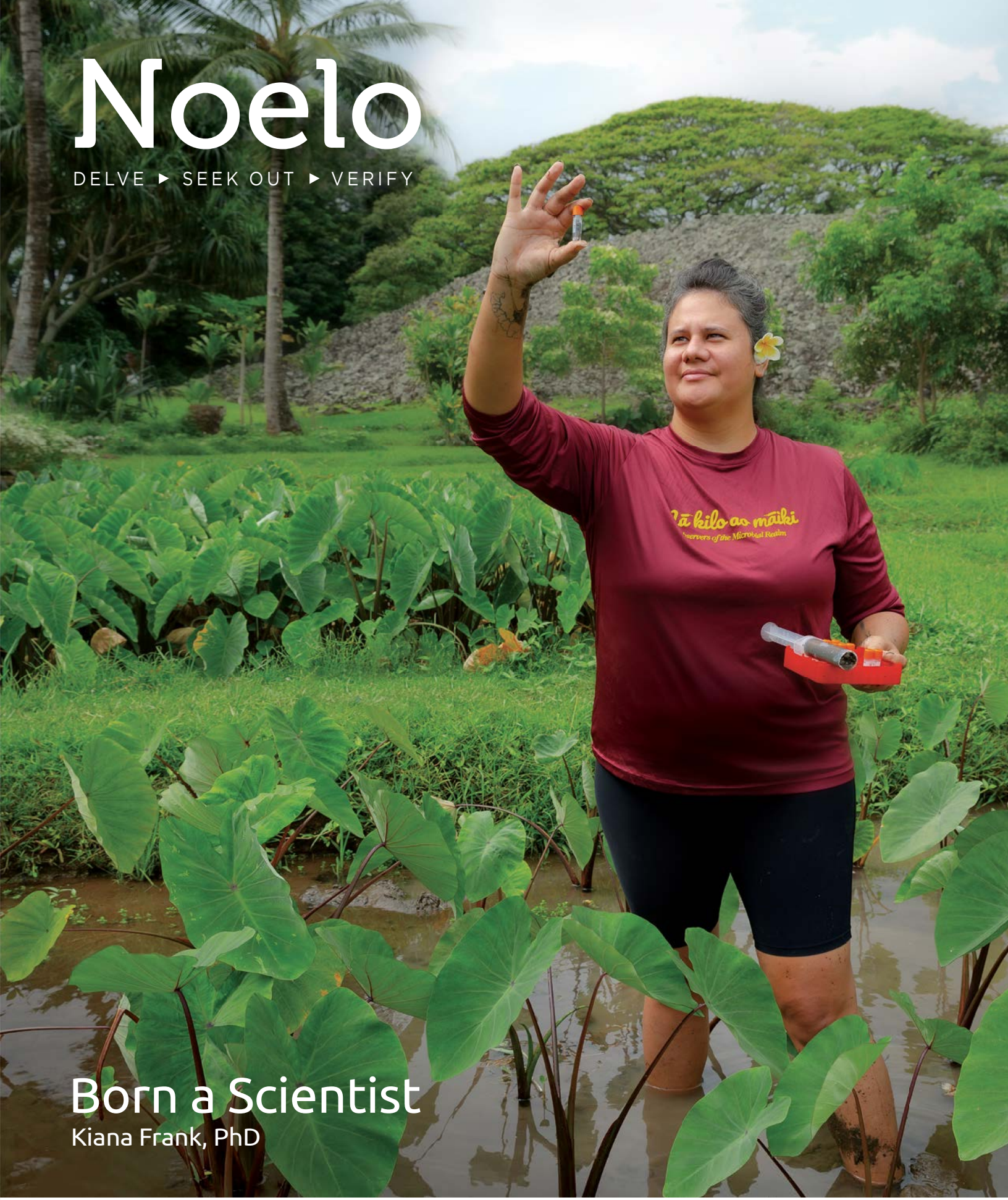
Noelo

DELVE ▸ SEEK OUT ▸ VERIFY



Born a Scientist

Kiana Frank, PhD

RESEARCH AND INNOVATION AT THE UNIVERSITY OF HAWAIʻI - 2023

UNIVERSITY of HAWAIʻI® SYSTEM


Delve. Seek. Verify.

University of Hawai‘i System

David Lassner, PhD
President

Vassilis L. Syrmos, PhD
Vice President for Research and Innovation

***NOELO,* WHICH MEANS "TO DELVE, SEEK OUT OR VERIFY" IN HAWAIIAN, IS THE RESEARCH MAGAZINE OF THE UNIVERSITY OF HAWAI‘I SYSTEM PUBLISHED ANNUALLY BY THE OFFICE OF THE VICE PRESIDENT FOR RESEARCH AND INNOVATION.**

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(Facing page)
A chemical sensor is printed onto a 3D-printed ring using high-precision hybrid electronics developed by the Ray Research Group

For an island state like Hawai‘i, which imports about 90 percent of its supplies, food and energy security is paramount. But it wasn't always this way, as the land and sea once provided an abundance of food for a pre-contact Native Hawaiian population that was estimated to be as high as one million inhabitants, as compared to the state's current population of 1.4 million today.

Responding to threats on our food system from increased demand, unsustainable modern food production, world conflict, overdevelopment and environmental changes due to global warming, researchers at the University of Hawai‘i (UH) are viewing their research through a uniquely different lens. Equipped with a deeper understanding and a relationship with place, as practiced by Native Hawaiian kupuna (ancestors), our researchers are incorporating indigenous innovation and knowledge with contemporary science to develop sustainable solutions and healthy communities not only in Hawai‘i, but throughout the world.

As a part of this effort, the National Science Foundation (NSF) recently awarded UH a $1 million grant to establish the Climate-Resilient Food Innovation Network, a first-of-its-kind multidisciplinary, multi-organization hub that will serve Hawai‘i and the U.S.-Affiliated Pacific Islands. With the initial award, UH could be eligible in two years to receive an additional $160 million from NSF to continue this important initiative.

Unfortunately, the issue of being an island state does not end at food security. With a lack of indigenous fossil fuel resources, Hawai‘i must rely on costly imports of oil and gas to keep the state powered. Although renewable energy such as solar and wind are making significant headway, they still remain intermittent and unreliable. As such, UH researchers continue to investigate the viability of hydrogen as a clean, low cost and reliable energy alternative.

Hawai‘i's geographic isolation also leads to health equity issues in medical care, especially for patients requiring advanced cancer treatments. For many residents, long trips to cancer centers on the U.S. mainland are beyond reach due to high costs and other significant factors. Our new director of the UH Cancer Center is looking to change that with more clinical trials, forging stronger ties with the major healthcare systems, improving cancer care and treatment among physicians through the development of an oncology fellowship program, and of course, putting an end to this horrible disease.

In the following pages, I urge you to take a look at our body of work captured in the pages of *Noelo,* and experience how our research and innovation makes the University of Hawai‘i—like no place else on Earth.

Vassilis L. Syrmos, PhD
Vice President for Research and Innovation
University of Hawai‘i System

In This Issue

COVER: *Kiana Frank at Ulupō Heiau, supports the restoration of ʻāina by observing the realm of microorganisms*

"Through the blueprint established through the sweatainer and other technologies like wearable ring sensors, we are hopeful that this will continue to drive innovation to create a future where personal health monitoring is more accessible, convenient, and insightful."

TYLER RAY

Sweating it Out

CREATING ADVANCED SENSORS THROUGH ADDITIVE MANUFACTURING

WORKING UP A GOOD SWEAT DURING EXERCISE IS A GREAT WAY TO STAY HEALTHY and provides a sense of accomplishment. However, most people are unaware that sweat also holds vital information about human health, providing clues to dehydration, fatigue, blood sugar levels and even serious conditions such as cystic fibrosis, diabetes and heart failure.

Because of the numerous health signatures that can be obtained from sweat, Mechanical Engineering Assistant Professor Tyler Ray from University of Hawai'i at Mānoa College of Engineering and his student researchers have developed an innovative 3D-printed wearable sweat sensor called the "sweatainer," which represents a giant leap forward in sweat analysis.

"The sweatainer is a small, wearable device similar in size to a child's sticker that collects and analyzes sweat, offering a glimpse into the future of health monitoring," said Ray, a leading researcher in the field of additive manufacturing (3D printing), with a particular emphasis in healthcare. "By incorporating various sensors, the sweatainer can analyze sweat in a mode similar to previous wearable sweat-sensing systems."

Efficiency and cost-effectiveness are the advantages of Ray's device. Traditional methods for sweat collection use absorbent pads or microbore tubes pressed against the epidermis using bands or straps to capture sweat as it emerges from the skin. These techniques require trained personnel, special handling and costly laboratory equipment. The recent emergence of wearable sweat sensors has addressed some of these challenges, but these devices still remain single-use.

A unique feature of the sweatainer is its "multi-draw" sweat collection method, which allows for the collection of multiple, separate sweat samples for analysis either directly on the device or sent to a lab. Inspired by the vacutainer used in clinical blood sampling, this advancement not only makes sweat collection more efficient, but also opens up new possibilities for at-home testing, storing samples for future research, and integrating with existing health monitoring methods.

ABOVE: *A Ray Research Group high-precision 3D-printer fabricates the electrical circuitry of a wearable sensor*

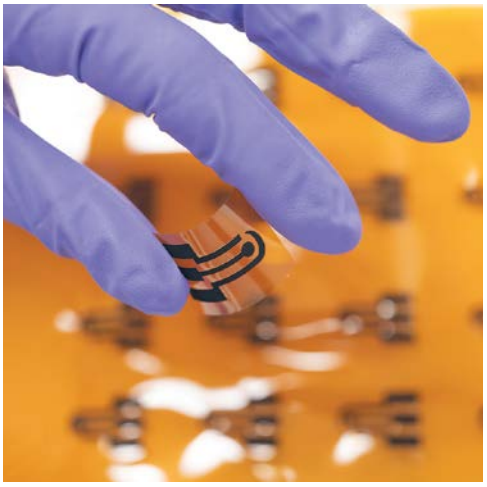
(Facing page)

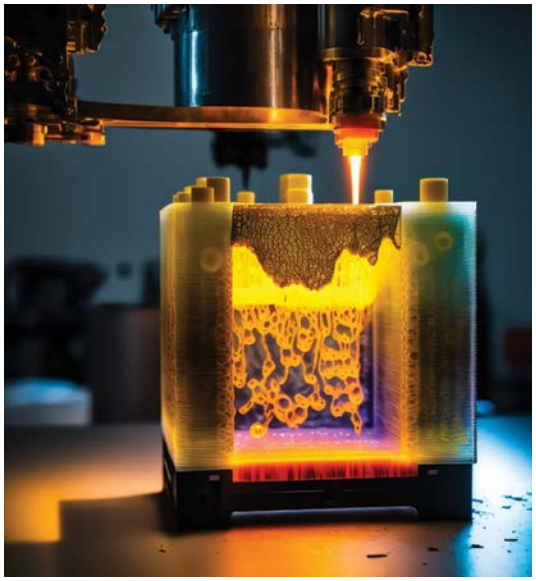
LEFT TOP: *A 3D-printed epidermal microfluidic device "sweatainer"*

LEFT MIDDLE: *An example of one of the flexible sensors created the Ray Research Group*

LEFT BOTTOM: *Ray consults with Patents2Products Postdoctoral Fellow Kaylee Clark as she characterizes the performance of a 3D-printed biosensor*

RIGHT: *An artistic rendering of a battery fabricated by a 3D printer*





"3D printing enables an entirely new design mode for wearable sweat sensors by allowing us to create fluidic networks and features with unprecedented complexity," said Ray. "Through the blueprint established through the sweatainer and other technologies like wearable ring sensors, we are hopeful that this will continue to drive innovation to create a future where personal health monitoring is more accessible, convenient, and insightful."

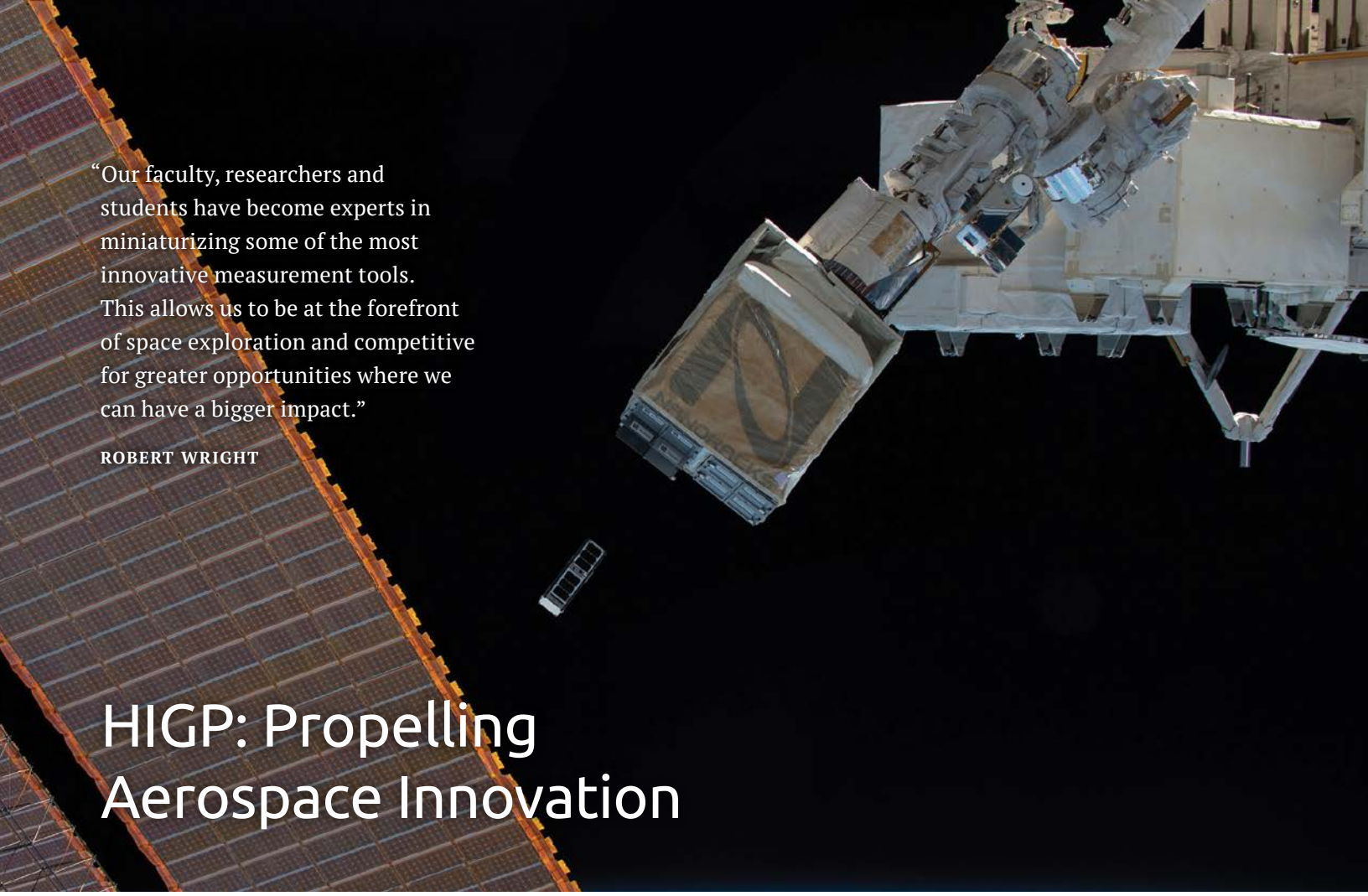
In 2021, Ray and researchers from Northwestern University developed a cutting-edge skin-mounted sticker to diagnose cystic fibrosis, one of the most common life-shortening genetic disorders. The novel wearable device absorbs sweat and then provides a simple, accurate diagnosis within minutes using a color changing sensor.

The concentration of chloride in sweat is the most robust biomarker for a positive diagnosis of cystic fibrosis. Previous leading methods used a hard, rigid, wrist-strapped device. Ray's research team developed a soft, flexible sweat sensor that is both comfortable and imperceptible to the wearer, enabling the sticker to collect 33 percent more sweat than the current clinical method and ensuring that one test will consistently provide a sufficient sample for an accurate diagnostic result.

The sticker also incorporates built-in colorimetric sensors that detect and measure the chloride concentration using a smartphone camera in real-time. This integrated analytical capability eliminates the need for expensive laboratory equipment and lengthy, emotionally challenging wait times. This opens the possibility for testing in locations lacking access to certified cystic fibrosis testing facilities, as is the case for most Hawai'i residents.

In 2022, Ray received a two-year, $237,916 grant from the National Science Foundation (NSF) to explore innovative fabrication techniques to create high-capacity batteries in many different areas, including healthcare. With this grant, Ray aims to address the challenges currently faced in the production of silicon nanoparticle electrodes, a promising material for high-capacity batteries with applications in industries such as electric vehicles, power systems and medical devices. The project seeks to develop a scalable and robust method of manufacturing silicon nanoparticle electrodes, with the ultimate goal of advancing battery technology through the use of additive manufacturing. Ray will work closely with Distinguished Professor Ram Seshadri at the NSF-supported Materials Research Laboratory at the University of California, Santa Barbara, one of the top five materials research facilities in the world.

Last summer, Ray became the first researcher from Hawai'i to participate in the 28-year history of the National Academy of Engineering's The Grainger Foundation Frontiers of Engineering program. In June of this year, Ray received the prestigious NSF Career Award for his work in additive manufacturing, becoming the first faculty member from UH Mānoa's College of Engineering to receive this honor since 2016.



"Our faculty, researchers and students have become experts in miniaturizing some of the most innovative measurement tools. This allows us to be at the forefront of space exploration and competitive for greater opportunities where we can have a bigger impact."

ROBERT WRIGHT

HIGP: Propelling Aerospace Innovation

FROM BEING ABLE TO PREDICT VOLCANIC ERUPTIONS IN ORBIT, to analyzing soil composition from space, to detecting extraterrestrial life and improving space mission integration, the Hawai'i Institute of Geophysics and Planetology (HIGP) at the University of Hawai'i at Mānoa (UH Mānoa) has become a major player in advancing space exploration.

Renowned for its expertise in earth and planetary science, HIGP bridges science and engineering, replicating the successful science-technology synergy that national laboratories like the National Aeronautics and Space Administration's (NASA) Jet-Propulsion Laboratory (JPL) have created to pioneer aerospace research, analysis and cutting-edge technologies.

Every year, HIGP brings in nearly $7 million for space-science initiatives through lucrative grants from agencies such as NASA, the Department of Defense and National Science Foundation – approximately half of which are dedicated to instrumentation development.

"Designing scientific measuring instruments is not necessarily difficult, but producing instruments that can take accurate measurements from a spacecraft, where size, weight, power and environment are an issue, is," said Robert Wright, HIGP director. "Our faculty, researchers and students have become experts in miniaturizing some of the most innovative measurement tools. This allows us to be at the forefront of space exploration and competitive for greater opportunities where we can have a bigger impact."

Developing World-Class Technologies

The centerpiece of HIGP's space science initiatives is the Hawai'i Space Flight Laboratory (HSFL), a multidisciplinary research and education center formed in collaboration with UH Mānoa's School of Ocean and Earth Science and Technology and the College of Engineering.

Established in 2007, HSFL's reputation and resources skyrocketed after leading the state's first and only rocket launch in 2015, which allowed it to design and build world-class facilities with state-of-the-art equipment including: clean rooms; thermal vacuum chamber; vibration table; and an attitude determination and control testbed simulator.

These resources have helped HIGP design, build, test and operate world-class space instrumentation.

Since then, HIGP has developed a string of successful NASA-funded technology develop-

TOP: *NEUTRON-1 CubeSat launches from the International Space Station*

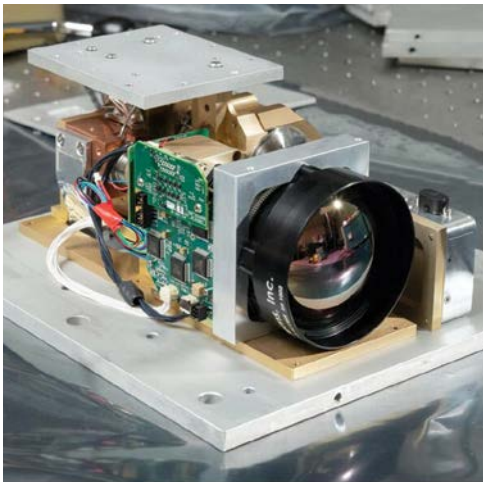
BOTTOM: *HIGP Director Robert Wright*

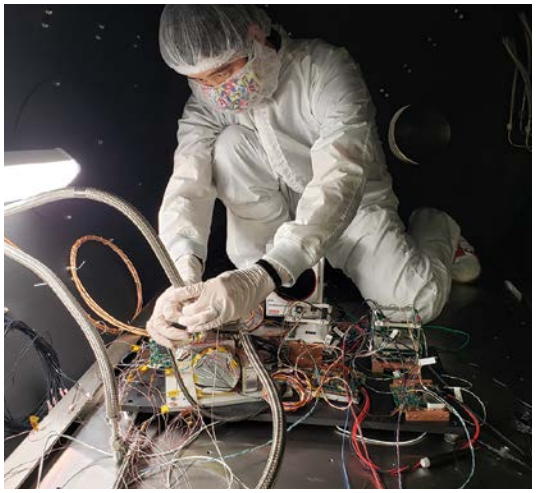
(Facing page)

TOP LEFT: *Hawai'i's first rocket launch from Pacific Missile Range Facility on Kaua'i*

BOTTOM LEFT: *Hyperspectral Thermal Imager (HyTI) technology*

RIGHT: *Mechanical Engineer Lance Yoneshige sets up the HyTI payload for testing in HSFL's thermal vacuum chamber*





ment projects in collaboration with its Spectral Technology Group and Infrared and Raman Spectroscopy Laboratory, including the Airborne Hyperspectral Imager, the Hyperspectral Thermal Imager (HyTI), Thermal Infrared Compact Imaging Spectrometer (TIRCIS), and the Miniature Infrared Detector for Atmospheric Sciences.

The compact spectroscopic technologies use interference phenomenon to measure long-wave infrared spectral radiance data (between 8-11 microns) to remotely identify and characterize the chemical composition of solids, gases and liquids. The key technology was developed by HIGP faculty member Paul Lucey, and is used under license by local technology company, Spectrum Photonics.

In addition to measurement tools, HSFL has developed a Comprehensive Open-architecture Solution for Mission Operations System (COSMOS) that provides integrated flight software, ground station and mission operations for small satellites. Funded by NASA's Space Grant and Established Program to Stimulate Competitive Research, COSMOS proved its success on the NEUTRON-1 CubeSat and is now an integral part of all HSFL missions.

New Flagship Project

Due to its launch expertise, HSFL secured an $8 million technology demonstration mission funded by the NASA Earth Science Technology Office's competitive In-Space Validation of Earth Science Technologies program, one of only 15 awarded since 2012.

The flagship HSFL project led by Wright features HSFL's HyTI, a high-performance successor of its Space Ultra-Compact Hyperspectral Interferometer and TIRCIS technologies, in a 6U CubeSat (nanosatellite). The instrument uses a Fabry-Perot interferometer which splits light emitted by the materials that make up Earth's surface and atmosphere, and from an orbit 400 km above Earth's surface will allow HyTI to measure the chemical composition of gases, rocks, and soils based on their unique 'spectral fingerprints.'

Built without any moving parts that can be damaged during launch, HyTI will deliver spatial resolution or image quality similar to the Landsat 9 satellite, currently the only U.S. satellite operating to observe the Earth's surface. HyTI will offer even higher spectral resolution—which will help to identify and characterize materials and objects – greatly advancing the ability to study Earth system processes and broader applications.

"This technology demonstration mission is designed to be a pathfinder for a potential future science mission to show the capabilities and potential of HyTI," said Wright. "As a CubeSat, HyTI is designed to work in constellations of 25-30 HyTIs during a larger science mission, which could then monitor volcanic gasses to predict eruptions or map soil moisture to aid crop management."

HyTI will be delivered to NASA at the end of 2023, and will be launched on a Falcon 9 rocket as part of the SpaceX SpX-30 mission in early 2024. Advanced on-board computing will enable scientists to quickly access and analyze extremely high volumes of data.

HSFL recently received $2.5 million to work with Utah State University and NASA's JPL to build a larger version for a 16U CubeSat and secured funding from a private company to see whether the HyTI instrument can be flown on other types of spacecraft.

Growing Application and Impact

As U.S. Space Policy Directives focus on sending astronauts back to the Moon and eventually Mars, there is an ever-increasing demand to search for organic matter and other signs of life.

Because of HIGP's interdisciplinary expertise, it can provide dual-use opportunities for many of its innovations like its Compact Color Biofinder. The biological sensing fluorescence imaging instrument, developed by HIGP Researcher Anupam Misra, can rapidly and accurately locate and characterize minute organic material among rocks and minerals from a distance. Having detected residues of biological materials up to 50 million years old, the first-of-its-kind device offers game-changing opportunities for future NASA missions.

"As an Organized Research Unit, our students are able to learn from scientists internationally recognized for their contributions in earth and planetary science," said Wright. "Our research is world-class and laser-focused on STEM disciplines and highly relevant to current and future local and global issues."

NSF Director Visits UH

"The National Science Foundation essentially is responsible for unleashing great ideas and talent all across our nation, and in the state of Hawai'i, there is tremendous talent and ideas."

SETHURAMAN PANCHANATHAN

AFTER RECEIVING MORE THAN $427 MILLION FROM THE NATIONAL SCIENCE FOUNDATION (NSF) over at 10-year period from fiscal year 2012 through 2021, the University of Hawai'i (UH) has caught the attention of both the NSF and its Director Sethuraman Panchanathan. So much so, that Panchanathan paid a visit to the flagship University of Hawai'i at Mānoa (UH Mānoa) campus last August to learn more about the world-class, cutting-edge research being conducted by faculty and students throughout the UH System.

In FY 2021, UH was among the top 50 institutions receiving the most funding from NSF, notably ranking higher than Harvard University and Duke University. Panchanathan offered high praise to UH's research efforts.

"The National Science Foundation essentially is responsible for unleashing great ideas and talent all across our nation, and in the state of Hawai'i, there is tremendous talent and ideas," said Panchanathan. "There is also amazing context. If you look at the domain of sustainability, or if you want to understand climate and oceanography, and understanding astronomy, here is a place that is a living laboratory. …The University of Hawai'i and other institutions in the islands are doing a fantastic job."

During the whirlwind half-day visit, Panchanathan had a chance chat with faculty and students over lunch and got a closer look at some of UH's outstanding NSF-funded research programs they represented through special presentations, which included:

Marine Sciences at UH, Center for Microbial Oceanography: Research and Education

David Karl
Professor
School of Ocean and Earth Science and Technology (SOEST), UH Mānoa

Hawai'i Ocean Time Series

Angelicque White
Professor
SOEST, UH Mānoa

Established Program to Stimulate Competitive Research (EPSCoR)/Change Hawai'i: Harnessing the Data Revolution for Island Resilience

Gwen Jacobs
Hawai'i EPSCoR Director
UH System

Jason Leigh
Professor/Director
Laboratory for Advanced Visualizations and Applications, UH Mānoa

NSF CAREER: Soil Pedogenesis, Agroecology, and Their Interactions

Noa Lincoln
Assistant Professor
College of Tropical Agriculture and Human Resources (CTAHR), UH Mānoa

Ola I Ka Aina: Revolving Ecosystems Utilizing Science, Math and Indigenous Knowledge

Esther Widiasih
Associate Professor
Mathematics, Natural and Health Sciences
UH West 'Oahu

Hoomalu Halelea: Community led Innovation for Integrated Flood Resilience

Mehana Vaughan
Associate Professor
CTAHR, UH Mānoa

Shortly after Panchanathan's visit, UH received word that it was selected as part of a $1 million award with seven other western region universities to launch an NSF Innovation Corps Hub that will help to convert research into real-world solutions that have public impact. Then in May 2023, UH was awarded another $1 million under the NSF Engines Development Award: Advancing Climate Resilient Food Innovations (HI, USAPI) to develop a regional innovation engine to facilitate climate resilient food systems in agriculture, fisheries and aquaculture.

"We are grateful that the National Science Foundation awards an average of more than $42 million annually to UH research projects over the past 10 years," said Vassilis L. Syrmos, UH vice president for research and innovation. "This is validation to the high quality of research being conducted throughout the UH System and true testament to outstanding efforts of our world-class faculty, students and staff."

"Integrating indigenous knowledge systems with western methodologies is fundamental to our approach to developing holistic and sustainable food systems and transformative economic opportunities."

ERIK FRANKLIN

UH to Spearhead Climate-Resilient Food Innovation Effort in the Pacific

OVER THE NEXT TWO YEARS, THE UNIVERSITY OF HAWAIʻI (UH) PLANS TO ESTABLISH a first-of-its-kind Climate-Resilient Food Innovation Network (CliRFIN)—a hub for Hawaiʻi and U.S-Affiliated Pacific Islands (USAPI) to develop collaborative and innovative solutions to mitigate climate change impacts on food security.

The initiative is made possible by a $1-million National Science Foundation Regional Innovation Engines (NSF Engines) Development Award, a new program that aims to help partners create economic, societal and technological opportunities for their regions. With the award, UH is eligible to compete for a subsequent award of up to $160 million.

"To build a collaborative regional network to provide innovative solutions to global issues like food insecurity due to climate change," said Vassilis L. Syrmos, UH vice president for research and innovation. "Through our efforts, we hope to serve as a global leader in identifying and developing scalable, climate-resilient food systems that are reflective of a region's culture and environment."

Over the next two years, CliRFIN will focus on building an organizational structure and strategy, including identifying partnerships, resources and initiatives to expand workforce development and commercialization opportunities throughout the region.

The initiative's long-term goal is to facilitate the commercialization and scaling of novel, climate-resilient food products, methods and technologies in agriculture, fisheries and aquaculture, through indigenous and modern research.

"Integrating indigenous knowledge systems with western methodologies is fundamental to our approach to developing holistic and sustainable food systems and transformative economic opportunities," said Erik Franklin, CliRFIN's director and fisheries team leader. "In establishing inclusive principles and equitable practices, we hope to broaden engagement and participation of underserved and underrepresented populations throughout the Pacific to create more diverse and effective opportunities for identifying problems and solutions."

The UH Office of the Vice President for Research and Innovation will provide leadership support to CliRFIN, which includes the University of Hawaiʻi at Mānoa's School of Ocean & Earth Science and Technology, College of Tropical Agriculture and Human Resources, Hawaiʻi Sea Grant, and the College of Engineering.

The initiative will also bring together the skills and expertise of a diverse group of innovators and entrepreneurs from different industries, governments, small businesses and venture capitalists including: East-West Center; Elemental Excelerator; HATCH; Hawaiʻi Good Food Alliance; Hawaii Technology Development Corporation; Natural Energy Lab of Hawaiʻi Authority; Office of the Governor, State of Hawaiʻi; Pacific Disaster Center Global; Hawaiʻi ʻUlu Cooperative; and the University of Guam. CliRFIN will also engage a collective of 18 Minority Serving Institutions for Native Hawaiians, Asian Americans and residents of the USAI.

For more on CliRFIN, visit: research.hawaii.edu/clirfin/

ABOVE: *He'eia Fishpond, O'ahu*
CREDIT: KELI'I KOTUBETEY/PAEPAE O HE'EIA

ʻIole

A LIVING SCIENTIFIC LABORATORY

THE COVID-19 PANDEMIC. A DOCKWORKER STRIKE ON THE WEST COAST. SUPPLY CHAIN ISSUES. THE WAR IN UKRAINE. Because Hawai'i imports about 90 percent of its food supply, these global events have caused shortages that have exposed the state's vulnerability to situations often beyond its control.

To address this vital issue of sustenance, the University of Hawai'i (UH) and other stakeholders are now taking a hard look into incorporating contemporary science with sustainable practices of the past to help provide solutions to food and energy security, for the state and beyond. As a result, UH has partnered with ʻIole, a non-profit place-based research center and living scientific laboratory on Hawai'i Island that is gathering academic experts, Native Hawaiian practitioners, community members, students and government representatives to develop sustainability solutions based on ancestral knowledge and indigenous practices.

Located on approximately 2,400 acres in the historic community of Kohala, the ʻIole *ahupua'a* (self-sustaining sections of land that run from mountain to the sea) was gifted to the Hawai'i Community Foundation (HCF) 2021 by longtime stewards, the Kohala Institute and the New Moon Foundation, in an effort to increase capacity to the area's restoration. To help carry out its mission, HCF partnered with UH and Arizona State University to leverage their expertise and resources in three focus areas: energy security, food security and place-based learning. All three entities have committed to jointly identifying opportunities for extramural funding to advance ʻIole's mission.

The guiding principle of ʻIole is based on the Native Hawaiian sense of shared responsibility to care for, learn from, and thrive off of the ahupua'a. In addition to its restoration and cultivation of the ahupua'a, ʻIole will look to develop solutions-based sustainability models that can be appropriately scaled and replicated in other parts of the world.

"We are all excited at this opportunity to collaboratively envision and create a 21st century ahupua'a," said UH President David Lassner. "'Iole can be a place grounded in Hawaiian values and knowledge where we are jointly committed to the innovation and courage necessary to integrate traditional and modern ways of learning, doing and living."

One of the first priorities of ʻIole was to assess and inventory the critical natural resources found throughout the ʻIole ahupua'a. The findings helped to establish the foundation of ʻIole's strategy and engagement, *He Le Aloha no ʻIole,* which was crafted by Sharon Ziegler-Chong, director of Research & Community Partnerships at University of Hawai'i at Hilo (UH Hilo) and Kamuela Enos, director of the UH Office of Indigenous Knowledge and Innovation. The wide range of multi-disciplinary research projects are being spearheaded by UH Hilo with a commitment to the project's goal:

Identify how twenty-first-century iterations of pre-contact indigenous governance of ahupua'a systems can be restored in partnership with community, regional students, and external partners. Work will be woven together like a lei of aloha for the land, for the ancestors of the land, for the community, starting with ʻIole, extending outward to Kohala, West Hawai'i Island and beyond.

Map of historic buried taro fields at ʻIole
CREDIT: BOB ENDRESON

ʻIole team members assess the mauka pasture formerly known as Kohala Sugar Company's ʻIole Field 10
CREDIT: SHARON ZIEGLER-CHONG

Partially restored gulch pond field

While Enos noted that there has been a long and storied history of ahupua'a restoration efforts around the state, he has not seen this kind of high level of support from foundations and institutions of higher education before for a specific valley. "The value proposition here is that we have a real opportunity with an intact valley to create a world-class facility to show the importance of traditional practices not just as culture, but as deep scientific regenerative biosystems management," said Enos. "To restore the valley, to center our work in empowering Kohala youth in process of learning, and to support the development of future scientist practitioners both *kanaka* (Native Hawaiian) and *kama'āina* (Hawai'i resident)—offers a unique opportunity and responsibility for UH to hold in this consortium."

Earlier, HCF announced that it has engaged additional local organizations, including Kamehameha Schools and Hawaiian Electric Industries, which are directly interested and impacted by 'Iole's focus areas.

"As the university on and of Hawai'i Island, we are a grateful member of the 'Iole *'ohana* (family)," said UH Hilo Chancellor Bonnie Irwin. "The work provides excellent research and learning experiences for our faculty and students, and just as important, this work provides them with an opportunity to give back to the island we call home."

BACKGROUND IMAGE: *A view of 'Iole from Kauhola Point*
CREDIT: BRUCE MATHEWS

ABOVE: *'Iole team members review the Kohala Sugar Company's last plantation field map printed in 1963*
CREDIT: SHARON ZEIGLER-CHONG

'Iole Projects Led by UH Hilo

VISUALIZATION

LEAD: Associate Professor Ryan Perroy, Geography

GOAL: Create a baseline geodatabase for the 'Iole ahupua'a to serve as a resource for managers, researchers, students, and the community. This geodatabase can be used to better understand and quantify spatial change over time, to inform management and research projects, and as an educational and visualization tool for the ahupua'a.

BASELINE SENSORS

LEAD: Professor Patrick Hart, Biology

GOAL: To understand the current distribution and abundance of birds and bats across the ahupua'a

ASSESSING SOIL/VEGETATION HEALTH

LEAD: Instructor Nicholas Krueger and Professor Bruce Mathews, College of Agriculture, Forestry and Natural Resource Management

GOAL: A quantitative understanding of the area's soil characteristics is needed in order to determine the best land management practices and uses possible to restore the ahupua'a.

RECONSTRUCTING THE PAST

LEAD: Professor Peter Mills, Anthropology

GOAL: Understand the historical ecology of North Kohala

KAI (SEA) AND WAI (WATER)

LEAD: Marine Science

GOAL: Gather information that will provide a baseline analysis of wai and kai resources to inform future revitalization, restoration, and coastal management actions.

PLANNING THE PLACE

LEAD: Professor Jonathan Price, Geography; and Professor Rebecca Ostertag, Biology

GOAL: Pull together information all projects through geographic information system and other tools and discussions to explore the boundaries and interactions, as well as the tradeoffs and scale, of different potential land uses

BUILDING ENGAGEMENT AND CAPACITY

LEAD: All

GOAL: Engage students and community into collaborative research projects to gain experience in weaving ancestral and contemporary interdisciplinary knowledge and practices together to address regional resilience challenges.

With the UH Cancer Center, Ueno takes the helm of the only National Cancer Institute (NCI) designated cancer center in Hawai‘i and the Pacific and one of only 71 centers in the United States.

Bringing change to the UH Cancer Center

Naoto T. Ueno, MD, PhD

CHANGE CAN SOMETIMES BE GOOD, SOMETIMES IT CAN BE BAD, and sometimes it is necessary.

For noted cancer researcher and educator, Naoto T. Ueno, MD, PhD, his huge moment of change came when he decided to leave behind a distinguished 30-year research and administrative career at The University of Texas MD Anderson Cancer Center to become director of the University of Hawai‘i Cancer Center (UH Cancer Center). Ueno, who started in December 2022, most recently served as executive director of MD Anderson's Morgan Welch Inflammatory Breast Cancer Research Program and Clinic in Houston, which flourished under his watch to become the world's largest and most-renowned for treating the rare disease.

While it may be difficult for some to understand why Ueno would seemingly leave at the height of his tenure, Ueno is a firm believer that "Change" is necessary.

Change is nothing new for Ueno, who, at age seven, moved from Japan to the United States when his father, a chemist for a Japanese rubber company, was sent to Akron, Ohio. Upon returning to Japan for high school, Ueno realized that his intended career path of serving in political science or the military required a high skill level in linguistics, which he lacked due to his extended time in America. Forced to make another change, Ueno elected to pursue science.

He eventually ended up in medicine and graduated from Wakayama Medical University, where he also completed his fellowship at the U.S. Naval Hospital in Yokosuka. Ueno went on to complete his internal medicine residency at the University of Pittsburgh School of Medicine and his medical oncology fellowship at The University of Texas MD Anderson Cancer Center. He received his PhD in cancer biology from the University of Texas Health Houston Graduate School of Biomedical Sciences.

"I decided to leave MD Anderson because it was time for me to expand my leadership skills and to test things that I learned about my research on a grander scale," said Ueno. "I feel you shouldn't be in the same position for too long. Good things will happen there because I left, and similarly, I expect good things to happen here now that I'm at UH. Change can cause confusion and chaos, but it

can bring exciting new changes that will benefit the team and the community."

With the UH Cancer Center, Ueno takes the helm of the only National Cancer Institute (NCI) designated cancer center in Hawai'i and the Pacific and one of only 71 centers in the United States, with strengths in diversity, population science, and cancer biology. It is also home to the acclaimed Multiethnic Cohort Study. This epidemiological study assesses the development of cancer and other chronic illnesses of over 215,000 participants, including men and women in five main ethnic groups: Japanese Americans, Native Hawaiians, African Americans, Latinos, and Caucasians.

"Hawai'i has the world's largest catchment area and its central location allows the UH Cancer Center to address a number of health equity issues that many patients face in cancer treatment and prevention," said Ueno. "We want to be a role model in this capacity and to uniquely position ourselves as a hub connecting the U.S. to Asia. I will work to strengthen our team and research scope further so that people feel the UH Cancer Center is worth investing in."

One of these strengths is the Early Phase Clinical Research Center (EPCRC), which is scheduled to be completed in 2024. The $13 million, first-of-its-kind center in Hawai'i, will provide cancer patients with access to Phase 1 and possibly Phase 2 clinical trials without having to travel to the U.S. mainland for specialized treatments. These trials involve cutting-edge, experimental treatments recommended to patients who are not responding to standard treatments or have a more challenging type of cancer.

"Currently, patients with advanced diseases have to leave the islands for specialized treatments, and if they can leave, they are very fortunate," said Ueno. "However, most patients are unable to leave, so they end up completing their treatment earlier than necessary."

As a two-time cancer survivor, Ueno has a strong conviction about science and the impacts that both have on the patient and the community. Interestingly, Ueno was involved in the development of some of the drugs that were later prescribed to help him battle the disease.

"I'm healthy and alive because somebody spent a lot of money to conduct research and develop new treatments," said Ueno. "I'm here today because of clinical trials and other scientific discoveries that allowed me to receive the necessary drugs I needed to fight my cancer and survive."

When the EPCRC is up and running, Ueno will be looking at attracting more Phase 1 trials to the state to help narrow the health equity gap surrounding cancer treatment and prevention. To do so, he will be seeking to develop a deeper relationship between the UH Cancer Center and the Hawai'i Cancer Consortium. Established in 2010, this partnership enables the UH Cancer Center and John A. Burns School of Medicine to provide clinical affiliations with Hawai'i's four healthcare systems: The Queen's Health Systems, Hawai'i Pacific Health, Kuakini Medical Center and Adventist Health Castle, plus health insurer HMSA.

In addition to the clinical trials, Ueno's vision is to create a truly cohesive patient-centered oncology care system in Hawai'i that improves their quality of life through supportive care at all levels with academic clinical oncologists providing the necessary training to the community and health system physicians. With the establishment of a medical oncology fellowship, Ueno hopes that the UH Cancer Center will be able to train and retain more cancer specialists to work here on the islands to provide patients with equal access to leading-edge cancer treatments and care.

"My job at the UH Cancer Center is to ensure that people receive the highest quality care regardless of their location," said Ueno. "We will impact not only patients in Hawai'i and the Pacific, but also internationally."

Change is here for the UH Cancer Center and the future of cancer care in the state is looking pretty good.

TOP RIGHT: *Ueno with former CDC Director Rochelle Walensky during a recent visit to the UH Cancer Center*

BOTTOM RIGHT: *Ueno and his MD Anderson clinic team Angela Ali Muhammed (l) and Neelam Kishor Patel*

(Facing page)

TOP: *Governor Josh Green congratulates Ueno at his welcome reception at the UH Cancer Center* CREDIT: SCOTT NISHI, UH FOUNDATION

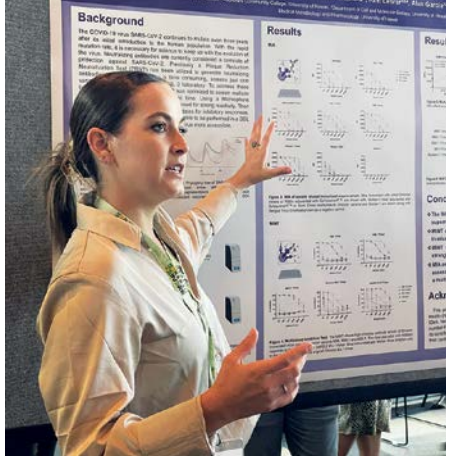
"Our hope is to transform MASFTC into a UH core facility to be able to service any UH campus or department as well as other local companies and organizations that need antibody research and development."

JOHN BERESTECKY

UH Mānoa undergraduate research student Claudia Choy, performs a DNA extraction procedure on monoclonal cell lines

MASFTC

A HIDDEN GEM FOR ANTIBODY RESEARCH AND DEVELOPMENT



ANTIBODIES ARE AMAZINGLY VERSATILE PROTEINS that identify and eliminate microbial invaders, toxins and cancer cells. Monoclonal antibodies, or mAbs, are highly purified antibodies developed in laboratories using biotechnology. As universally critical reagents, mAbs have also played an instrumental role in developing immunotherapies that have curbed or prevented outbreaks and the severity of critical illnesses.

Since the COVID-19 pandemic, global awareness and understanding of the benefits and potential of antibodies have become commonplace, and the market for antibodies is exponentially growing.

Developing Successful Antibodies

Decades before the COVID-19 pandemic, Kapi'olani Community College's (KCC) Monoclonal Antibody Service Facility and Training Center (MASFTC) had been developing antibodies for research and educational purposes. MASFTC has worked with more than 20 researchers across the state and the country to develop hundreds of antibodies to support the development of potential immunotherapies for mesothelioma, cancer, Zika, COVID-19 and the Ebola virus.

"MASFTC is a unique facility in that most of the work such as animal immunizations, immunoassay development, hybridoma creation and cloning, and antibody validation, are performed locally and by the undergraduates enrolled in the certificate and degree programs," said Monika Ward, professor and chair of the Developmental and Reproductive Biology graduate program in the Institute for Biogenesis Research at the UH John A. Burns School of Medicine (JABSOM).

MASFTC has also provided antibodies to illuminate research related to wildlife diseases. In partnership with Thierry Work, wildlife disease specialist and project leader for the National Wildlife Health Center Honolulu Field Station, MASFTC developed mAbs that led to novel discoveries about Hawai'i's endangered green sea turtles. While studying Fibropapillomatosis (FP), a tumor-causing disease in green turtles, Work and his team discovered that due to their unique antibody structure, Hawai'i's green turtles have a very different immune response to FP than those in Florida.

Work and his team are now conducting further research to identify the code for green turtles' novel antibodies in order to determine if FP has an autoimmune component, which would provide greater insight on how the disease affects turtle health.

"As a fundamental tool for biomedical research, we are incredibly fortunate to have a facility in Hawai'i that operates as a partner and an engaged, constructive member of Hawai'i's scientific community," said Work. "I would find it hard to see how we could do some of this specialized research here without them."

New State-of-the-Art Technology

To enhance its research and services, MASFTC just received the state's only Surface Plasmon Resonance (SPR) machine, a powerful optical-based, biosensor that will provide researchers with the ability to observe a wide range of molecular interactions in real-time. The cutting-edge instrument will enhance researchers' ability to create new antibodies in the discovery and development of vaccines and therapies.

Expanding its Education & Training Opportunities

In 1994, KCC's Microbiology Professor John Berestecky expanded the facility into a training center to provide undergraduate and graduate students opportunities to engage in higher level laboratory activities, through federal funding from the National Institutes of Health National Institute of General Medical Sciences IDeA Network for Biomedical Research Excellence (INBRE).

Since then, more than 70 students have graduated from the program into advanced degrees or careers with biotech companies, the Hawai'i State Department of Health, clinical diagnostic labs and COVID-19 testing facilities.

"The work performed by the MASFTC has not only been a reliable, local resource for investigators to obtain high quality antibody reagents important for their research, but has served as a highly successful nucleus of education and training opportunities for students interested in biomedical sciences," said Hawai'i INBRE Principal Investigator and Director Peter Hoffman, professor and vice chair of the Department of Cell and Molecular Biology at JABSOM. "HI-INBRE's mission is to build research capacity throughout the state, and HI-INBRE's support for the MASFTC as a core facility in our statewide network for the biomedical research community has fostered the growth and diversity of our workforce, while providing local monoclonal antibody services to aid research."

More recently, MASFTC secured a National Science Foundation Advanced Technological Education grant that enabled it to bring on Postdoctoral Researcher Brien Haun to develop and integrate an education program to advance antibody engineering through computational techniques.

"Our hope is to transform MASFTC into a UH core facility to be able to service any UH campus or department as well as other local companies and organizations that need antibody research and development," said Berestecky. I'm hoping our efforts allow us to eventually run a research lab to support and develop our antibody therapeutics capacity and initiatives."

TOP: *UH Mānoa undergraduate research student Amber Caranchini presents her project poster at the 2023 Biomedical Sciences and Health Disparities Symposium at JABSOM*

BOTTOM: *MASFTC team: Lecturer Alan Garcia, Professor John Berestecky and Postdoctoral Researcher Brien Haun*

Born a Scientist

Kiana Frank, PhD

TOP RIGHT: *A six-year-old Frank explores Kawainui marsh to hunt for lepo ʻaiʻia*

BOTTOM RIGHT: *A first place finish for Frank at the 2004 International Science and Engineering Fair*

RIGHT: *I ka wā ma mua ka wā ma hope — looking to the future of Kawainui guided by the moʻolelo of of Kawainui's past*

SOME PEOPLE BECOME SCIENTISTS. For Assistant Professor Kiana Frank of the Pacific Biosciences Research Center (PBRC) at the University of Hawaiʻi at Mānoa (UH Mānoa), it was evident early on in her childhood that she was born a scientist.

As an inquisitive six-year-old growing up in Kailua, Oʻahu, Frank listened to her great grandmother's story about the *lepo ʻai ʻia* (edible mud) in the nearby Kawainui marsh. According to the legend, the mud was eaten by King Kamehameha the Great's warriors after the fierce Battle of Nuʻuanu, and Frank was told it to be similar in taste to her favorite food, *paʻiʻai,* (pounded taro). However, there was a catch — to gather the mud, one had to maintain absolute silence. While conducting her first silent expedition — eagerly tasting all the different colors and textures of mud in the marsh (that were not delicious) — she refined her *kilo* (observational skills), and developed a deep sense of ecological inquiry. While she did not find the magical mud, Frank discovered something more. Her calling as a scientist, and one who would later become one of Hawaiʻi's leading experts in environmental microbes and their role in sustaining healthy ecosystems.

"I did not become a scientist, I was born a scientist because my *kupuna* (ancestors) before me were natural scientists," said Frank. "For me, science is how I connect to and better understand the places I love. Science is my tool to *mālama ʻāina* (protect, care for the land)."

One of these areas is Kawainui. Frank vividly recalls an old painting in her grandmother's house that portrayed Kawainui not as the invasive marsh she was familiar with but as a *loko iʻa* (fishpond) that had once provided an abundance of food for all of Kailua. It was at that point, she began to ponder the impact of human activity on places like this. Frank delved into the foundational *moʻolelo* (stories) and *mele* (songs) of Kailua to gain insights into a healthy Kawainui ecosystem and its historical functioning. Moʻolelo such as the lepo ʻai ʻia or the *Makalei* (the fish-attracting branch of Kawainui) shed light on the holistic resource management practices employed by ancient caretakers who recognized the interconnectedness of upland and near-shore ecosystems. However, they also served as powerful reminders of the potential consequences of inadequate stewardship, with poignant warnings that neglecting the care of Kawainui could result in the transformation of its waters into land.

"Our kupuna laid the groundwork with their scientific discoveries and passed on their knowledge to us in their moʻolelo," said Frank. "It is our responsibility to learn from their observations and to continue to tell their stories."

As a freshman at Kamehameha Schools Kapālama, Frank discovered the magnificent world of microorganisms. Microbes — the most abundant and diverse tiny organisms — hold immense power in shaping our ecosystems. They form the foundation of the food web, influencing the availability of nutrients and carbon for other organisms like algae, zooplankton, and fish. Frank believed that understanding the role of microbes in the ecosystem was

crucial to restoring the productivity back to *loʻi* (taro patch) and loko iʻa, as well as the key to finding the lepo ʻai in Kawainui. So, she began to collect samples of microbes across Koʻolaupoko investigating how land management influenced the diversity and distribution of microorganisms across *ahupuaʻa* (traditional unit of land management that runs from mountain to sea). She eventually developed a novel technique for DNA extraction from small volumes of water so she did not have to hike up and down mountains with gallons of water. For her ingenuity and innovative work that was a part of her high school science project,she earned first place and best-in-category in environmental sciences at the 2004 Intel International Science and Engineering Fair in Portland, Oregon.

After graduating, Frank earned a full merit scholarship to the University of Rochester where she studied molecular genetics and earned her Bachelor of Science degree magna cum laude in 2008. She continued on to Cambridge, Massachusetts to pursue research at the intersection of microbial ecology and biogeochemistry under Professor Peter Girguis—earning her Master of Arts and PhD in molecular cell biology at Harvard University in 2010 and 2013, respectively. When she returned home to the islands, her childhood dream of becoming a professor at the UH Mānoa was realized.

Today, Frank uses modern techniques in microbiology, molecular biology and geochemistry to complement and expand upon the observations of her kupuna. With a unique blend of storytelling and scientific rigor, she brings to light the intricate workings of the world. From the tiniest microorganisms to the vastness of nature, Frank unravels mysteries of the unseen to deepen humankind's understanding of and relationship to place.

"I did not become a scientist, I was born a scientist because my *kupuna* (ancestors) before me were natural scientists. For me, science is how I connect to and better understand the places I love. Science is my tool to *mālama ʻāina* (protect, care for the land)."

KIANA FRANK

"The deep held *pilina* (relationship) between *'āina* (the land), *akua* (natural elements, spiritual deities), and *kānaka* (the people) provided the foundation for ancient Hawai'i's thriving abundance. Microbes are the physiological representations of this pilina." said Frank. "Microbes are our akua, they are the unseen mediators of geochemical processes and ecosystem services that shape productivity *ma uka i kai* (from the mountain to the sea)."

Reminiscent of her childhood days, a majority of Frank's work at PBRC takes her into the field, working side by side with local communities, to collect mud and water samples. Integrating contemporary scientific techniques with *'ike kupuna* (traditional knowledge), Frank decodes the reasons behind traditional management practices and constrains of biogeochemical cycling associated with agriculture and aquaculture production. She recognizes that her ancestors, although unable to physically see microorganisms, possessed a deep understanding of their existence. This understanding is evident in many traditional management techniques, such as how the development of *auwai* (continuous flow irrigation) and act of *hehihehi* (stomping) oxygenates lo'i to prevent root rot caused by anaerobic microbes; or how the planting of *hau* (Hibiscus) around loko i'a serves as a biological indicator of microbial nitrogen cycling, signaling the need to adjust the mixing of water. Her lab also monitors the diversity and distribution of microbial communities along ahupua'a to assess health risks associated with aquatic pathogens—highlighting the profound effects that modern development, industrial agricultural and climate change have on ecosystem function. Frank's data helps to support informed decision-making, effective management, and impactful policies for long-term social-ecological resilience.

"Ecosystem sustainability was not just a concept of our kūpuna, it was their daily practice," said Frank. "They used conscientious management strategies based on strong kilo to create sustainable and manageable systems to feed people. We need to move back to that—*i ka wā ma mua ka wā ma hope* (moving forward into the future with your eyes to the past). Ancestral Hawaiian management practices are the models that we need to emulate as a foundation for contemporary innovation in response to climate change."

Helping to accomplish that is a summer Research Experiences Undergraduates (REU) program for Native Hawaiian and Pacific Islander (NHPI) college students that Frank co-runs with Assistant Professor Matt Medeiros and is funded by the National Science Foundation. The objective of the 10-week REU program hosted by UH Mānoa is to cultivate a cohort of NHPI students who receive comprehensive training in scientific research and engagement of indigenous communities, particularly in disciplines important to their islands' future, such as ecology, environmental biology, and conservation science. These students work alongside multidisciplinary faculty mentors from UH and members of Kauluakalana, a non-profit community based organization working out of the Ulupō Heiau—dedicated to the ecosystem restoration of Kailua through culturally informed protocols and Hawaiian ways of knowing.

"Through Kiana's work and teachings, our young scientists are able to pair what we know from our kupuna with what we know today from her study of microbes to help revive this area," said Kaleo Wong, executive director of Kauluakalana.

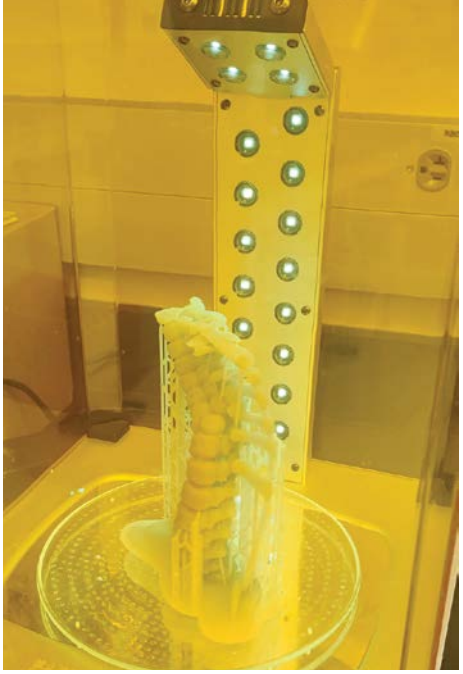
Frank's work is driven by her commitment to fostering inclusive spaces for transdisciplinary research, honoring indigenous knowledge, and embracing ancestral practices for contemporary innovation. By nurturing a deep connection to the land and collaborating with 'āina-based community organizations and stakeholders, she ensures that her research is rooted in the values and principles of traditional management. Through her exploration of the intricate world of microbes, Frank unveils a hidden realm of immense significance, shedding light on the profound influence of these microorganisms in shaping the environment. Her findings not only expand humankind's knowledge, but also hold the potential to unlock innovative solutions for pressing global issues. By perpetuating place-based knowledge and ecological-based studies, she paves the way for a future where science and tradition intertwine to sustain and protect the natural world—a future where fish have returned to Kawainui loko i'a, and a little Kailua girl can savor the delightful taste of the lepo 'ai 'ia.

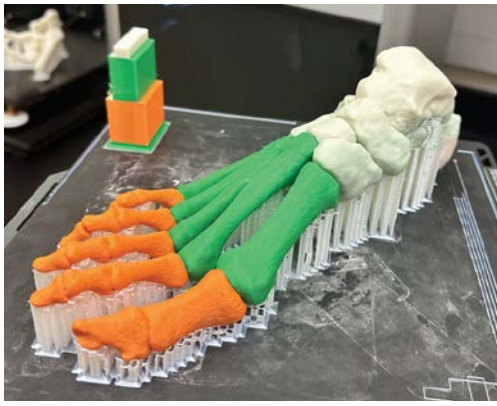
LEFT: *Kauluakalana Executive Director Kaleo Wong engages students in 'āina-based learning at Ulupō Heiau.*

RIGHT: *Frank collects water samples at He'eia fishpond to study microbial community dynamics*
CREDIT: JACOB CHIN

XR LABS

HARNESSING 3D TECHNOLOGY TO ACHIEVE OPTIMAL HEALTHCARE OUTCOMES





IN THIS AGE OF ADVANCED HEALTHCARE AND TECHNOLOGY, modern techniques for pre-operative planning are still underutilized, as many surgeons still rely on two-dimensional (2D) imaging and limited information regarding a patient's anatomy for surgical preparation.

With the advent of three-dimensional Extended Reality (3DXR) visualization technology, doctors can now provide patients with individualized 3D models of anatomy. However, while 3DXR technologies have become ubiquitous, 90 percent of doctors in Hawai'i do not use either when planning surgeries, according to XR Labs LLC, a digital medical planning company working to transform pre-surgical planning and clinical training in Hawai'i.

As a University of Hawai'i (UH) startup, XR Labs developed its 3DXR visualization technology and unique, turn-key Artificial Intelligence (AI) solutions at the John A. Burns School of Medicine (JABSOM). Its founders—Chief Executive Officer and Anatomy, Biochemistry and Physiology Professor Scott Lozanoff; Chief Technology Officer and Technical Director of Anatomical Imaging Jesse Thompson; and Chief Medical Officer and Clinical Assistant Professor Thomas Noh—have a combined 40 years of clinical and academic experience in healthcare and biomedical visualization.

"Using 2D scans in pre-operative planning are insufficient in depicting the complexities of 3D human anatomy, especially when surgeons are tasked with making as small an incision as possible," said Noh. "For example, in removing tumors, spatial relationships of the tumor location and extent are necessary to accomplish complete resection. In prosthetic surgeries, doctors must have a clear understanding of the amount of tissue available for prosthetic device insertions in order to achieve the necessary bony incorporation. Access to 3D tissue contour patterns is also critical for doctors to restore full esthetic quality during pediatric surgeries."

XR Labs has already developed 3D models for a pediatric Scoliosis case, which allowed the surgeon to preoperatively plan the complex operation and successfully treat the patient. The company also helped orthopedic surgeon and JABSOM Associate Professor Paul Morton significantly alter his surgical plan for a hip dysplasia case after being able to see and feel the cracks and crevices of the patient's hip architecture and pre-operatively study the bony framework.

The 3D images are created using hundreds of 2D patient scans and AI models which can be sent directly to smartphone platforms within a matter of hours. Accurate life-sized versions in 3D allow surgeons to rehearse an operation to help prevent intraoperative issues or the need for corrective surgeries.

"As 3D medical data becomes more accessible, we see ourselves as a company that helps patients receive more individualized care," said Thompson. "We want to empower patients and doctors with more impactful visual information. AI tools allow us to more rapidly prepare medical imaging data and maybe in the future play a role in early detection of disease and cancer."

Positive clinical outcomes have long-been known to correlate with a patient's medical knowledge of their own condition, and providing tools, like 3D images and models, helps to improve patient education about an upcoming surgery. This can significantly reduce patient anxiety as well as promote pre- and post-surgical compliance, adherence, and result in more efficient and cost-effective recovery.

XR Labs hopes its technology and services can also enhance access to learning models and advanced clinical training opportunities for medical students and other healthcare providers, especially on the neighbor islands and in other remote areas.

"What we're really developing is a simple, turn-key system that provides doctors, students and patients with rapid access to personal, anatomical, 3D XR visualization in order to achieve optimal healthcare outcomes," said Lozanoff.

"We want to empower patients and doctors with more impactful visual information. AI tools allow us to more rapidly prepare medical imaging data and maybe in the future play a role in early detection of disease and cancer."

JESSE THOMPSON

TOP LEFT: *3D model of a spine in preparation for a hemivertebrectomy and insertion of an expandable rod to control the scoliosis*

TOP RIGHT: *3D model of a foot to educate a patient, which demonstrates the use of multiple filament colors to show contrast between the tarsals (white), metatarsals (green) and phalanges (orange)*

BOTTOM RIGHT (L-R): *Thomas Noh, Jesse Thompson, Scott Lozanoff*

Assessing Hawai‘i’s Geothermal Potential

AS ONE OF THE MOST GEOGRAPHICALLY ISOLATED REGIONS IN THE WORLD, Hawai‘i residents contend with the highest electricity prices in the U.S., about double of the national average. This is due largely in part due to a heavy dependence on imported petroleum and lack of indigenous fossil fuel resources.

However, below the Hawaiian Islands lies a geological hot spot in the earth’s mantle that has been active for the past 70 million years, formed the island archipelago and today—continues to fuel Hawai‘i’s active volcanoes. Because of this hot spot and the presence of subsurface heat, the use of geothermal energy can prove to be a viable option to solve some of the state’s energy woes.

Geothermal electricity is clean, inexpensive, and firm—with the last meaning that is “always on” regardless of weather conditions or time of day. Geothermal also has the lowest land footprint compared to solar power and wind, and unlike the other intermittent resources, no battery storage is needed. Currently, the state’s lone geothermal plant on Hawai‘i Island produces five times the amount of electricity as one of the state’s largest solar farms, while requiring 80 percent less land area.

Evidence collected by the University of Hawai‘i at Mānoa (UH Mānoa) suggests that all of the major Hawaiian Islands may hold the subsurface heat that is necessary to produce geothermal energy. However, the current state of understanding of geothermal potential outside of Kīlauea’s East Rift Zone (KERZ), the most active rift of the state’s most active volcano on Hawai‘i Island, is very limited. KERZ is where geothermal exploration was focused in the 1970s, and is the only location in the Hawaiian archipelago where geothermal electric power is being produced.

The Hawai‘i Groundwater and Geothermal Resources Center

As Hawai‘i is the only U.S. state without a geological survey, UH Mānoa has contributed much of what is known about Hawai‘i’s geology. Since producing Hawai‘i’s first geothermal well in the 1970s, UH Mānoa has spearheaded Hawai‘i’s geothermal research, including producing the only two statewide resource assessments by Professors Donald Thomas and Nicole Lautze of the Hawai‘i Institute of Geophysics and Planetology in 1985 and 2017, respectively.

Realizing the need to provide a central hub from which to disseminate legacy data and information from their numerous geothermal and groundwater research projects throughout the state, Lautze and Thomas founded the Hawai‘i Groundwater and Geothermal Resources Center (HGGRC) in 2014. The HGGRC, led by Lautze, conducts research on Hawai‘i’s fresh groundwater, geothermal (including shallow geothermal heat pump technology for building cooling), and carbon storage potential. Visit https://www.higp.hawaii.edu/hggrc/

Hawai‘i Play Fairway Project

The Hawai‘i Play Fairway project was among HGGRC’s most important initiatives. The University of Hawai‘i at Mānoa was one of eleven initial phase I projects selected and funded by the U.S. Department of Energy from across the country to identify blind hydrothermal systems (those without surface expression). The project, led by Lautze, received subsequent phase II and III funding from 2014-2020 and ultimately provided the first statewide geothermal assessment of the Hawaiian Islands since Thomas’ original report in 1985.

As one of the most geographically isolated regions in the world, Hawai‘i residents contend with the highest electricity prices in the U.S., about double of the national average.

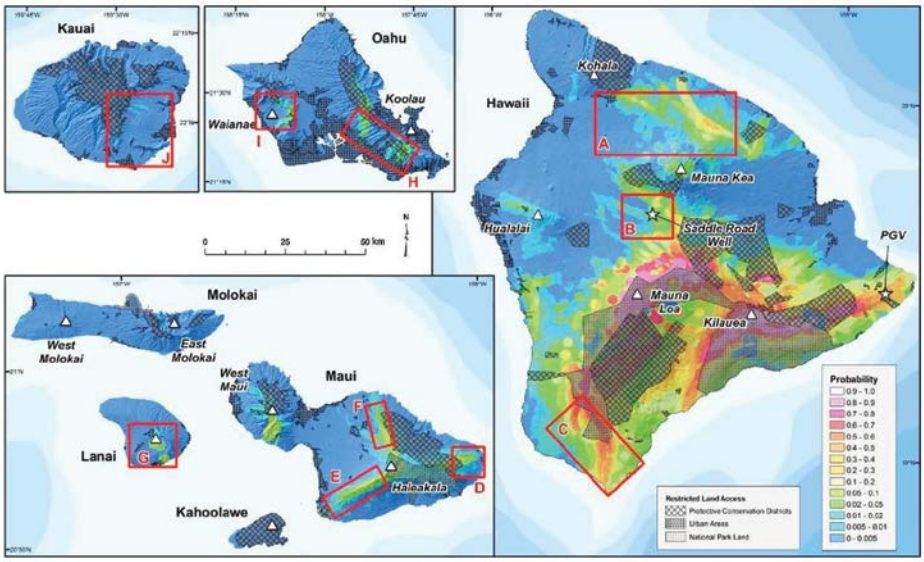
BOTTOM: *Lāna‘i drill site with the islands of Maui and Kaho‘olawe in the background* CREDIT: HGGRC

(Facing page)

TOP LEFT: *Skylight view of a lava tube.*

BOTTOM LEFT: *Lautze at the Kīlauea Caldera, Ca. 2012* CREDIT N. LAUTZE

RIGHT: *Results of DOE Phase III indicating the probability of subsurface heat across the State of Hawai‘i. Summit of each Hawaiian shield volcano shown as a white triangle* CREDIT: HGGRC



The research project accomplished the following objectives:

Phase I - Identified, compiled, and ranked existing geologic, groundwater, and geophysical datasets relevant to subsurface heat, fluid and permeability. Developed a statistical methodology to integrate into a statewide resource probability map. The team considered this map, confidence in the calculated resource probability, and development viability to identify 10 locations across the state for phase 2 geothermal exploration activities.

Phase II - Collected new groundwater data in 10 locations across the state, new geophysical data on three islands, and modeled topographically induced stress to better characterize subsurface permeability. Through combining data from the first and second phases, the team determined locations for exploration drilling in phase 3.

Phase III - Deepened a groundwater well in Lāna'i's Pālāwai Basin to approximately 3,500 feet, performed more geophysical surveys, and collected limited new encouraging groundwater data. The team measured a roughly linear temperature gradient averaging 42°C/km and a maximum bottom hole temperature of 66°C, similar to some exploration wells within KERZ. This is now the deepest and warmest well off of Hawai'i island. The team considered these results encouraging for Lāna'i's resource potential.

Ultimately, the Hawai'i Play Fairway Project provided an updated statewide geothermal resource assessment, expanded understanding of Hawai'i's groundwater location and quality, and a roadmap for additional work to better characterize both resources. HGGRC's philosophy is that more data will bring more knowledge, and that when this knowledge is shared with stakeholders and communities, more informed decisions can be made.

"I think nearly everyone in Hawai'i would value a low cost, low footprint, resilient, indigenous, energy supply. But there are tradeoffs for some. If geothermal has a chance, community engagement will play a critical role," said Lautze. "HGGRC will continue to work with stakeholders and local communities to advocate for the necessary funding to move the state one step closer to understanding and realizing its geothermal potential."

She added, "The global geothermal community wonders why there isn't more geothermal electricity generation in Hawai'i. The answer is complex, but I think that if we could get even a small power plant online in a location where the local community is supportive, I think it would be transformative for our state."

ABOVE: *Lautze and UH President David Lassner discuss groundwater and geothermal prospects on Lāna'i*

"Atmospheric sciences, especially climate and seasonal forecasting, is a data-intensive field and the most important and applied research areas going forward. Almost all industries will be impacted by climate change and knowing how and when things will change can positively or negatively impact a business, community or individuals."

JENNIFER GRISWOLD

Hawai'i's Weather Women

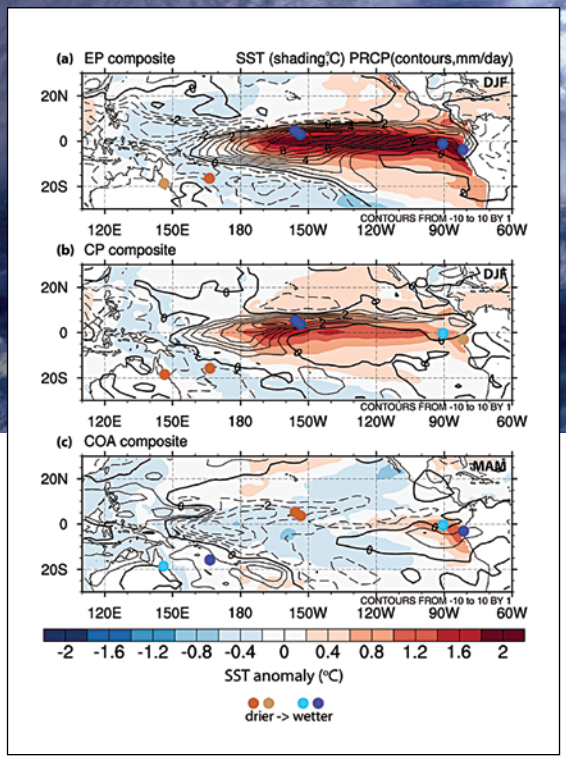
ELEVATING THE IMPACT OF ATMOSPHERIC SCIENCES

THE EFFECTS OF CLIMATE CHANGE ARE NO LONGER FAR-OFF THREATS and are now contributing factors to many of today's disasters, often exacerbating the frequency of wildfires and heat waves, flooding, and the intensity of rainfall during hurricanes and storms. These unprecedented weather events have triggered a global urgency to prioritize research-based initiatives to understand, predict, mitigate and reverse the impacts of climate change.

Despite its modest size, the Department of Atmospheric Sciences at the University of Hawai'i at Manoa (UH Mānoa) has earned both national and international acclaim for its research and is a part of the renowned School of Ocean and Earth Sciences and Technology. In a field often dominated by men, three distinguished female faculty are further elevating the department's research and prestige, making atmospheric waves in climate modeling and cloud microphysics.

Enhancing Global Climate Models Professor Christina Karamperidou's research focuses on El Niño-Southern Oscillation (ENSO)—a coupled ocean-atmosphere phenomenon in the tropical Pacific—which is the primary factor affecting variability in water temperature, rainfall, and wind strength in the Pacific, and has far-reaching impacts on weather and climate.

One of the methods Karamperidou uses to study ENSO is to synthesize climate model simulations with paleoclimate data, much of which is gathered from ancient, preserved material such as coral skeletons, shells or lake sediment, which can indicate past temperature and rainfall across the Pacific. Using paleoclimate ENSO records from the Holocene (the past 12,000 years) along with climate model



ABOVE: *El Niño flavors; Warm sea surface location: Eastern, Central or coastal.* CREDIT: KARAMPERIDOU, DINEZIO 2022

simulations, Karamperidou and her team can study the climate mechanisms behind the ENSO phenomenon—its predictability, impacts and how its characteristics may change under the influence of natural or anthropogenic climate change.

In her research, Karamperidou combines numerical models of weather and climate with advanced statistical and machine learning methods, to develop a novel framework to understand how El Niño (warming of sea surface temperatures) and its impacts may respond to climate change

"Coming out of a longer [three-year] La Niña (cooling of sea surface temperatures), most models currently predict a big El Niño for the end of this year, which could lead to potentially more tropical Pacific cyclones, and altered rainfall patterns in our islands and around the world," said Karamperidou who recently received the prestigious Early Career Scientist Award from the International Union of Geodesy and Geophysics. "Improving our understanding of ENSO mechanisms through our studies of modern and past climates allows us to improve ENSO representation in global climate model simulations to help reduce uncertainties and improve accuracy of El Niño prediction and future climate projections."

Understanding Clouds One of the most uncertain and complex Earth systems represented in climate models is clouds and the aerosols that they form on. Studying the fundamental structure and processes involved in clouds and aerosols not only allows scientists to better parameterize them in models, but also improves our understanding of the atmosphere and weather patterns.

Associate Professor Alison Nugent studies orographic precipitation, how mountain topography induces or modifies precipitation. Breaking down cloud microphysics, Nugent explained, "In one cubic centimeter—the size of a sugar cube—a cloud has 100 cloud droplets. In a polluted atmosphere, it can have many more times that in the same volume. The size and number of cloud droplets is important for their relationship to precipitation and to radiation. For example, a cloud with many small cloud droplets will be brighter and reflect more radiation, and may take longer to precipitate than a cloud with fewer, large droplets."

While most aerosols increase the number of cloud droplets, making clouds brighter and delay the formation of precipitation, sea salt aerosols, a super hygroscopic or water-friendly aerosol, does the opposite—growing cloud droplets to precipitation size faster than others.

Nugent recently received a National Science Foundation (NSF) Faculty Early Career Development (CAREER) award that will allow her team to investigate the role of wind, waves and other atmospheric and oceanic properties that influence the production of sea salt aerosols in coastal environments on three Pacific Islands.

RIGHT: *First weather station installed near Nu'uanu Reservoir as part of the Hawai'i Mesonet*

Through a highly competitive grant from NSF's Major Research Instrumentation program, Nugent helped to secure funding to install 84 climate stations throughout the state. As the first NSF-funded mesonet, the multidisciplinary project will allow the state to collect long-term, real-time observational data including rainfall, air temperature, humidity, wind speed and direction, solar and net radiation, and soil moisture.

Broadening Horizons in Atmospheric Sciences Another researcher making major strides not just in the field of cloud microphysics, but for UH Mānoa, is Associate Professor Jennifer Griswold, the Atmospheric Sciences Department's first female chair. Since becoming chair in 2021, she has already formalized the department's commitment to diversity, equity, and inclusion and has spearheaded a national initiative locally for the past few years called Expand Your Horizons - Hawai'i, an annual STEM conference for young women in sixth to eighth grades to encourage and support young girls' enthusiasm in STEM careers.

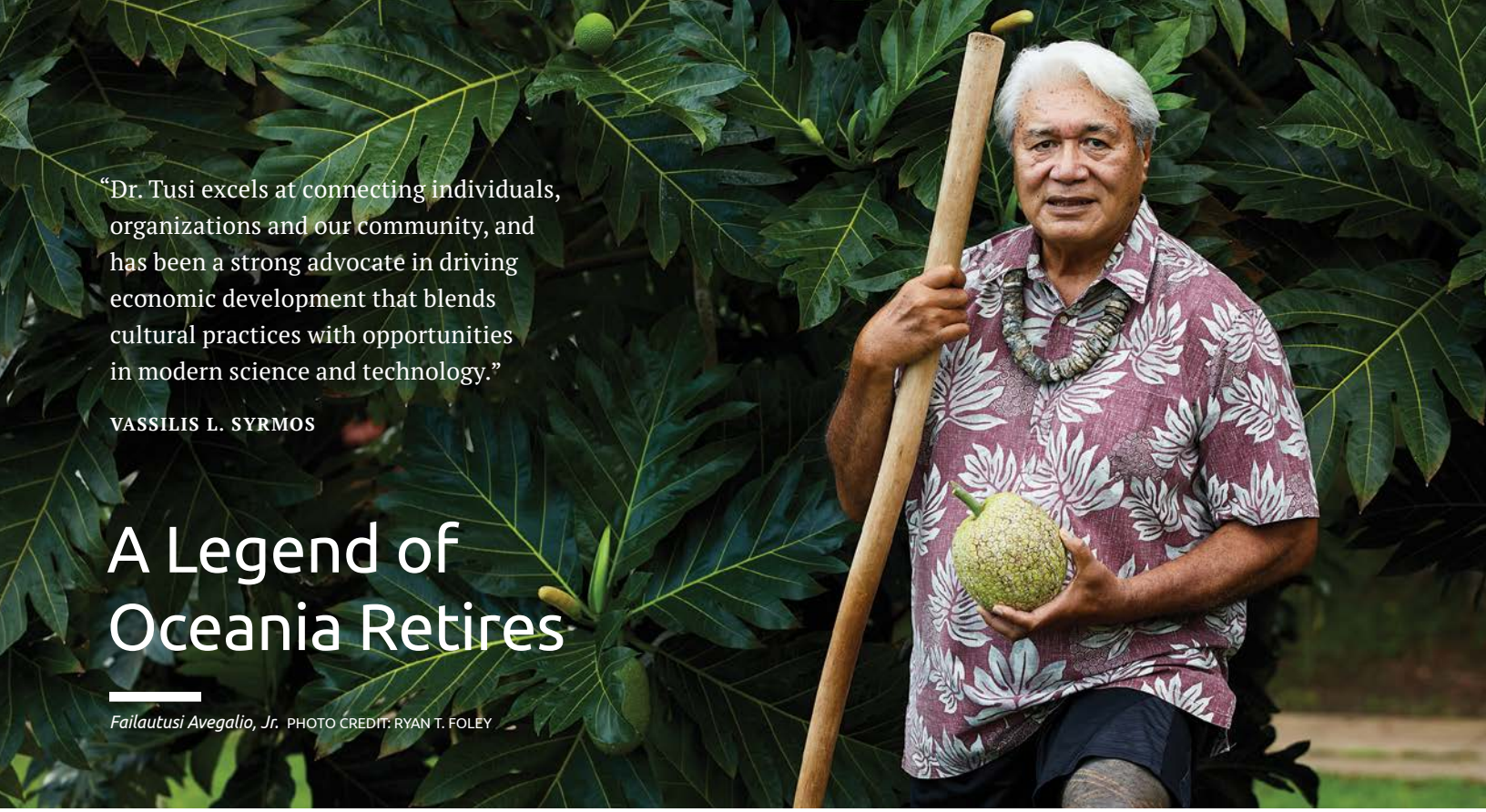
Prior to joining UH, she had already established an impressive resume, having helped build the first Phase Doppler Interferometer (PDI) and data processing program, a breakthrough innovation and process that significantly improved the study of cloud structures and properties. Now used at several institutions, the PDI measures cloud droplet size and velocity for each spherical droplet, as well as record the arrival time of the droplet to determine droplet clustering and turbulence.

Having done her postdoctoral fellowship at the National Aeronautics and Space Administration's internationally renowned Jet Propulsion Laboratory, she gained expertise in using a variety of high-resolution satellite data from space to investigate cloud processes, aerosols and cloud-aerosol interactions. She now uses remote-sensing for all of her research today, and trains students how to utilize and analyze satellite data.

Griswold's research continues to focus on improving the understanding of physical and dynamical processes governing global cloud aerosol precipitation interactions, from volcanic activity, biomass burning and even changes in anthropogenic aerosol levels during the COVID-19 pandemic shutdown.

"Atmospheric sciences, especially climate and seasonal forecasting, is a data-intensive field and the most important and applied research areas going forward," said Griswold. "Almost all industries will be impacted by climate change and knowing how and when things will change can positively or negatively impact a business, community or individuals.

ABOVE: *Flight Probe Dual Range Phase Doppler Interferometer*



"Dr. Tusi excels at connecting individuals, organizations and our community, and has been a strong advocate in driving economic development that blends cultural practices with opportunities in modern science and technology."

VASSILIS L. SYRMOS

A Legend of Oceania Retires

Failautusi Avegalio, Jr. PHOTO CREDIT: RYAN T. FOLEY

FOR MORE THAN 20 YEARS, FAILAUTUSI AVEGALIO, JR., affectionately known as "Dr. Tusi," forged deep and powerful relationships across the Pacific—strengthening the foundation and success of the University of Hawai'i's (UH) Pacific Business Center Program (PBCP).

Having grown up in American Samoa with genealogical and historical roots from all major island groups of Polynesia, Melanesia and Micronesia, Avegalio was born and raised with an intrinsic understanding and appreciation for Pacific traditions, values and practices. As a *papali'i* (traditional leader) of Savaii, Samoa, he has always embraced and espoused the importance of local history, culture and ancestral wisdom.

After graduating with bachelor's degrees in education and social science from Emporia State University, he earned his master's degree from Truman State University and then a EdD from Brigham Young University. His dissertation proposed educational provisions that were adopted into the Constitution of American Samoa in 1984, creating a platform for the country to weave traditional values, lessons and practices into modern education.

Crediting "spiritual IQ as the basis of truly effective leadership among Polynesians," Avegalio emphasized that, "Good leaders lead, and great leaders heal," a mantra and technique that has guided his long and successful career as an educator, advocate and leader.

Avegalio joined the College of Business Administration at the University of Hawai'i at Mānoa in 1982, becoming its first tenure-track professor from Oceania. He became a nationally and internationally recognized expert and business consultant regarding courses he taught over the years at multiple institutions including organizational behavior, theory and development, executive leadership, international human resource management, cross-cultural dynamics, collaborative decision-making, total quality management and quality circles theory.

Ten years after joining UH, Avegalio resigned to return to American Samoa Community College (ASCC), where he previously served as an administrator, at the behest of the government — as the college was at risk of losing its accreditation. During his brief term as president, he secured ASCC's accreditation and established greater institutional autonomy from the government.

Shortly after, he was appointed as director of PBCP, where he helped expand and deepen its network and initiatives throughout the Pacific with the help of his dedicated team. Avegalio focused on weaving traditional wisdom and culture with modern science, knowledge and technology to establish more holistic, systems-based economic development opportunities that reflect U.S. Affiliated Pacific Islands culture, landscape and values.

Through his "management by mana" leadership style, Avegalio consulted and developed strong relationships with traditional leaders and village councils gathering cultural context of their organic worldviews to balance and merge them with Western perspectives and opportunities.

"UH is uniquely positioned to be a beacon of the 'Blue Continent' as a global model," Avegalio said. "We understand the importance of values shared throughout the Pacific, and have the expertise and resources to integrate modern science and technology into traditional practices, to allow us to thrive while living in balance with Mother Earth."

Through this rule of thought, Avegalio significantly broadened PBCP's network and successes through new innovative efforts, including:

Stars of Oceania, an event held every few years to honor and gather PBCP partners, organizations and project collaborators, including prominent government and community leaders, educators, innovators, cultural practitioners, athletes and more.

Pacific Regional Breadfruit Initiative, with its award-winning breadfruit summit held in tandem with Stars of Oceania, has continued to gather hundreds of stakeholders and experts to share research and resources, and discuss the market potential and export opportunities around the region's indigenous breadfruit crop.

Multi-Purpose Business Incubator, addresses the lack of basic needs in remote, regional areas by providing a high-impact, symbiotic university and private partnership model that supports proven, regenerative practices and

technologies that weave modern science and traditional wisdom to drive local economic development. PBCP partnered with five local organizations that provided holistic solutions to Pacific Island challenges including food security, water access, waste management, healthcare and connectivity. Each initiative was recognized as a finalist or winner by the University Economic Development Association (UEDA), making PBCP one of the most distinguished UEDA programs in the nation.

In his role at PBCP, Avegalio also served as a catalyst for establishing various organizations including:

Honolulu Minority Business Enterprise Center at the UH Mānoa Shidler College of Business, provides customized business solutions for Hawai'i's minority entrepreneurs.

Rising Voices Center for Indigenous and Earth Sciences, a national network of indigenous, tribal and community leaders, scientists, students, educators and other experts from around the world dedicated to advancing science through indigenous and Earth science partnerships and opportunities.

Collaborative Leaders Network, a select group of top facilitators in the state, as identified by nationally and internationally renowned collaborative decision-making expert Sam Kaner, that helps leaders resolve complex issues through diverse approaches and collaborative methods that offer real, lasting change.

For his prodigious efforts throughout Hawai'i and the Pacific, Avegalio has received numerous local, regional and national awards including the 2009 Entrepreneur of the Year by the U.S. Department of Commerce Minority Business Development Agency and National Disaster Preparedness Training Center's 2017 Community Resilience Leadership Award.

"Dr. Tusi excels at connecting individuals, organizations and our community, and has been a strong advocate in driving economic development that blends cultural practices with opportunities in modern science and technology," said Vassilis L. Syrmos, UH vice president for research and innovation. "Leading with humility and respect, we want to recognize and thank him for the knowledge, experience, connections and significant contributions he has given to us over his remarkable career at UH."

TOP LEFT: *Multi-Purpose Business Incubator partner Phoenix Carbon Company and its Thermal Conversion of Organic Material technology*

BOTTOM LEFT: *Avegalio and Multi-Purpose Business Incubator partner Kyle Stice (center) of the Pacific Farmer Organisations receives the UEDA 2022 National Award of Excellence*

RIGHT: *Retirement ceremony for Avegalio*

Established in 1979, *PBCP supports business and economic development in the State of Hawai'i and U.S.-Affiliated Pacific Islands (USAPI), including the Territories of Guam and American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Republic of the Marshall Islands and Republic of Palau. PBCP continues to develop business plans, identify investment opportunities and connect and adapt UH resources to support USAPI entrepreneurs, businesses, nonprofits and government agencies to grow their economies and local capacity.*

New Innovation Programs

AS HAWAI'I'S ECONOMIC HISTORY ILLUSTRATES, THE 50TH STATE HAS BEEN OVERLY DEPENDENT ON SINGLE PRODUCT INDUSTRIES. Whaling, sugar and pineapple have all but faded, with the military and tourism serving as the current standard bearer. However, recent events have shown the fragile nature of these mature industries, including growing movements to scale back, which may further limit economic growth.

The University of Hawai'i has long been a proponent of innovation and continues its effort to help build a thriving research and innovation sector that can become an economic growth engine for the state. To do so, it has created a unique suite of programs to help motivated faculty become the instruments of change in the classroom, labs and the marketplace.

Faculty Fellows

The Faculty Fellows program will enhance faculty involvement in innovation and entrepreneurship by providing experiential certificate training in the Lean Startup methodology. Tailored to educators, the program will support UH faculty by weaving key innovation and entrepreneurship principles into course design, while also growing an active and collaborative network of innovative educators and academic entrepreneurs.

Classes will be delivered through a curriculum co-developed by VentureWell, a longstanding collaborator with the National Science Foundation, whose mission is to cultivate a pipeline of inventors, innovators, and entrepreneurs by advancing innovation and entrepreneurship education from research labs, classrooms, and beyond.

The inaugural program will pilot this summer with six faculty from the College of Engineering at the University of Hawai'i at Mānoa who have a track record of high-impact teaching practices and transformative approaches in the courses that they currently teach. Each faculty member is currently engaged in areas that warrant new approaches to addressing pressing challenges, such as engineering design, advanced additive manufacturing, concrete technology development, microelectronic design, and coastal modeling.

Faculty Fellows will participate in interactive workshops and engage in panel discussions to learn: how to leverage the customer discovery process; teach using the business model canvas; and guide the application of Lean Startup methodology.

Following completion of the program, Faculty Fellows will gain access to future funding opportunities in teaching and course development to continue pioneering new ways to engage students in inclusive STEM innovation and entrepreneurship.

"This stimulation of greater entrepreneurial thinking through teaching will help build a community of practice around innovation by fostering cross-disciplinary collaboration in course development and facilitating curriculum mapping to develop future STEM leaders in emerging industries," said Rebecca Chung, OIC associate director, innovation programs and Faculty Fellows program lead.

For more information on Faculty Fellows, visit: research.hawaii.edu/oic/programs.

The inaugural cohort includes:

Oceana Puananilei Francis
Professor
Civil and Environmental Engineering/Sea Grant College Program

Aaron Ohta
Professor
Electrical and Computer Engineering

Tyler Ray
(FACULTY LEAD)
Assistant Professor
Mechanical Engineering

Lin Shen
Associate Professor
Civil and Environmental Engineering

Zac Trimble
Associate Professor
Mechanical Engineering

Jeff Weldon
Associate Professor
Electrical and Computer Engineering

Patents2Products

Patents2Products is another exciting program that will be launched this year that will focus on developing innovation acumen and business fluency, to mature the development of impact-driven technologies in UH research labs.

"This fellowship program seeks to effectively train PhD candidates and postdoctoral researchers in translational research with a focus on innovation," said Chung. "The opportunity to broaden scientific training to increase innovation capacity will accelerate the translation of scientific discoveries into meaningful commercializable opportunities."

Patents2Products Fellows, who will be selected this summer, will each work alongside a faculty sponsor, an active investigator in the area of the proposed research, who will oversee the training and research experience throughout the duration of the one-year program.

Fellows will receive intellectual property training, technology transfer guidance, and industry mentorship. They will also learn and apply the Lean Startup methodology through the NSF I-Corps™ program, as well as participate in professional development workshops and networking opportunities to seek future funding and research collaborations. Each Fellow will receive salary compensation, a stipend for research and supplies; and have access to state-of-the art facilities and specialized equipment.

The following faculty sponsors and selected projects will receive technical support from Patents2Products Fellows:

Novel Metagenomic Sequencing Technology to rapidly characterize influenza diversity and dynamics in wastewater to better inform flu vaccine development. Faculty Sponsor: Tao Yan, Water Resources Research Center, Department of Civil and Environmental Engineering, College of Engineering, UH Mānoa

Innovative Desalination Technology through solar thermal conversion to help solve freshwater shortage issues and replace existing energy-intensive processes with sustainable, green technologies for water purification. Faculty Sponsor: Woochul Lee, Department of Mechanical Engineering, College of Engineering, UH Mānoa

eDNA Filtration System that allows for simultaneous environmental DNA (eDNA) analysis to amplify and improve the efficiency and accuracy of researching ecological aqua/water/ocean communities. Faculty Sponsor: Timothy Grabowski, Marine Science Department, UH Hilo; Marine Biology Graduate Program, UH Mānoa; and Unit Leader, Hawai'i Cooperative Fishery Research Unit

At-Home Body Composition Assessment Technology that provides highly effective obesity models to improve access and use particularly in low- and middle-income environments and increase awareness and early detection and intervention of body composition risk factors for obesity. Faculty Sponsor: John Shepherd, UH Cancer Center, UH Mānoa

Programmable Genome Insertion Tool to actively and accurately incorporate DNA into the genome of somatic cells at specific locations to develop clinical therapies that use insertional vectors to treat genetic disease. Faculty Sponsor: Jesse Owens, Cell and Molecular Biology Department, John A. Burns School of Medicine, UH Mānoa

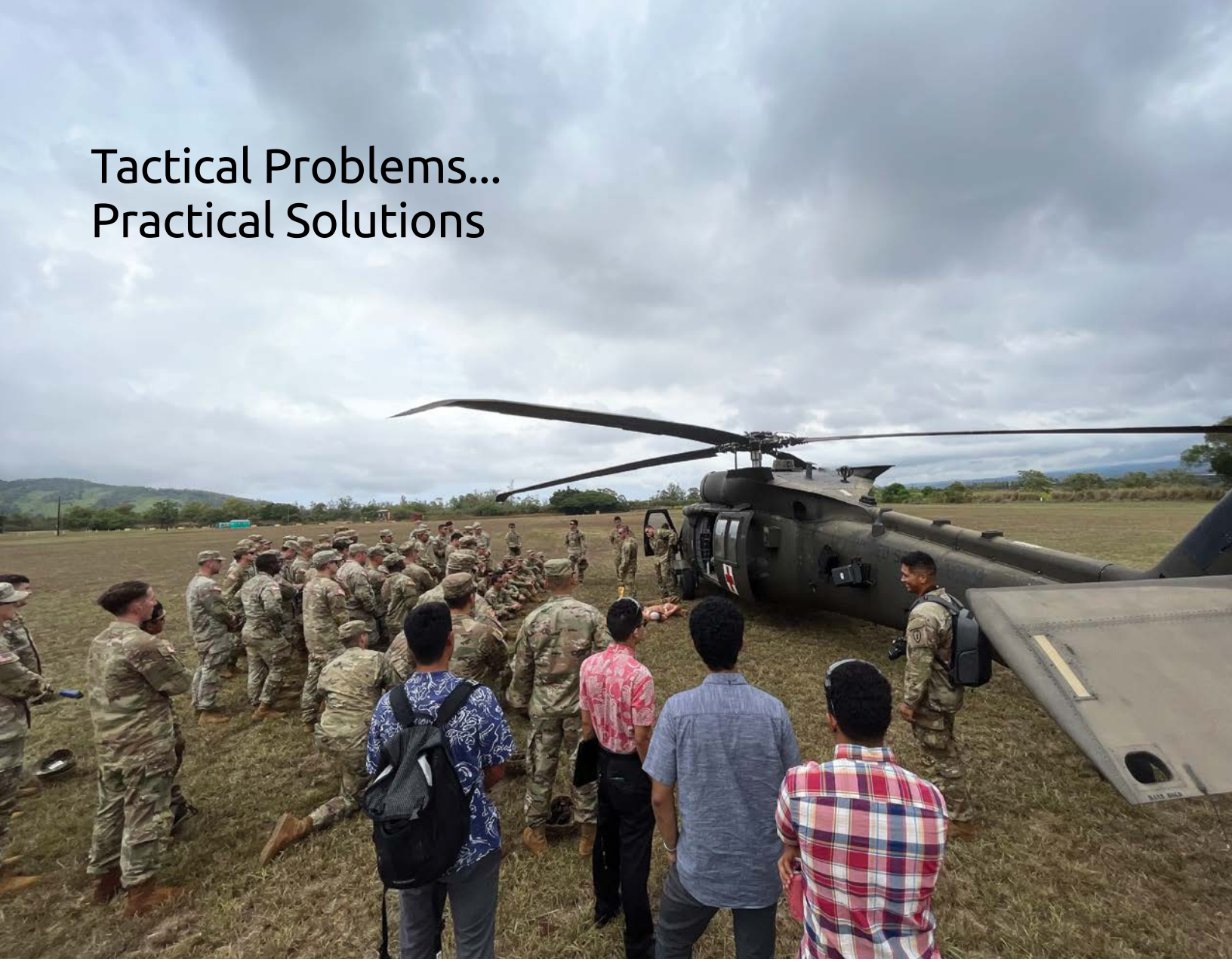
Expression Vector System using an improved insect cell line to develop a fully customizable product that can be used for the expression of almost any protein and provide high-yield production of vaccine antigens. Faculty Sponsor: Axel Lehrer, Department of Tropical Medicine, Medical Microbiology and Pharmacology, John A. Burns School of Medicine, UH Mānoa.

Wearable Sensor for detecting date rape drugs will be a stylish and functional ring equipped with integrated sensors for personal detection of flunitrazepam (also known as Rohypnol) in beverages to mitigate drug-facilitated assaults. Faculty sponsor: Tyler Ray, Department of Mechanical Engineering, College of Engineering, UH Mānoa

Ultrasonic Sensor System to quantitatively assess the initial fixation of orthopedic implants and prevent aseptic loosening and the problematic need for revision surgeries, which are more difficult to perform, have increased risks, longer recovery and greater healthcare burden. Faculty sponsor Jeff Weldon, Electrical Engineering, College of Engineering, UH Mānoa

For more information about the Patents2-Products programs, visit: research.hawaii.edu/oic/programs.

Tactical Problems... Practical Solutions



"Working with the DoD and other private sector partners on real-world problems and project-based team learning is the best way for our students to get the kind of experience they need once they graduate."

BRENNON MORIOKA

FROM ADDRESSING CLIMATE CHANGE AND HAWAIʻI'S HIGH HOUSING COSTS to expanding mental health services and preparing for active shooter scenarios on base, the University of Hawaiʻi's (UH) Hacking4X program has created opportunities for its undergraduate and graduate students to gain hands-on innovation education and training while developing viable solutions to real-world problems.

The semester-long course focuses on training students in the Lean Startup methodology used by entrepreneurs and businesses around the world. While working in multidisciplinary teams, students conduct at least 50 stakeholder interviews during the customer discovery process to validate and iterate a Minimum Viable Product (MVP) or solution. Students present every single week on the interviews they conducted to understand how to synthesize new information and continuously improve or pivot their minimum viable product.

"Hacking4X is designed as a flipped classroom, and the goal is to understand what your customer really wants," said Gloria Choo, National Security Innovation Network (NSIN) regional engagement principal for Hawaiʻi. "It's a fantastic way to understand and apply the skills that they learn in the classroom to a problem out in the real world."

Improving Mission Safety

Since launching the program in 2021 in partnership with the U.S. Department of Defense's (DoD) NSIN, UH has engaged various military branches throughout the state to collaborate on addressing mission-related challenges.

"We've got a lot of tactical problems since we operate a lot of complicated equipment in different environments from dense urban

environments to jungles all the way out in the Indo-Pacific, across a division of 13,000 people," said 25th Infantry Division (25th ID) Brigadier General Jeffrey Van Antwerp.

"Being able to bring in people who have different perspectives, networks and resources to take a look at those problems with us, is great! Even if we don't find an immediate solution, we gain a better appreciation and understanding of a problem to help us curate a better solution, which is very beneficial."

A couple major issues that the 25th ID brought to the program related to helicopter rescue missions, including accidental injuries and deaths from helicopter rotor blades, particularly in non-designated landing zones in Southeast Asia.

"We started off interviewing a lot of people to better understand their interpretation of the problem," said Jason Kanemoto, a University of Hawai'i at Mānoa (UH Mānoa) College of Engineering undergraduate student, who worked on the rotor blade project. "We got to visit the base a few times, see the problem and talk to different people, which gave us a clearer understanding of what the issue actually was."

That led Kanemoto and his team to present solutions that included LED-lit pathways and rotor blades to increase visibility of the helicopter's rotor blades.

"What I really liked about this class is that it's so hands-on. No one wants to be an engineer to sit in a lecture hall. You want to be an engineer to do something, to build something. What was cool about this class is that you get the funding to go and actually try to build something," added Kanemoto.

Some students have also taken advantage of additional opportunities through NSIN's X-Force summer internship and Maker programs, which provide additional funding, resources and guidance to advance conceptual ideas into working prototypes—like the Downward Shield, which decreases patient stretcher spinout and improves patient transportation safety during helicopter rescue missions.

"Hacking4X provides an opportunity to dig deeper, to really learn about the user, learn about different customers, learn about soldiers in the field and create products that really change the world," said 25th ID Captain Mahdi Al Hussein, who worked with Kanemoto's team. "This is what it means to really be an engineer or a computer scientist or in the business field. It means actually implementing your craft in a way that affects the lives of others."

Addressing Hawai'i's High Cost of Living

For the programs' first private industry partnership, students worked with First Insurance Company of Hawai'i to address increasing deferred maintenance costs for rampant water damage repairs in aging condominium buildings, the number one source of insurance claims and a top driver of insurance premiums.

The team created an educational website and app to provide property managers, condo board members, owners and insurance companies with access to interactive training videos and quizzes to be able to identify signs of water damage in order to address repairs sooner.

Securing Internships and Jobs

Since the course launched, 86 students from UH Mānoa and University of Hawai'i Maui College have participated in the program and more than a dozen have secured internships and jobs as a result, crediting the course for helping them develop professional skills and network.

"Working with the DoD and other private sector partners on real-world problems and project-based team learning is the best way for our students to get the kind of experience they need once they graduate," said Brennon Morioka, dean of the UH Mānoa College of Engineering. "This program is giving our students an opportunity to learn more about themselves and how they approach teamwork, working for customers and clients, and on projects where they can see an actual product that can be used in the real world."

Due to the success of the program, UH plans to continue to expand the program to address community issues in its other research areas of excellence, including healthcare, energy, water and climate resilience and food security.

FACING PAGE: *H4X students visit Schofield Barracks*

TOP: *H4X end-of-year presentation at The Entrepreneurs Sandbox*

BOTTOM: *H4X Fall 2022 student teams and program partners at Schofield Barracks Lightning Lab for their end-of-semester presentations*

A HITIDE of Innovation

"PIVOTS ARE A PERMANENT FACT OF LIFE FOR ANY GROWING BUSINESS. Even after a company achieves initial success, it must continue to pivot." – Eric Ries, Fast Company

Like the startups that it serves, the Hawai'i Technology Innovation Development Ecosystem, a University of Hawai'i (UH) incubator better known as HITIDE, continues to adjust and improve its program and offerings to better support the university's "deep tech," science-based startup companies.

The novel 24-month incubator provides customized education, guidance and networking opportunities that complement and support the unique demands and experiences of academic entrepreneurs, many of which have full-time teaching and/or research positions.

In addition, HITIDE offers up to $50,000 in seed funding including matching funds for those that secure a Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) federal grant and matching grant with Hawaii Technology Development Corporation (HTDC).

Enhanced Program Offerings

Since piloting the incubator in 2022, UH has brought on significant resources to build and strengthen HITIDE's curriculum and opportunities, including NSF I-Corps and a new collaborative partnership with MassChallenge, a nonprofit that connects startups, experts, corporations, and communities to grow and transform business and economies.

"Partnering with MassChallenge provides a huge opportunity to connect local innovators and entrepreneurs with a global network of thousands of innovators and entrepreneurs," said Vassilis L. Syrmos, UH vice president for research and innovation. "They bring a powerhouse of mentors and potential partners from major corporations, government contractors, and other institutions who have the experience, insight and influence in the sectors that our HITIDE cohort companies are trying to get their technologies into."

In addition to growing HITIDE's mentor and networking pool, MassChallenge is providing in-depth education around: pitching; sales and marketing; financial modeling and projections; and funding opportunities including tips and tricks on securing federal grants.

"The mentor-matchmaking process has been a truly enriching experience, allowing me to learn from seasoned and accomplished professionals who share a similar career path and offer invaluable insights for my entrepreneurial growth," said Marcelo Kobayashi, HITIDE Cohort 2 member and Generative Design Software founder and chief technology officer. "My experience with HITIDE has been nothing short of transformative and the engaging coaching and other interaction sessions so far have not only been enlightening but also enjoyable, playing a pivotal role in refining my business pitch."

Anticipated Outcomes

"Developing and advancing technology for commercialization can be a winding and complicated endeavor, and having coaches and mentors that can empathize and support individual journeys can help companies mitigate or even avoid some of the challenges and pitfalls, and expedite their progress and success," said George Yarbrough, HITIDE program lead and associate director of entrepreneurship programs for the UH Office of Innovation and Commercialization (OIC).

At the end of the program, all cohort participants should be able to walk away from HITIDE with a solid understanding of their product-market fit; a federal grant or contract; a broader and stronger business network; and milestones to qualify them for a growth accelerator to help them scale their business.

"We are here to provide the right tools and resources to build business acumen and advance technology development," added Yarbrough.

"We are pleased to support this diverse group of UH startups, said Interim OIC Director Steven Auerbach. "Their innovations reflect the caliber of our world-class research institution and have the potential to significantly advance health initiatives, space exploration and engineering design. With the right resources and support through HITIDE, we hope to help them change the world."

UH will begin recruiting for cohort 3 in summer 2023. For more information about HITIDE, visit: hitide.research.hawaii.edu.

"Their innovations reflect the caliber of our world-class research institution and have the potential to significantly advance health initiatives, space exploration and engineering design. With the right resources and support through HITIDE, we hope to help them change the world."

STEVEN AUERBACH

FACING PAGE: *Welcome reception for HITIDE Cohort 2*

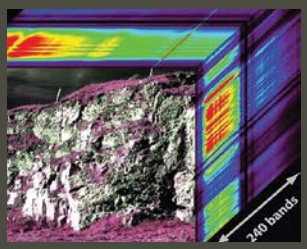
BOTTOM: *HITIDE Cohort 2 grounding day orientation*

New Cohort

In Fall 2022, HITIDE welcomed Cohort 2, five UH-affiliated startups with innovative technologies, including:

GENERATIVE DESIGN SOFTWARE is disrupting engineering design by using emerging, computer-aided, artificial intelligence (AI) engineering technologies and an advanced algorithm to pull various forms of data to improve engineering design, while reducing cost and the number of development cycles to prototyping in aerospace, automotive and building industries.

TEAM: Marcelo Kobayashi, Mechanical Engineering Professor, College of Engineering, UH Mānoa



HI-SPECTRAL provides groundbreaking snapshot hyperspectral imaging capabilities that advances the characterization and identification of different substances and materials beyond astronomical observations, with potential applications in health, agriculture, earth and environmental science.

TEAM: Haosheng Lin, Astronomer; Morgan Bonnet, Sr. Mechanical Engineer, Institute for Astronomy

INTERSTEL TECHNOLOGIES is on a mission to develop operations capabilities for the future of aerospace exploration through its iCOSMOS software, a fully responsive mission operations system for robust, coordinated operation satellites, UAVs, and other vehicles, in dynamic environments.

TEAM: Trevor Sorensen, Specialist and Project Manager; Eric Pilger, Lead Software Engineer; Miguel Nunes, Deputy Director and Systems Engineer; Lynzee Hoegger, Junior Software Engineer, Hawai'i Space Flight Laboratory (HSFL)

MAHINA AEROSPACE is a low-cost, spaceflight-ready, educational, small 1U cube satellite paired with a collection of STEM curricula that advances aerospace education and provides a low-cost option for industries to send integrated payloads to space.

TEAM: Amber Imai-Hong, Avionics Engineer and Program Manager; Frankie Zhu, Assistant Researcher; Luke Clements, Software Engineer; Chris Amendola, Systems Integrator, HSFL

XR CORE offers image processing and 3D printing using artificial intelligence segmentation to enhance presurgical planning and clinical training for current and future clinicians.

TEAM: Scott Lozanoff, Professor, Anatomy, Biochemistry and Physiology; Jesse Thompson, Technical Director of Anatomical Imaging; Thomas Noh, Clinical Assistant Professor, John A. Burns School of Medicine

NSF I-Corps™ Hub

HELPING ACADEMIC ENTREPRENEURS BRING THEIR INNOVATIONS TO MARKET

"This was the most eye-opening learning process in the last 10 years of my professional life. The program gave us new knowledge and practical tools to turn our invention into an innovation and discover new market segment opportunities."

ANDRAS BRATINCSAK

THE UNIVERSITY OF HAWAIʻI (UH) IS ONE OF FIVE NEW AND 10 TOTAL NATIONAL SCIENCE FOUNDATION (NSF) INNOVATION CORPS (I-CORPS™) HUBS in the nation that provide experiential, virtual entrepreneurship training to accelerate the translation of discoveries from the lab to the market. The program prepares scientists and engineers to extend their focus beyond the laboratory to increase the economic and societal impact of NSF-funded and other basic research projects.

The newly created NSF I-Corps™ Hub: Desert and Pacific region includes seven other universities—Arizona State University; University of Arizona; Northern Arizona University; University of California, San Diego; Boise State University; University of Idaho; and University of Nevada, Las Vegas.

Together they will be responsible for supporting academic researchers in science and engineering throughout the region by: creating and implementing innovation capacity-building resources, tools, and training activities; identifying, developing and supporting research with market potential; gathering, analyzing, evaluating, and utilizing the data and insights resulting from the experiences of those participating in local, regional and national I-Corps™ programs; providing opportunities to diverse communities of innovators; and sharing and leveraging effective innovation practices on a national scale, to impact economic growth and improve quality of life throughout the nation.

"Having an NSF I-Corps™ Hub in Hawaiʻi allows UH and the state to elevate, grow and diversify our innovation ecosystem and economy in line with UH's strategic initiative to drive economic diversification and development across the state through research, innovation, entrepreneurship and technology," said Vassilis L. Syrmos, UH vice president for research and innovation. "It also allows us to contextualize content and complement opportunities tailored to our local research and entrepreneurial community."

Selected cohort members will participate in four weekly virtual workshops to learn and apply the Lean Startup Methodology and customer discovery process in order to assess their inventions' market potential, and develop a business strategy to accelerate commercialization.

"This was the most eye-opening learning process in the last 10 years of my professional life," said Andras Bratincsak, Hawaiʻi Pacific Health pediatric and adult congenital cardiologist and associate professor at JABSOM, who participated in the inaugural Desert Pacific Hub cohort. "The program gave us new knowledge and practical tools to turn our invention into an innovation and discover new market segment opportunities."

Bratincsak and his team qualified for and plans to participate in the national NSF I-Corps™ program to advance their patent-pending methodology for improving the electrocardiograms (ECG). By allowing doctors to more accurately and rapidly identify heart-related issues, these novel ECG evaluation tools could improve early detection and result in timely interventions and lower complication risks. Through the national program, Brantincsak's team will be eligible to receive up to $50,000 to further the team's customer discovery and commercial potential evaluation process.

"NSF I-Corps™ provides a gold-standard in innovation training," said Steven Auerbach, UH project director for the NSF I-Corps™ hub. "Being part of a regional hub allows us to attract and integrate national resources and opportunities to enhance our innovation pathway, and we look forward to supporting more academic entrepreneurs through this program."

For more information about the UH Desert and Pacific region NSF I-Corps™ Hub, visit: research.hawaii.edu/icorps.

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Lava fountain in the Halema'uma'u crater at the summit of Kīlauea, June 2023
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