIGHT ON PAST AND FUTURE ERUPTIONS

San Diego State University geology lecturer Victor Camp has spent a lifetime studying volcanic eruptions all over the world, starting in Saudi Arabia, then Iran and, eventually, the Pacific Northwest. Mantle plumes—upwellings of abnormally hot rock within Earth's middle layer—that feed the largest of these eruptions fascinate Camp because of their massive size and potential effect on our environment.

Over the past few years, he has discovered that the mantle source rock that rises from beneath Yellowstone National Park to feed its periodic supereruptions also spreads west all the way out to Northern California and Oregon.

On its westward journey, it acts as the catalyst for fairly young—meaning less than two million years old— volcanic eruptions at places such as Craters of the Moon National Monument and Preserve in Idaho, before reaching Medicine Lake Volcano in northeastern California.

Many miles deep beneath Earth's surface, the mantle rock spreads laterally through narrow flowline channels for more than 500 miles, bifurcating twice: once as it leaves Yellowstone and again as it reaches the California-Oregon border. These lines end at Medicine Lake, an active volcano near Mount Shasta, and at Newberry Volcano, an active volcano about 20 miles south of Bend, Oregon.

This discovery, published in the journal Geology in May 2019, is significant because it reveals how mantle plumes similar to the one beneath Yellowstone behave as they feed the majority of the world's largest volcanic eruptions of basaltic lava, including those in Hawaii.

"Since the plume is not controlled by plate tectonics, it can rise and emerge anywhere on Earth, depending on where it manages to break through the earth's surface," Camp said. "So, knowing this will help us understand supereruptions that have occurred before, and those that will occur in the future."

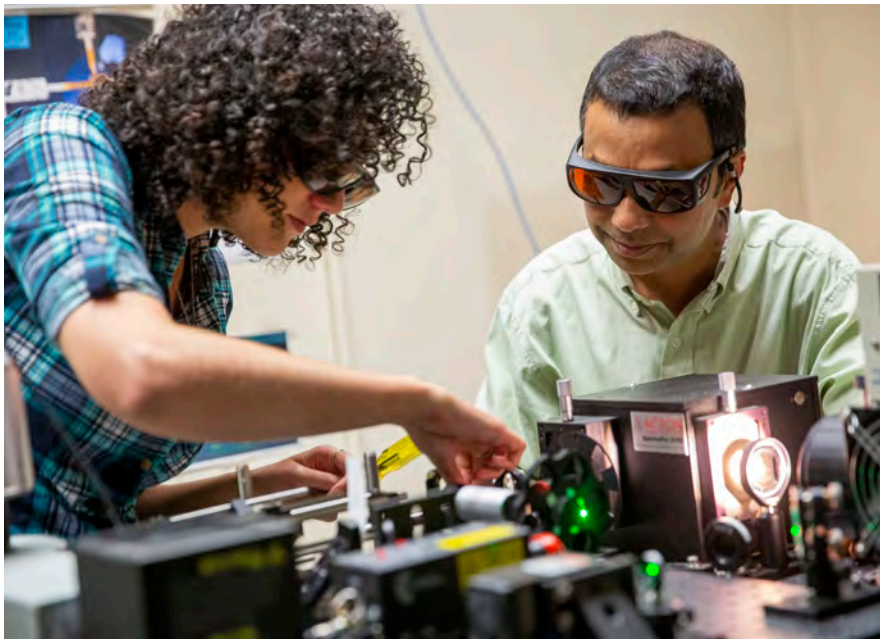
When the Yellowstone plume first reached the base level of the North American tectonic plate, it was blocked by the cold plate's rigidity. At the depth of about 62 miles, the plume began to decompress and melt, while spreading laterally to the west.

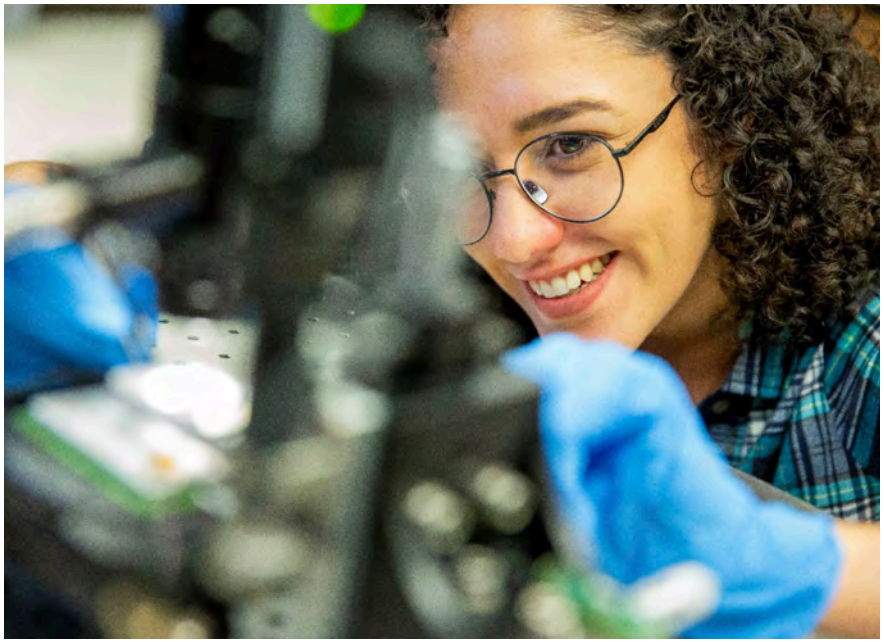
The mantle rock under Yellowstone today originated at the bottom of the mantle geographically centered near what is now San Diego and took millions of years to move east before tracking back west.

Camp sourced seismic tomography images, similar to X-rays and CT scans (computerized tomography scans), that show how the mantle plume ascended. He also analyzed field data and published chemistry and age data on volcanic rocks at the surface to demonstrate its westward flow.

SAN FRANCISCO

Located in one of the world's most vibrant cities, San Francisco State University is a leader in addressing regional and global issues. Its graduates have contributed to the economic, civic and cultural fabric of San Francisco and beyond. Through them—and its world-class faculty—San Francisco State proudly embraces its legacy of academic excellence, community engagement and commitment to social justice.





SAN FRANCISCO STATE RESEARCHERS USE LASERS, GOLD TO TEST SUPER-THIN MATERIALS

As technologies become more compact—with the room-sized computers of the past shrinking to smartphones as just one example—a limit will eventually be reached. In a new study, San Francisco State University scientists push against that limit, probing the properties of a futuristic material made up of just a single layer of molecules. The team used lasers, vaporized gold and even some strategic sticky tape to gain a better understanding of the materials that one day may allow for extreme miniaturization of technologies, including lasers and LED lights.

AKM Newaz, San Francisco State assistant professor of physics and astronomy, started digging into the material molybdenum disulfide (or MoS_2) in 2016. He was intrigued by its ability to create a single molecule thick layer—nearly 100,000 times thinner than a human hair. It is also a semiconductor, a class of materials that play a crucial role in computers due to their ability to alter electric currents.

The same trait that gives MoS_2 its interesting properties also makes it difficult to work with. To test the material in the way that it will eventually be used in next-generation technologies, it needs to be sandwiched between metals. However, the typical process for doing so involves placing it on a gold surface that has hills and valleys bending the material out of shape. "You're putting a blanket on a mountain," Newaz said. The resulting curvature makes it impossible to accurately measure the material's properties.

Newaz and his lab members found a way around that. They developed a technique that involved evaporating gold onto a flat surface with super-hot temperatures, sticking a flat sheet of silicon wafer on the condensed molten metal and then peeling it off. The resulting, far smoother gold surface allowed the team to mount the MoS_2 on its surface with sticky tape—a must-have in any lab studying ultrathin materials—while keeping its properties intact. "That was one of the most important things in this work: We found a way to make this ultraflat gold surface," he said.

The next step was scanning a tiny metal tip paired with a laser attached to an instrument, known as an Atomic Force Microscope (AFM), over the material to map out its physical peaks and valleys. "It senses the ups and downs, like reading Braille," Newaz said. Combining that with measurements of electric currents let the team measure MoS_2's electric characteristics and how those characteristics change when layers of the material are stacked on top of one another.

Using a similar setup with a transparent metal, his team then measured the material's "opto-electric" behavior—how light influences the electric current. That led to a surprising discovery: shining a laser on the material decreases, not increases, the electric current running through MoS_2, a rare property called negative photoconductivity. The results of this work were published in the journal ACS Applied Materials and Interfaces in August 2019 with graduate student Hao Lee (M.S., 2019), now an alumnus, as lead author.

It is not yet clear how these properties will translate into the material's usefulness, but the study is an important fundamental step toward identifying uses for ultraflat materials, Newaz said. The team's next step will be figuring out why the material behaves the way it does, performing similar tests with different colors of light and under varying temperatures down to just a few degrees above absolute zero.

SCIENTISTS LAUNCH FIRST LONG-TERM EFFORT TO MEASURE ACIDIFICATION IN SAN FRANCISCO BAY

Visitors to the Tiburon shoreline may notice a new addition to the seascape—a five-foot-tall, bright yellow buoy anchored just offshore San Francisco State University's Estuary & Ocean Science (EOS) Center. The Bay Ocean Buoy (BOB) and its companion mooring for Marine Acidification Research Inquiry (MARI) bring together researchers at San Francisco State, University of California, Davis, and funders. It represents the first effort to perform long-term scientific monitoring of ocean acidity and carbon dioxide in the waters of the bay.

"By monitoring the carbon chemistry of the San Francisco Bay, we will learn how global climate change and changing ocean chemistry are interacting with local habitat restoration and conservation efforts," said Dr. Karina Nielsen, director of the EOS Center and SF State biology professor. "It will enable us to recognize the most promising management solutions and make better investments to promote the environmental health of the bay, benefiting both people and wildlife."

Waters from the Pacific Ocean and the Sierra meet in San Francisco Bay. In terms of pollution, the focus traditionally has been on the water brought to the bay by rivers and runoff from the land. However, deep, cold ocean waters that upwell along the California coast may bring their own issues. A portion of the carbon dioxide released into the atmosphere by burning fossil fuels is absorbed by the world's oceans, making them more acidic. This acidity has the potential to affect a variety of marine and estuarine life, such as oysters, mussels and crabs that use calcium carbonate to build their shells and other hard body parts.

"Eventually we will have a finger to place on the pulse of major chemical changes that we expect are happening in San Francisco Bay in response to global environmental changes in the ocean and watershed," said Dr. John Largier, associate director of UC Davis' Coastal and Marine Sciences Institute and a professor of oceanography in the campus's department of environmental science and policy.

To track these changes, the newly deployed BOB and MARI moorings carry sensors for measuring carbon dioxide—in the atmosphere and the water—dissolved oxygen, pH, chlorophyll a (a measure of the amount of microscopic algae in the water), water clarity, temperature and salinity. The sensors will make measurements at the surface, and also deep in the bay where ocean waters flow in.

The moorings are intended to be long-term additions to the shoreline. Along with providing an immediate snapshot of water conditions, the collected data will let scientists assess how changing ocean waters are affecting the long-term health of the bay. They'll also assist in tracking the success of efforts to manage local water quality and to conserve and restore natural habitats.

"EPA is pleased to support many varied aspects of San Francisco Bay water quality monitoring," said Alexis Strauss, U.S. Environmental Protection Agency's acting regional administrator for the Pacific Southwest. "These new sensors are a welcome addition to help us understand changing conditions in the bay."

The project is funded by the U.S. Environmental Protection Agency through the San Francisco Estuary Partnership and by the Central and Northern California Ocean Observing System (CeNCOOS), a regional association of the National Oceanic and Atmospheric Administration's (NOAA's) U.S. Integrated Ocean Observing System. The Carbon Group at NOAA's Pacific Marine Environmental Laboratory also contributed time and expertise. This initiative adds new capabilities to the network of shore stations supported by CeNCOOS.

SOCIAL INNOVATION (SOUL) LAB

Antwi Akom, Ph.D., is a star professor at San Francisco State University for his ability to bring together health, science, technology and innovation in the first College of Ethnic Studies in the United States. For example, recently Dr. Akom was a part of a $17 million National Science Foundation SF Build grant, led by Dr. Leticia Marquez-Magana of San Francisco State and Kirsten Bibbins-Domingo of University of California, San Francisco, that aimed to create the next generation of biomedical researchers from low-income communities and communities of color. Currently he is the recipient of the Robert Wood Johnson Pioneer Award (2019) and the PI for a National Science Foundation Big Data 2 Knowledge award. In addition to these accolades, Dr. Akom said that one of his greatest honors was being invited by then-President Obama to the White House Frontiers Conference and being named by his administration as one of the world's top innovators for his work in social innovation, health tech, real-time data and community-driven big data. As a formerly incarcerated person who grew up in a single-parent household, Akom said he never expected to achieve these forms of success and wants to be an inspiration and hope for others that they too can do this!

Akom's 2015 TEDx talk "Innovation Out of Poverty" further solidified his "star" status as a public intellectual in health, equity and technological innovation. In his talk, he lifts up the power of innovation and climate justice with women and poor people—people who have innovated their way out of poverty through hard work, grit and determination.

Fast-forward three years and with the help of Dr. Marquez-Magana, Dr. Bibbins-Domingo and the SF BUILD project, Akom became the founding director of the Social Innovation and Urban Opportunity Lab, the first transinstitutional, translational, transdisciplinary research lab between UC San Francisco and San Francisco State.

At the lab, Akom is finding new ways to inspire hope with our nation's most vulnerable populations by leveraging the power of community-driven technology, big data and innovation. In its third year, the SOUL Lab has grown to engage more than 30 researchers across institutions and affect the lives of hundreds of students and countless community members across cities, rural spaces and places, nationally and internationally.

For these reasons and more, we are proud to lift up Akom's research and scholarship for being a health tech and eco-visionary—especially with underserved youth, Indigenous communities and with our nation's most vulnerable populations. Thank you, Akom, the College of Ethnic Studies, and the Department of Africana Studies for the inspiring research that you do. And thanks to everyone at CSU, UC and those working in low-income neighborhoods and communities who continue to believe in themselves and one another to create agents of change. Keep moving forward. You are inspiring more people than you know!

SAN JOSÉ

San José State University is one of the most transformative universities in the nation. A breadth of academic programs and a growing research and innovation environment allow the university to adapt to and set the pace of change. As Silicon Valley's public university, SJSU is an essential partner in the economic, cultural and social development of the region and California—perfectly positioned to examine questions facing the community and the world.

RESEARCH ON ABOLITIONIST EDUCATOR PROVIDES AN EARLY EXAMPLE OF HOW EDUCATION CAN BE A CATALYST FOR SOCIAL CHANGE

San José State Humanities Professor Jennifer Rycenga's expansive research interests include religion, politics, popular and classical music and lesbian history. An alumna of University of California, Berkeley, and the Graduate Theologian Union, she has taught at SJSU for more than 20 years and coordinates its comparative religious studies program. Co-editor of "The Mary Daly Reader" (NYU Press, 2017), "Queering the Popular Pitch" (Routledge, 2006) and "Frontline Feminisms: Women, War and Resistance" (Routledge, 2001), she is working on a cultural biography of white abolitionist educator Prudence Crandall (1803-1890).

Rycenga first learned of Crandall in 1997, when she visited the Crandall Academy in New England. Crandall opened an academy for women in Canterbury, Connecticut, in 1831. Her school represented one of the strongest early coalitions across lines of difference in American history. Black women and men worked with white women and men to launch and maintain the academy in Canterbury, and they understood the need to protect one another.

"Crandall's legal team—who, of course, were white men—built an insightful argument for both black citizenship and female citizenship," said Rycenga. "Their arguments would reappear in the Dred Scott case and Brown v. Board of Education. Part of what I have discovered is the existence of an American antiracist genealogy. To be antiracist means that you embrace the equality of all people and do not seek to blame the victims of prejudice for the prejudice directed against them. Crandall grasped that the problems created by racism were in no way the fault of Black people."

Despite facing considerable racist threats from the surrounding community, the academy remained an active school until 1834, when a vicious attack left the building inhabitable. Rycenga's research demonstrates that, despite such opposition, the students went on to achieve roles of importance in the free Black community, affecting the movements for change that led up to and past the Civil War. "The rock that Crandall threw into the complacency of white society in the north resulted in many generations of Black self-determination and a richer sense of who we can be as a country," she said.

Crandall's story highlights the importance of intersecting identities, she said. Black students faced prejudice primarily because of race, but also by virtue of their gender, age, sexuality and class status. Crandall was dismissed by some opponents, then and now, because she was a woman. The academy in Canterbury offered a unique opportunity for Black families to give their daughters an advanced education and the skills necessary to extend education more broadly through the Black community by training them to become teachers. When Rycenga interacts with the many future teachers of California who go through the liberal studies program in SJSU's humanities department, she is reminded that their wonderful diversity, across race, language, gender, sexuality and religion, reflects Crandall's legacy.

"History is the place where the big ideas of what is meaningful meet up with the details of life as it is experienced," Rycenga observed. "In the case of the Canterbury academy, I found that by examining women's lives and interracial cooperation, I have discerned how the participants were expanding the boundaries of what was possible for women to do and be."

A NEUROPHYSIOLOGY LAB AT SJSU EXPLORES HOW AND WHY THE HUMAN BODY INTERACTS WITH THE WORLD AROUND US

The human body has between 800 and 900 muscles. Each one has anywhere from five to 50 stretch sensitive sensory neurons—cells that help the brain build a three-dimensional representation of the body in space. This sense of position in space, known as proprioception, helps people move. If sensory neurons fail, it affects how a person moves.

"How does your body take sensory information and use that to do the things that you need to do?" asked Katie Wilkinson, associate professor of biological sciences at San José State. She trains students to use electrophysiological tools to record activity in muscles, examine sensory neurons and study possible applications of these findings to health care and robotics.

Her team explores how people use sensory information to move, balance and position ourselves—how and why the human body interacts with the world. They study how proprioceptors sense muscle length, when and why they fail and explore how stretch sensors in muscles work. The data they collect could help scientists understand how neurons communicate movement, which could aid people who have trouble with balance.

Dr. Wilkinson hopes their research will help identify therapies for patients whose sensory neurons do not work well. Their findings could apply to prosthetic limbs or robotics.

"We have sophisticated robotics and prosthetic limbs, but their senses, even with top-of-the-line sensors, are nowhere near as good as ours," she said. "We have circuits built in—some are very quick reflexes and some go to the brain and smooth our movement and adapt to challenging environments. Understanding the basic science of how our sensory neurons work may help us translate that into prosthetics, give people more sensation and perhaps a better range of movement. My lab pursues very basic science research but, hopefully, some of the things we learn can contribute to that."

Dr. Wilkinson came to SJSU after completing an Institutional Research and Academic Career Development postdoctoral fellowship at Emory University that emphasized mentorship, teaching and research experience. She said that she sought out SJSU because it values teaching as much as research. She believes in creating opportunities for students to pursue big questions and contribute to discoveries and experiments.

Her lab studies the mutations that occur in people living with distal arthrogryposis type 5, a rare disorder that causes limb dysfunction, joint rigidity or limb deformities. The goal is to identify how sensory neurons work and pinpoint potential therapies. Together with her master's and undergraduate students, they are applying for research grants, gathering and analyzing data, publishing papers and presenting at conferences. Wilkinson is guiding generations of scientists as they find their way to careers in academia, biotech and research.

To understand what causes neurological problems, scientists must first identify where and when they occur. How can a doctor treat a disease if it's unclear how it originates? By investigating how proprioceptors sense muscle length and how stretch sensors work, Wilkinson and her team, in collaboration with Ardem Patapoutian's lab at The Scripps Research Institute, identified the ion channel that opens when muscles stretch. This discovery, the subject of a cover article in Nature Neuroscience in 2015, locates where mutations that cause imbalance or neurological problems may sometimes occur.

"We are doing cutting-edge science here at San José State," she said. "Students are publishing papers and contributing to their disciplines. Universities should be where you make new knowledge—and that's how we train students. Teach them what science really is. Students leaving our lab are well-trained and competing on equal footing with students from other universities. San José State students are some of the most motivated people I've ever met."

NEARLY 1,000 SCANNED DOCUMENTS BELONGING TO NOTABLE AFRICAN AMERICAN SCHOLAR W.E.B. DU BOIS WILL BE ADDED TO THE DR. MARTIN LUTHER KING JR. LIBRARY

San José State Associate Professor of Journalism Duane "Michael" Cheers said studying African American history "has been part of my DNA since childhood." The great-grandson of slaves became immersed in the story of W.E.B. Du Bois, the first African American to earn a doctorate from Harvard University and a co-founder of the NAACP, while Professor Cheers was studying for master's degrees in African American studies and journalism at Boston University. He is now digitally preserving damaged photographs and personal documents belonging to the sociologist, civil rights activist and historian.

"During my 1978 summer internship at Ebony and Jet magazines in Chicago, I shadowed the editors who were finishing, 'Du Bois: A Pictorial Biography', [a book] by Shirley Graham Du Bois, his second wife," he said. "I'm also probably the only African American professor at San José State who owns a first edition [of Du Bois'], 'The Souls of Black Folk,' first published in 1903."

In 1993, he traveled to Senegal for National Geographic Television, filming his experience as a descendant of slaves. "That experience was also rooted in my reading of Du Bois' book 'The World and Africa: An Inquiry Into the Part Which Africa Has Played in World History,' where the father of Pan-Africanism hauntedly discussed the horrors of the slave trade," said Professor Cheers.

During a 2016 visit to the W.E.B. Du Bois Centre for Pan African Culture in Accra, Ghana, he noticed ants and termites had eaten away at the materials Du Bois had brought to the home where he died in 1963. The institute granted his request to digitize the materials and the project began.

Cheers is collaborating with SJSU's Dr. Martin Luther King Jr. Library, and librarian Kathryn Blackmer Reyes, director of the campus's Africana, Asian American, Chicano and Native American Studies Center, to add the Du Bois materials to the library's digital Africana Collection archives. Dr. Tracy Elliott, dean of the Dr. Martin Luther King Jr. Library, Elliott loaned him a high-resolution scanner, and Cheers and his daughter, Imani, an assistant professor of media and public affairs at George Washington University, have teamed up on the project.

"We scanned close to 1,000 documents in Ghana—photographs, papers, diaries—everything they had," Cheers said. He found some VHS tapes from the 1980s in a basement crawl space at the Du Bois Centre and has been working with SJSU Media Producer Keith Sanders to digitize as many videos as possible. To date, "two really important" videos—of Du Bois' 1963 funeral and the 1985 opening of the center, when Maya Angelou was a keynote speaker—have been rescued. They are expected to be part of a documentary examining the final two years of Du Bois' life.

A memorandum of understanding between the Du Bois Centre and King Library to house the digital archive at SJSU is in the works, "making it available, free to students, scholars and researchers around the world," he added.

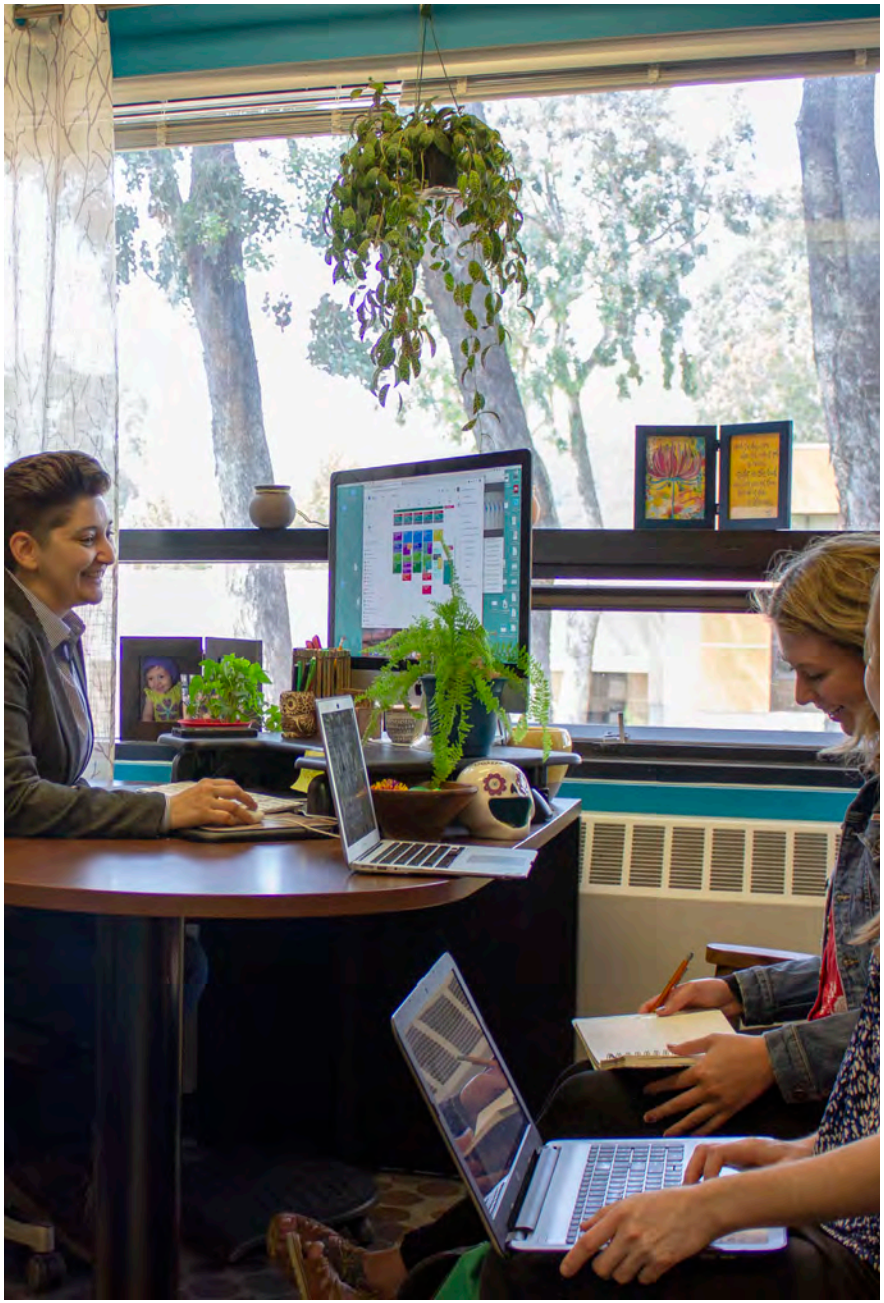
In 2018, Cheers curated the 150th birthday tribute to Du Bois in King Library. "I was annoyed by how few students knew of Du Bois and his contributions to African American history," he said. "I realized I could stand on the sidelines and complain or become a partner in educating this generation of students."

Harvard and the University of Massachusetts-Amherst have digital collections of Du Bois' works, but Cheers has scanned, digitized and archived photos and documents those universities don't have.

"Hopefully, our campus library's Africana Collection will become a repository of this material, and professors at SJSU will include Du Bois in their lesson plans."

SAN LUIS OBISPO

California Polytechnic State University, San Luis Obispo, is a nationally ranked public university centered on solving California's most pressing problems through a "learn by doing" philosophy. Our learning community of expert faculty and academically motivated students takes a polytechnic approach to find solutions across disciplines and boundaries. Our graduates are ready to be community leaders, top earners and game changers in industries that shape our state and our world.



INCREASING LGBTQ+ AFFIRMING MENTAL HEALTH CARE SERVICES IN SAN LUIS OBISPO COUNTY

Dr. Jay Bettergarcia (they/them/their) is an assistant professor in the Psychology and Child Development Department at Cal Poly, San Luis Obispo, and a licensed psychologist whose work supports the mental health and wellness of transgender, nonbinary and gender-diverse individuals and communities. As a nonbinary person and Cal Poly alum, Dr. Bettergarcia recognized, personally and professionally, the need for more affirming mental health care services for the lesbian, gay, bisexual, transgender and queer (LGBTQ+) community in San Luis Obispo County. Now, as a Cal Poly professor and local therapist, Bettergarcia is working to increase access to affordable, culturally competent and affirming care for these communities.

As part of this work, Bettergarcia runs the Queer Community Action, Research, Education and Support (QCARES) program that involves students, community members and leaders in developing, conducting and disseminating research for policy change and social justice action. QCARES started on campus in 2017 by conducting an LGBTQ+ mental health needs assessment to explore barriers to accessing care, their experiences with providers, and the local services needed to support mental health and wellness. The San Luis Obispo County Behavioral Health Department funded this project; more than 500 LGBTQ+ youth, adults and elders shared their experiences through an extensive online survey and several focus groups. The results pointed to the need for more well-trained and affirming providers, suicidal prevention efforts targeted to LGBTQ+ youth, affirming services for transgender and gender-diverse people and LGBTQ+ community spaces that help increase their feelings of safety and connectedness, which can help to buffer the negative effects of stigma and discrimination on mental health. The results and recommendations are being used to develop affirming programs and initiatives that support LGBTQ+ mental health across San Luis Obispo County.

Bettergarcia then set out to create more local training opportunities to help increase providers' cultural competence and to collect data about the effectiveness of such trainings. With a campus Research, Scholarly and Creative Activities grant, they conducted a series of one-day trainings for medical and mental health providers on transgender affirming care. This study assesses the changes in providers' knowledge, attitudes and interpersonal comfort from pretest to posttest. With this coastal county being semirural, accessibility to affirming care providers can mean the difference between people getting the care they need or none at all.

Bettergarcia also developed the Affirming Cultural Competence Education and Provider Training (SLO ACCEPTance) project, a four-year program funded by the Mental Health Services Act, through SLO County Behavioral Health. This innovative program tests a nine-month training model to increase the cultural competence (including knowledge, awareness and skills) of therapists, and the feasibility of specific training activities. Through this research, Bettergarcia and their collaborators hope to better understand and study various methods of conducting diversity-related training. Additionally, approximately 60 local therapists will be trained further to provide affirming mental health care and support for LGBTQ+ people, thereby expanding access to quality care.

Bettergarcia hopes these various projects will increase access to LGBTQ+ affirming care and to reduce barriers to accessing services. Having more well-trained therapists available is one step in that direction. Research shows that prejudice, discrimination and stigma can have extensive deleterious effects on the mental health of queer and transgender people. Bettergarcia hopes that through their work, LGBTQ+ people will not have to face bias and discrimination from their doctors, nurses, and therapists as well.

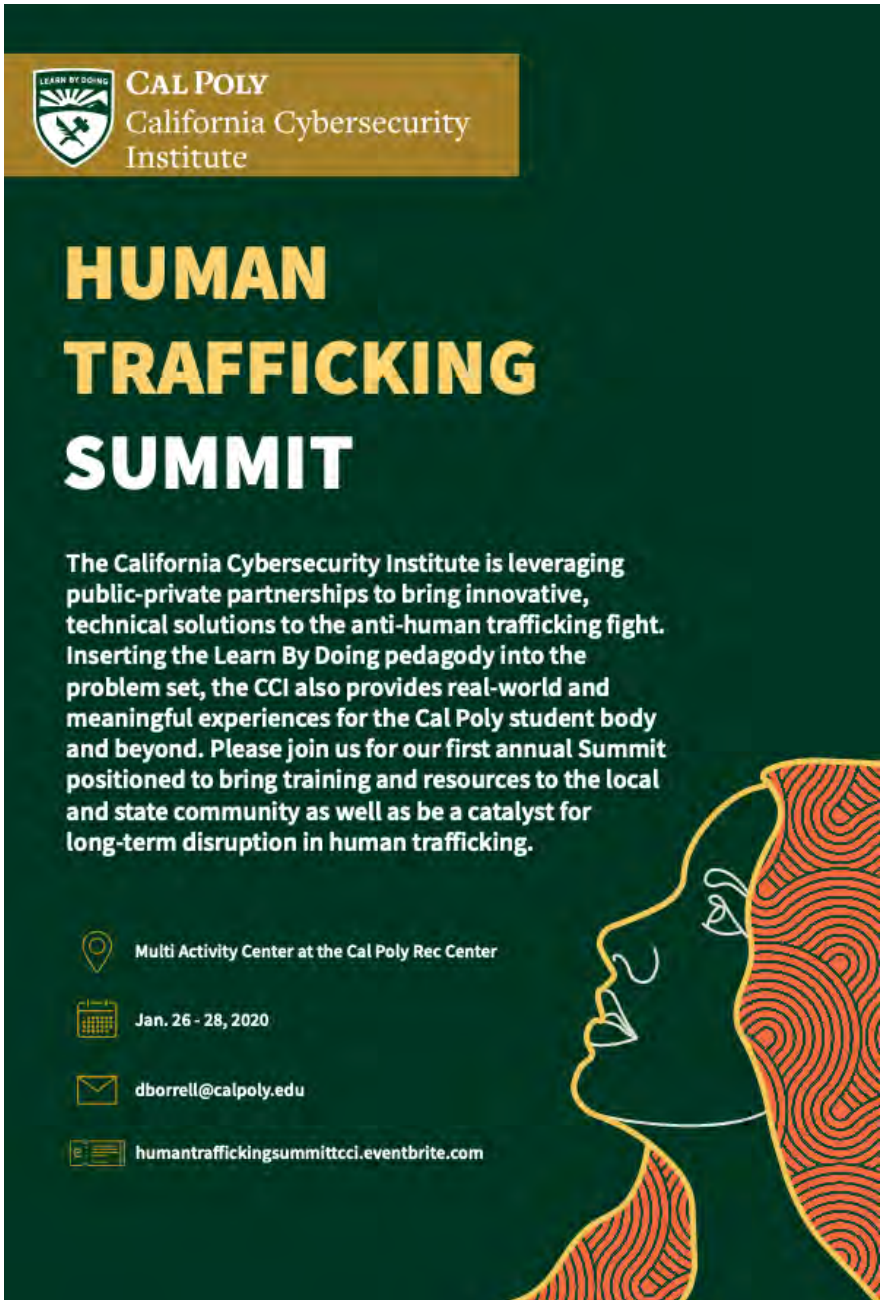
COMBATING HUMAN TRAFFICKING

Human trafficking is one of the most significant human rights violations of our time. Victims are often physically, mentally, emotionally and economically manipulated, controlled and abused. Human trafficking targets our youth, including college students, preying upon the innocent and vulnerable. It is a public health crisis and is deeply connected to other crimes such as arms and drug trafficking. Human trafficking generates more than $150 billion annually and is becoming the fastest growing crime worldwide. California, being home to some of the nation's largest cities (San Diego, Los Angeles and San Francisco), is overwhelmed with curbing demand and assisting victims. It has routinely been the state with the largest number of identified victims and open cases, with the amount increasing every year.

The Trafficking Investigations Hub (TIH) at Cal Poly's California Cybersecurity Institute (CCI) is uniquely positioned to assess this issue and threat as well as provide the cutting-edge tools, education and training needed to combat this global and local issue. Over the last two years, Cal Poly has created live, immersion-training courses to help equip organizations such as Polaris, a nonprofit that operates the U.S. National Human Trafficking Hotline, and the California Peace Officers Association to fight human trafficking. From video production to data science, many of Cal Poly's students, faculty, staff and class projects are working to combat the crime.

This past January, Cal Poly hosted a human trafficking summit on how human trafficking is affecting California. A panel discussion, resource fair, and cyber training for law enforcement were featured. This event provided the public with a deeper understanding of trafficking and provided tools to combat it. It also trained the law enforcement community and IT professionals on how to disrupt human trafficking effectively and sustainably.

Cal Poly's Danielle Borrelli from the CCI TIH was recently featured in CSU's "Cybersecurity Needs You" regarding Cal Poly's efforts to combat human trafficking. "There's been an uptick in the way that technology has been used to exploit individuals," Borrelli said. To read the full article, visit **https://www2.calstate.edu/csu-system/news/Pages/cybersecurity-fights-human-trafficking.aspx.**



GRADUATE NAMED FIRST-PLACE WINNER OF THE CALIFORNIA STRAWBERRY COMMISSION'S STRAWBERRY AUTOMATION RESEARCH AWARD

Bioresource and agricultural engineering (BRAE) senior Jack Wells was named first-place winner of the Strawberry Automation Research Award (STAR) 2019. The $1,000 award in the statewide competition is given by the California Strawberry Commission (CSC).

Wells was recognized for the research he carried out as a 2017-2019 automation engineering intern at the Cal Poly Strawberry Center Automation Laboratory. He was directed by his industry adviser, the center's automation manager, Dr. John Lin.

Wells' project focused on improving the removal efficiency of a widely used "bug vacuum" to manage organic Lygus spp. in California strawberries. This bug costs California strawberry growers an estimated $200 million in damaged fruit each year. Wells' early work involved creating a computer model to simulate airflow through the vacuum to identify aerodynamic inefficiencies. He later validated his models with entomologists at both the Cal Poly Strawberry Center and the University of California, Davis. This work led to the CSC funding a BRAE senior design class to further develop improvements to the bug vacuum. During 2019, Wells advised the 20 students in the class. The final design would remove approximately twice as much Lygus spp. than conventional bug vacuums. This design would later be field-tested by CSC staff on farm fields and commercialized by C&N Tractors, a local equipment manufacturer.

The Cal Poly Strawberry Center offers students the opportunity to move beyond the classroom by working with industry. The close partnership with the CSC allows the center access to more than 400 strawberry growers, shippers and processors in the state. Wells first started working with the Cal Poly Strawberry Center in 2015 at Cal Poly's Swanton Pacific Ranch. There, he spent much of his time scouting for strawberry pests. "Since coming to Cal Poly in 2015, I had hoped to get a foot in the door with a company designing ag-tech equipment," Wells said.

Looking back, he said, "I acted as a liaison between student groups and the Cal Poly Strawberry Center's automation program. I debuted the first prototype at the Cal Poly Strawberry Center's second annual field day in summer of 2018. I collaborated with (field researchers) to put our machine in a head-to-head comparison with conventional vacuums. I worked with a commercial manufacturer [to] produce a full-scale commercial prototype to be stress-tested."

Wells believes that the "key to the success and speed of the project has been the constant cycle between design, fabrication, testing and redesign. With all these processes taking place under the Cal Poly umbrella, few setbacks were related to lack of resources or personnel. The integration of the automation program with the CSC field research team resulted in unparalleled access to strawberry growers and their properties, equipment and operators."

After completing his bachelor's degree, Wells accepted an automation engineering position at the CSC. He also plans to publish his works on bug vacuum improvements in the International Journal of Fruit Science.

"Jack's personal characteristics are maturity, intelligence, curiosity, creativity, hard work and a refusal to allow any obstacle to prevent him from achieving his research aims," Lin said. "There is no doubt that he is deserving of the CSC's STAR award."

SAN MARCOS

Building on an innovative history, California State University San Marcos is a forward-focused institution, dedicated to preparing future leaders, forming great communities and solving critical issues. Located on a hillside in San Marcos, it is the only public four-year comprehensive university serving north San Diego, southwest Riverside and south Orange counties. More than half of the university's students are the first generation in their families to attend college.

PHYSICS PROFESSOR HELPS UNLOCK PUZZLE OF THE ORIGIN OF WATER ON ASTEROID SURFACES

The question has vexed astronomers for years: how do water and hydroxyl radicals, which have the same elements as water, surface on asteroids sluicing through space? A paper co-published by Cal State San Marcos physics professor Dr. Gerardo Dominguez in October in the peer-reviewed scientific journal Nature Astronomy provides the answer.

"Regenerative Water Sources on Surfaces of Airless Bodies" paper concludes that two primary mechanisms are the source of surface water—low-temperature oxidation of organics, and mineral dehydration—and they are transformed through the impact of micrometeorites and the heat pulses they generate during an asteroid's travels.

"Any mechanisms that are discovered that generate water on asteroids are fascinating and help us better understand what is happening in the universe," Dr. Dominguez said. "This helps answer a puzzle as to where this water on asteroid surfaces comes from."

Dominguez was unaware of the study until the principal investigator, professor Ralf I. Kaiser, contacted him. Dr. Kaiser and his team at the University of Hawaii had submitted their research to Nature Astronomy, but reviewers were skeptical that the duration of laser pulses mentioned in the experiments, which were aimed at mimicking the heat pulses caused by micrometeorite impacts on asteroid surfaces, were correct. Kaiser came across Dominguez's earlier research on micrometeorite impacts into on solids and asked the CSUSM professor to provide theoretical modeling on the amount of heat and the duration of heat-pulses generated by micrometeorite impacts to convince Nature Astronomy's peer reviewers.

Mission accomplished.

In fact, Dominguez's research long has been aimed at unlocking the secrets of the universe. His work has earned him recognition from the National Academy of Sciences, NASA and the newsmagazine Diverse: Issues in Higher Education as a top researcher in planetary astrophysics and atmospheric chemistry. Continuing research includes exploring the isotopic composition of molecular clouds to understand how the sun and the planets of our solar system were formed. Dominguez also has conducted extensive research in the application of nano-optical techniques for mapping the chemical composition of meteorites and cometary dust grains.

This past summer, a CSUSM team led by Dominguez was one of eight research teams from around the country awarded a $10.5 million NASA grant to study the origins of ice on the moon.

Not bad for a first-generation American and self-described nerd from San Pedro who grew up devouring books about how things worked.

"How the universe works, how atoms work, it all just fascinated me as a kid," he said.

Dominguez earned his bachelor's degree, master's degree and doctorate in physics from UC Berkeley. He has been teaching at CSUSM since 2011.

PSYCHOLOGY PROFESSOR LEADS PROGRAM THAT HAS MADE CSUSM A SMOKE- AND TOBACCO-FREE CAMPUS

CSU San Marcos established Clear the Air in 2017 to help it implement an executive order by California State University Chancellor Timothy P. White calling for smoke- and tobacco-free environments at all campuses. The program is led by psychology professor Kim Pulvers, who has done tobacco control research for 15 years, and is funded through a $400,000 grant.

Now that CSUSM has been smoke- and tobacco-free for two years, Dr. Pulvers is able to provide data when she hears a common question around campus.

"People want to know how it's going," she said. "And we've got some compelling data."

Among the most notable results has been a 54 percent decrease in cigarette litter on campus from spring 2017 to summer 2019, Dr. Pulvers said. Exposure to secondhand smoke or vapor has decreased 36 percent. Results are based on environmental scans and campuswide surveys of about 3,000 faculty, staff and students that have been conducted each fall since 2016.

Still, Pulvers said there is more work to be done when it comes to cigarette litter. In that regard, Clear the Air has implemented two techniques: an ambassador program and an online reporting tool.

The CTA online reporting tool, which launched in March, was made available through the campus app last fall. It allows people to quickly and easily pinpoint on a map where they saw smoking/vaping or cigarette litter. One of Pulvers' goals for the new academic year is to encourage more people to use the reporting tool. As an incentive, anyone who leaves their contact information after filling out the online form is entered into a weekly drawing for a $10 Starbucks gift card.

"We're partnering with UC Davis, and they have their own version of the tool," Pulvers said. "They've had a higher utilization rate than we have. We're trying to spread the word more about the tool so CSUSM students, faculty and staff can be more involved."

The CTA Ambassador Program was established last fall and is staffed by student interns and volunteers. Ambassadors encourage compliance with the smoke- and tobacco-free policy through peer-to-peer interaction, engagement and education. The program is registered with the Office of Internships through the CSUSM Sustainability Program.

CSUSM ALUMNUS PUBLISHED IN PRESTIGIOUS JOURNAL FOR STUDENT WORK THAT COULD LEAD TO ADVANCES IN PHARMACEUTICAL INDUSTRY

For former CSU San Marcos student Omar Apolinar, having his work published in a distinguished academic journal not only helped him forge a path to graduate school, but the study has the potential for advances in the pharmaceutical industry. Apolinar, who graduated summa cum laude with a degree in biochemistry in 2019, is now in his second year of a doctoral program at Scripps Research in La Jolla. He has been published in the scientific journal Angewandte Chemie.

Apolinar's co-written research paper, "Catalytic, Enantioselective α-Alkylation of Azlactones With Non-Conjugated Alkenes via Directed Nucleopalladation," reflected work completed as an undergraduate in the Engle Lab at Scripps Research through its Summer Undergraduate Research Fellows (SURF) initiative. The paper details a process utilizing palladium and chiral phosphoric acids to manipulate a simple compound into something far more complex in just one step. The discovery could lead to advancements in lifesaving pharmaceuticals.

Angewandte Chemie is a peer-reviewed journal of the German Chemical Society, and it has been published under different names since the late 19th century. Apolinar's paper appeared in the journal's February 2019 international edition.

"This is one of the higher-echelon peer-reviewed journals for organic chemistry published today," said CSUSM chemistry professor Robert Iafe. "Even for a graduate student, this would be an amazing feat. Only the most highly driven undergraduate could accomplish something like this."

Apolinar said the experience was beyond inspirational.

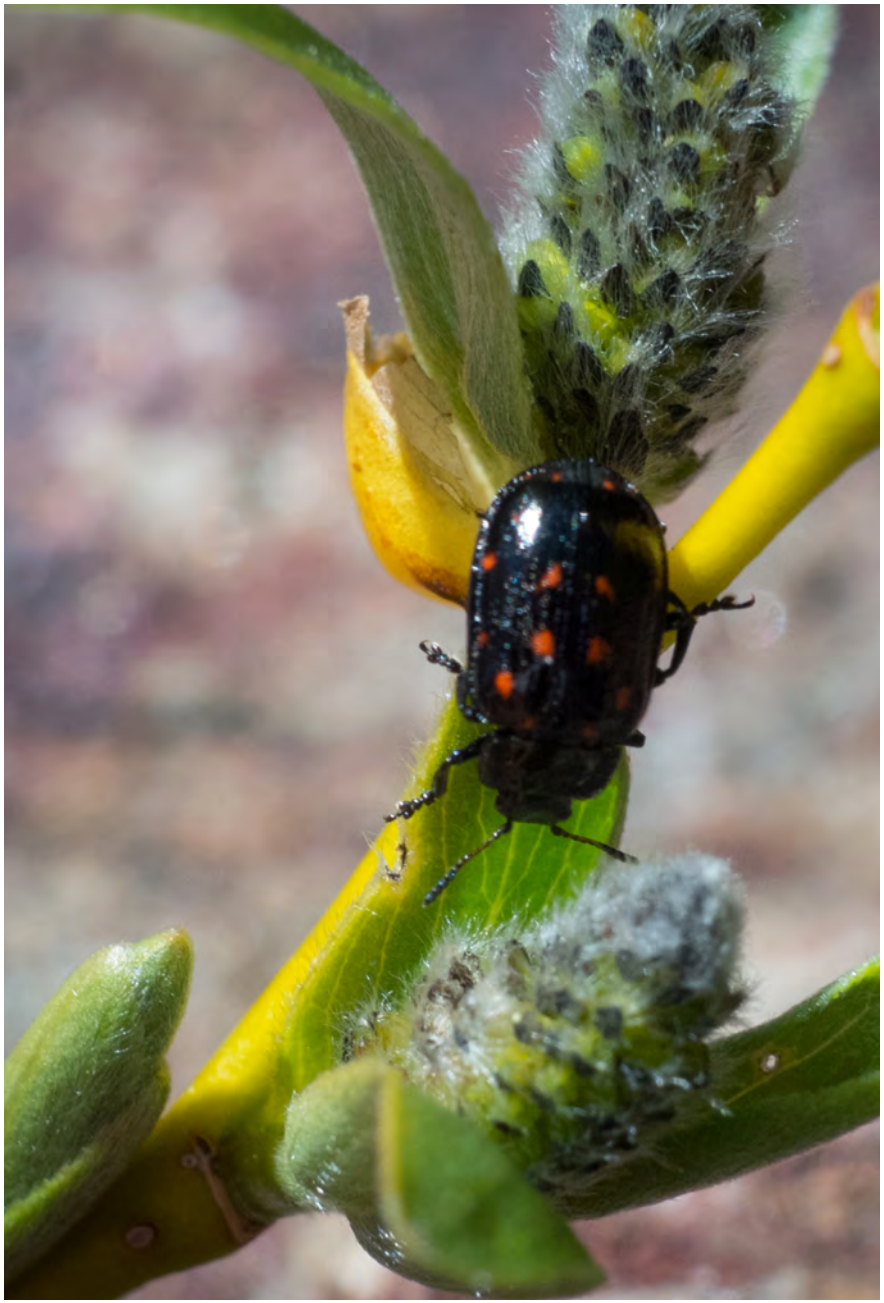
"I never would have imagined that I could ever have had a research paper published in a journal such as this," Apolinar said. "It's amazing to realize that I have contributed to the chemistry literature. It's something that can never be taken away, and it motivates me to want to publish more original work that can lead to other discoveries."

He should have plenty of opportunity. Apolinar is currently a National Science Foundation predoctoral fellow at Scripps Research. His goal is to become a process chemist in the pharmaceutical industry, breaking new ground in developing lifesaving drugs. In the summer of 2019, he spent 10 weeks interning with Janssen Research & Development's Discovery Process Chemistry Group, also in La Jolla.

Apolinar built a legacy as an undergraduate at CSUSM after graduating from San Marcos High School. He was selected as a California State University Program for Education and Research in Biotechnology (CSUPERB) Presidents' Commission Scholar in 2017. The program is aimed at increasing the number of undergraduate students who can access a full-time research experience, and it supports up to 11 CSU undergraduates each summer. He worked as an undergraduate research assistant in Dr. Iafe's laboratory his junior year. He was STEM Peer Educator at the CSUSM STEM Student Success Center. And he was chosen to take part in the first cohort of the TRIO McNair Scholar program, which is dedicated to boosting the number of low-income and first-generation college students who earn graduate degrees.

SONOMA

Located in Northern California's premier wine country, Sonoma State University is a small campus with big ideas. With a tradition of promoting intellectual and personal growth, leadership opportunities and technological proficiency, Sonoma State positively impacts student success and faculty excellence by providing opportunities to explore, investigate and solve the issues facing California's and the nation's diverse communities. Students collaborate with faculty researchers on cutting-edge projects, including sending satellites into space, joining professional archeologists in the field and creating new art and artistic performances.



SONOMA STATE AWARDED COLLABORATIVE GRANT TO CLOSE STEM EQUITY AND ACHIEVEMENT GAPS

Sonoma State chemistry professors Carmen Works and Jennifer Whiles Lillig are working with professors at three other colleges to create online transferable modules for gateway STEM courses that will be available to college faculty across California. The project looks to create more equitable and inclusive classrooms and combat evidence showing underrepresented students, such as women and students of color, leave science in greater numbers than majority students.

"Jenn and I are both very excited to do this meaningful work with great collaborators, especially Paul Daubenmire from College of Marin, for coordinating a dynamic team," Dr. Works said. "We have both spent almost two decades at SSU developing these types of learning and teaching approaches and feel grateful that our efforts have been recognized."

The online modules will focus on introductory-level STEM courses, specifically in chemistry. Dr. Works, Dr. Whiles Lillig and the six other co-principal investigators will develop modules and classroom strategies to engage underrepresented students and help increase their access to support networks. In addition, the team will create faculty development modules to educate chemistry faculty so that they foster student learning and a student's sense of belonging. The research phase of the project began in summer 2019, with the grant extending through June 2022.

EXPLORING EVOLUTION BY STUDYING BEETLES LIVING ON THE EDGE

Sonoma State professor Nathan Rank and Santa Clara University professor Elizabeth Dahlhoff, along with their collaborators and students, explore the evolutionary responses to environmental challenges by studying a beetle that lives two miles above sea level in the mountains of eastern California. That beetle, according to Dr. Rank, allows them to "study how natural populations of a native California insect cope with environmental stress in a region that is experiencing significant effects of changes in climate."

The researchers have identified in willow leaf beetles genes help the insects to process energy and cope with temperature stress. These genes "help them to survive and reproduce in a region with long winters and where annual fluctuations in rain, snow, and average temperature are high," Dr. Rank explained. "These findings are evidence that evolution is going on right before our eyes in a complex organism, not some single-celled bacterium in a petri dish. The implications here for scientific understanding of evolution and adaptation to climate change are profound."

Rank and Dahlhoff have methodically investigated the willow beetle for decades. He said: "Our most recent work shows that genes on the mitochondrion interact with genes from the nucleus to influence responses to environmental stress. It also appears that responses to low oxygen (hypoxia) interact with responses to stressful temperature to influence beetle populations in the wild. This has been a real surprise because, until now, most physiologists did not think a small insect would even be limited by low oxygen. Turns out, beetles are similar to humans in this respect—they can run out of breath at high elevation. Our current work aims to understand how populations survive both summer and winter thermal stress and environmental variation." They plan to investigate environmental stress factors on the beetle during severe winters, to look at how cold and energy stressors interact to shape the beetle's physiological performance during winter and the subsequent growing season. These studies are being conducted with Professor Caroline Williams at UC Berkeley, who is an expert on adaptation to winter in insects.

"We will complete our work on interacting stresses of temperature and oxygen supply on physiological and evolutionary responses to a changing environment," Rank said. The team's work on winter survival and responses to stress will be invaluable for studying environmental effects on population persistence. In other words, how does a population adapt and survive—and evolve—in the face of severe changes in climate? A beetle surviving at the limits of its environmental tolerance may offer us clues for how we can overcome challenges posed by the future climate.

SOUNDSCAPES TO LANDSCAPES: MONITORING ANIMAL BIODIVERSITY FROM SPACE WITH THE HELP OF CITIZEN SCIENTISTS

Sonoma State University Professor Matthew Clark leads a NASA-funded project to monitor bird diversity, with the help of collaborative researchers, students and volunteers known as "citizen scientists." The project, known as Soundscapes to Landscapes (S2L), relies on remote sensing, an important tool for long-term monitoring of biodiversity. S2L combines bioacoustic data collected by citizen scientists with satellite and environmental data to monitor bird diversity in Sonoma County, California.

S2L is using sound recordings collected by citizen scientists to map bird diversity across the region. The volunteers place low-cost, portable sound recorders, called AudioMoths, in various habitats in the county. The teams return to retrieve the recorders after two to five days and upload the "soundscape" recordings to a cloud-based bioacoustics platform called ARBIMON. Through a series of "bird blitzes," citizen scientists use a custom interface on ARBIMON to validate example birdcalls in a subset of the recordings. These validation data are then used to train a "deep learning" computer algorithm to identify bird species present in all field-site recordings.

The science team uses statistical modeling and satellite data to make maps of bird diversity based on the recordings collected by the citizen scientists. These maps are combined with habitat models

based on two of NASA's cutting-edge sensors: Global Ecosystem Dynamics Investigation (GEDI), a space-based lidar on the International Space Station, and a future satellite imaging spectrometer, called the Surface Biology and Geology mission, currently simulated from NASA's airborne visible/infrared imaging spectrometer (AVIRIS). Data collected from these sensors are used to understand species distribution and factors related to conserving bird diversity.

In the spring of 2019, the field campaign focused on surveying publicly owned properties with new research permits for Sonoma County Regional Parks, U.S. Fish and Wildlife Service and California State Parks. The project also obtained access to several larger private properties in the western area of Sonoma County and a large block of forest in the remote northwestern area of the county. Other volunteers participated through a "mail deploy" approach, in which landowners received AudioMoth recorders and instructions through the mail to deploy the unit on their property. Thirty-two citizen scientists participated in this activity. Collectively, volunteers spent 1,163 hours in the field.

Citizen scientists also helped identify, tag and validate birdcalls in recordings in organized "bird blitzes" or at home. These birdcalls will be used to sort through soundscape recordings and accurately identify target bird species at survey sites. As part of this process, collaborators at University of California, Merced (UCM) developed a prototype deep learning framework to identify bird species in noisy audio recordings. Because the field audio data were still being acquired and birdcalls validated for training, team member Shrishail Baligar at UCM downloaded a large dataset of birdcall audio files from the xeno-canto website to train and evaluate the prototype deep learning methods. The initial results were promising.

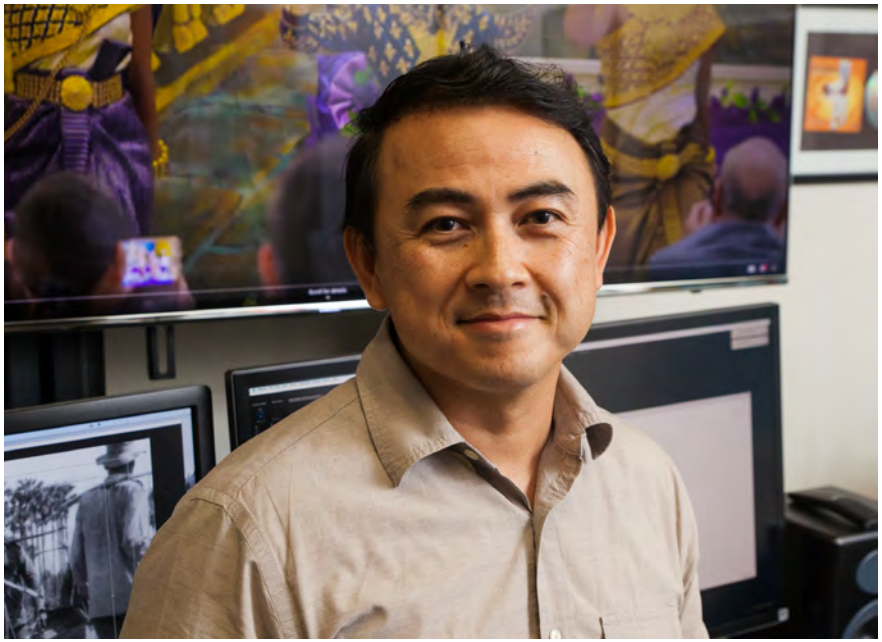
The in situ bird diversity data from field sites, as measured by bioacoustics, will be used with remote sensing, climate and other predictor variables in species distribution models (SDM) that estimate the probability of occupancy for a given bird species. During year one, collaborative researchers greatly improved the SDM code from the prototype phase to perform multiple machine learning models on a High-Performance Cluster (HPC) at Northern Arizona University. In an SDM analysis with simulated GEDI and existing bird diversity data (from online database eBird and the North American Breeding Bird Survey), the team found that canopy structure, as measured by GEDI, was the second-most important group of predictor variables, after climate predictors. Canopy structure was particularly important in predicting the occupancy of conifer forest birds.

The Soundscapes to Landscapes project is a partnership of the Center for Interdisciplinary Geospatial Analysis (CIGA) at Sonoma State, Point Blue Conservation Science, Audubon California, Pepperwood Preserve, Sonoma County Agricultural Preservation and Open Space District, Northern Arizona University, UC Merced and University of Edinburgh.

STANISLAUS

From first-generation college students and working parents to newcomers and multigeneration Californians, all are welcome at California State University, Stanislaus. Located in the heart of the Central Valley, the Stan State community embraces its rich diversity and strives to create an inclusive university experience where all can flourish.

Stan State is committed to academic excellence, personalized student learning and providing opportunities for the intellectual and cultural enrichment of the region.



STANISLAUS STATE ANNOUNCES PARTNERSHIP WITH NATIONAL AG SCIENCE CENTER

Stanislaus is the second-highest producing agriculture county in California, but the industry's bounty extends beyond the grapes, almonds and other crops that thrive in the valley's rich soil and dry heat.

Growing the understanding about the vast opportunities in the agriculture industry for students of all ages is behind the partnership between Stanislaus State and the Stanislaus County-based National Ag Science Center, which announced its alliance during a news conference last fall.

"So much of what we do at Stan State has relevance to the agriculture industry—be it in science, computer science, arts, behavioral health, public policy, etc.," said Dr. David Evans, dean of the College of Science at Stan State. "This partnership with the National Ag Science Center can help to bring attention to these cross-curricular relationships and will create new opportunities for the university to serve the agriculture community in our region."

The partnership gives the National Ag Science Center, founded in 1996, a greater platform from which to operate and qualifies the center for additional grant opportunities. Meanwhile Stan State increases its outreach in ag and STEM fields.

The ag science center's most prominent feature is its Ag in Motion mobile classroom, which made a stop at Stan State for the announcement.

Inside the movable feast are labs that 15,000 students—all seventh- and eighth-graders in Stanislaus County, south San Joaquin County and a portion of Merced County—experience throughout the school year.

Hands-on lab activities include "CSI Strawberry," where students extract DNA from one of the 200-seed pieces of fruit, and "Astronaut Farmer," where students determine whether crops can be grown on the moon. A microscope allows students to look at magnified bugs in the "Zombie Bug Lab."

"It's an amazing opportunity. I truly, truly love it," said Andres Dorado, a 2018 Stan State graduate who teaches the classes in Ag in Motion. "Most of these students don't have any experience or opportunity to perform hands-on experiences in their classrooms, because many of the schools I visit do not have actual laboratories. It's really nice giving these students the experience of learning about agriculture and science in a hands-on setting."

Stan State ag students visit third-grade classrooms of local schools as Ag Ambassadors, and Dr. Oluwarotimi Odeh, professor and Rolland Starn Endowed Chair in Agriculture, who oversees the program, embraces the partnership.

"The opportunity I see here is to ask questions about how to be more engaged," he said. "We need someone to work with them, to help them learn how to teach young kids in classrooms."

Further, the National Ag Science Center has built relationships with ag industry-related businesses, which Dr. Odeh said will benefit Stan State students.

"I see overlap, a lot of opportunity to work together," he said. "We can tap into resources they have, use connections they have already made."

USING FILM TO LEAD THE NEXT GENERATION OF ANTHROPOLOGY

The stories of people forced to move out of their home countries often focus on their gains and losses, of leaving behind belongings, careers and even family members for the promise of a new start in a new land.

Overlooked in many of these stories is an infinitely valuable item abandoned by many of these families—culture. Mexicans become Mexican Americans, those from Japan become Japanese Americans, and so on. But that doesn't mean cultural ties to their previous land have to be abandoned, and those in the Central Valley striving to keep the arts and ways of their native lands alive in the Central Valley are having their stories captured on film by Stanislaus State professor Steve Arounsack.

Dr. Arounsack, who earned his bachelor's degree at Stan State and returned as a lecturer in 2005, is gaining acclaim not only for his film work, but for sparking curiosity in students who take his courses and produce their own films in the university's Keck Visual Anthropology Lab.

"Some of our students have moved on to master's programs in visual anthropology and that's something that we're quite proud of since we're a smaller program," Dr. Arounsack said.

As he spoke in the lab, he gestured to the many colorful posters on the walls, each representing a film produced by one of his students.

"Despite being small, we're right up there with some of the top programs, having arguably one of the most advanced undergraduate visual anthropology labs in the state," he said. "And that's something we pride ourselves in—not just having the equipment that can get us the quality we aspire to have, but in the experiences we can foster and how we build bridges with the community. These are tools. It's not just about electronics in a room."

Arounsack's own film work in cultural anthropology is gaining nationwide attention for himself and for Stan State. In May, his documentary "Next Gen Asian American Art" was shown more than 500 times on PBS member stations across the country, and the equipment in the Keck Lab made it the first film sponsored by Sacramento PBS station KVIE completely shot in 4k.

The documentary explores how Asian Americans in the Central Valley use art to reveal and maintain their legacy as immigrants and to reshape tired narratives. It received a documentary fund award from the Center for Asian American Media.

Right now, visual anthropology is a single course at Stan State—not a program and not yet a concentration. Arounsack obviously would love to see the courses grow into a program, and in the meantime will be doing what he can to expose the region's students to the discipline, which in turn exposes the rich mosaic of the Central Valley region to the world.

"I just can't think of doing anything else other than using what I have and what I know to show kids a different path," he said. "I know what it's like to grow up in the valley, where some of the kids view the mountain ranges as restrictive. People don't leave and it's hard to leave."

"That first trip I took back to Laos got me hooked to seeing what the world is really like. It's important for me to be here to try to do something to prevent the brain drain. I'm back. I'm here. And I'm proud to be part of a culture of building."

STAN STATE STUDENT CREATES INTERACTIVE CATALOG OF 3,543 TREES ON CAMPUS

Overseeing 3,543 trees on a 228-acre college campus is a daunting task, but an interactive tree story map completed by Germán Silva during his senior year at Stanislaus State is helping university staff meet the challenge while serving as an educational tool for botany students.

"It was a complicated project, but very rewarding when the final product was completed," said Silva, now a graduate student at University of California, Santa Barbara, who developed the map using geographic information systems (GIS) technology as an intern in the Capital Planning and Facilities Management department. "In the beginning, I was barely introduced to web mapping. But once I had the web map created and linked to the database, and everything was functioning properly, it was very exciting."

The final map, posted on the Stan State website, shows an aerial photo of the campus with each tree clearly defined. When users select a tree, they can view pop-up boxes that contain the common name, Latin name, a photo, tree characteristics and other useful information. The only trees not on the map are those within a small teaching orchard near the Trans-California Pathway Project.

The electronic map is used regularly by facilities staff members who need an accurate tree inventory to manage the campus landscape. The map is also used by botany students working on tree identification, specimen preparation and DNA barcoding projects.

Silva is quick to share credit for the map with students who worked on it before he did. The map began in 2011 as a geography class project by alumnus Don Rajewich, who used GIS to catalog and record the locations of the majority of campus trees and create a paper map. In 2016, the map and tree catalog were updated and expanded by alumnus Juan Gutierrez, who preceded Silva as a facilities intern.

When Silva started his internship in June 2017, the paper map had been scanned as a PDF and stored electronically, but it wasn't accessible to people with visual access needs.

"I told Germán we really needed to come up with something accessible," said Mary Van Eyk, a specialist in the facilities department. "And Germán said, 'I just saw something that might be the answer.' He made a presentation of what he envisioned with examples of similar projects, and it went from there."

Silva proposed an online, interactive map that could be posted on the Stan State website and would be compatible with the screen reading software used by people who have visual access needs.

While planning the map's design, Silva expanded the original tree list into a detailed database and, in the process, he learned a lot about trees.

"It had to be a project of patience for Germán because you can't identify some of the trees until they are blossoming," said Julia Reynoso de Valadez, director of Capital Planning and Finance. That meant Silva had to wait for some trees to blossom so that he could collect flowers to make accurate identifications.

Silva worked with Stuart Wooley, professor of botany, and Andrew Gardner, assistant professor of botany, to ensure that he identified the trees correctly.

He is planning on a career in coastal or forest management and sees the map project as an important component in his portfolio since it shows he already has valuable skills and experience in managing natural resources.

"That is exactly what we are hoping to accomplish with this internship program," Reynoso de Valadez said. "The program has the dual purpose of fulfilling a campus facility need and helping the progress of our students."

The secret is out about CSU research, scholarship and creative activity! I hope you enjoyed reading about the many ways the CSU is helping to transform tomorrow.

This booklet highlights a tapestry of stories, but the running thread throughout them is the singular focus on our university's mission to advance student success and equity, enhance faculty excellence and address the pressing needs facing California and its diverse communities. Never has the need been more pronounced for CSU to continue to reimagine research and provide experiential opportunities for students as we negotiate the challenges related to the COVID-19 pandemic.

The story of Sara Toyloy at the beginning of this booklet demonstrates the power that CSU graduates have in shaping our future. Sara reflects on her journey from CSU East Bay student to president of a leading medical device and clinical consulting company. She and many other alumni like her credit the experiential learning opportunities at the CSU and the faculty and staff who mentored them.

Research, scholarship and creative activities are intrinsic and distinctive to the CSU. These hands-on learning opportunities provide a high-quality education where students can engage with course content, develop and test hypotheses and push boundaries.

The CSU's impact on California is evident through the work of our 10 multicampus affinity groups. Last year, the CSU launched a multicampus consortium that connects all 23 campuses in STEM education and research. CSU affinity groups address the most vital needs facing California by conducting research on a breadth of topics, from agriculture and biotechnology to ocean and desert life.

The wide range of topics in this booklet includes innovative astrophysics research using a gamma-ray telescope and big data science research to explore epidemiologic and neuroimaging data for disease prevention. Other stories highlight practical projects that benefit California agriculture through automation in the strawberry industry and improve California's transportation infrastructure by aerial mapping using unmanned air vehicles. Many campuses and multicampus consortia are also involved in ocean health and climate change research, addressing the marine environment by improved ballast water management systems. Creative and social change research includes improvisation theater experimentation, education for social change and social innovation labs. Finally, our faculty members are also reimagining the experiential component to include virtual and augmented reality options. Our research, scholarship and creative activity efforts are supported through external grants, contracts and awards. In 2018-19, the CSU research expenditures of external funding totaled nearly $676 million, an increase of nearly $100 million over four years.

Through research, CSU students and faculty are advancing our understanding of the world while meeting the needs of California and beyond. As we work to achieve our student success goals, particularly our goals to close equity gaps, we must continue to actively support student participation in these activities.

I am grateful to Chancellor Timothy P. White and Executive Vice Chancellor Loren Blanchard. They are tremendous champions of research and encouraged us to demonstrate the impact of CSU research. I also thank the campus presidents, provosts, chief research officers, affinity group directors and the production team for realizing this vision.

I invite you to stay abreast of research developments at **calstate.edu/impact-of-the-csu/research.**

Ganesh Raman
Assistant Vice Chancellor for Research

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  Assistant Vice Chancellor for Research
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