QUARTERLY NEWSLETTER

WINTER | 2024

UCONN
RESEARCH

RESEARCH TEAM DEVELOPS HYBRID PROPULSION COMMERCIAL AIRCRAFT

As the aviation industry strives to achieve net zero CO2 emissions by 2050, engineers at the University of Connecticut are designing a sustainable jet propulsion system with the ambitious goal of being cleared for take-off within the next three decades.

INVESTIGATING THE IMPACT OF WINDFARMS ON MARINE LIFE

Connecticut's first-ever wind farm project, Revolution Wind, is expected to power 350,000 homes in Connecticut and Rhode Island. Stakeholders in the project are embarking on a collaborative, multi-year fisheries program to study the relationship between offshore wind farms and marine life.

MEET THE RESEARCHER – Liisa Kuhn

Liisa Kuhn credits Willy Wonka's Everlasting Gobstopper for inspiring her work on designing bone grafts, growth plate repair gel—and most recently—breast prosthetics.

FIVE FACULTY NAMED HIGHLY CITED RESEARCHERS

Five University of Connecticut professors are repeat selections on a list of the world's most highly cited researchers. The list of Highly Cited Researchers is drawn from the highly cited papers that rank in the top one percent by citations for field and publication year in the Web of Science citation index over the past decade.

POSITIVE BEHAVIORAL INTERVENTIONS CENTER RECEIVES $21 MILLION TO REVOLUTIONIZE K-12 EDUCATION

The Center on PBIS, a multi-institution initiative headed by researchers at the University of Oregon, the University of Connecticut, and the University of South Florida, has been changing the way kids learn for over 20 years – and counting.

CHEMIST UNLOCKS PLASTIC ALTERNATIVES USING PROTEINS AND CLOTHING SCRAPS

Fed up with single-use, non-biodegradable plastics, Professor Emeritus Challa Kumar decided to use his chemistry expertise to develop plastic-like materials from natural sources.

STAFF HIGHLIGHT – Michael Invernale

UConn's own Michael Invernale, a senior licensing manager in Technology Commercialization Services was recently honored as one of only three university staff in the U.S. selected for the prestigious Howard Bremer Scholarship.

RESEARCH TEAM DEVELOPS HYBRID PROPULSION COMMERCIAL ELECTRIC AIRCRAFT

A UConn team and fellow research partners are designing a carbon-neutral energy storage and power generation system that could serve as an alternative for aircraft propulsion. This Boeing 737-sized airplane model is equipped with efficient open fan propulsors on the wings and fuel cell powerplants in the rear fuselage. (Image courtesy of John Carroll/University of Louisiana)

By Olivia Drake - UConn College of Engineering

'BUILDING A MORE SUSTAINABLE FUTURE FOR OUR UNIVERSITY, OUR NATION, AND THE WORLD IS THE GREAT CHALLENGE OF OUR LIFETIME'

As the aviation industry strives to achieve net zero CO2 emissions by 2050, engineers at the University of Connecticut are designing a sustainable jet propulsion system with the ambitious goal of being cleared for take-off within the next three decades.

While most aircraft rely on jet fuel to power a flight, the combustion of this fossil fuel releases greenhouses gases into the atmosphere, contributing to climate change and the depletion of finite oil resources. Using sustainable aviation fuels (SAF) is a viable option, but some scientists, like those at UConn, are exploring newer technologies such as using fuel cells for hybrid propulsion.

"This is an amazing time to see humans starting to transition from using internal combustion engines to electrics; kind of like when we moved from wood to coal and coal to oil," says David L. Daggett, a scholar affiliated with UConn's Center for Clean Energy Engineering (C2E2).

"This is an amazing time to see humans starting to transition from using internal combustion engines to electrics; kind of like when we moved from wood to coal and coal to oil."

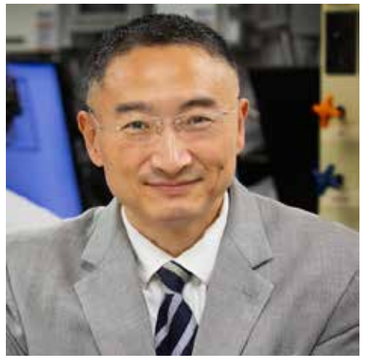
— David L. Daggett, C2E2 Scholar

A UConn team and fellow research partners are designing a carbon-neutral energy storage and power generation system that could serve as an alternative for aircraft propulsion.

The proposed system will consist of optimally sized fuel-to-electric power conversion devices (fuel cells and turbogenerators) using carbon-neutral SAF. Batteries will provide additional electrical power to the aircraft during the power-hungry climb phase of a flight and be recharged during descent.

Senior Design engineering students are currently building a small-scale airplane to demonstrate the concept.

The project, titled "High Performance Metal-Supported Solid Oxide Fuel Cell (SOFC) System for Range Extension of Commercial Aviation," is supported by a $4.5M cooperative agreement from the U.S. Department of Energy Office of Advanced Research Projects Agency – Energy (ARPA-E) under its Range Extenders for Electric Aviation with Low Carbon and High Efficiency (REEACH) Program. This grant will support Phase II of the project over a two-year period.



Xiao-Dong Zhou is the PI of the "Solid Oxide Fuel Cell (SOFC) System for Range Extension of Commercial Aviation" project.

"We are thrilled that ARPA-E is continuing to support this project as we've already made significant progress," says Xiao-Dong Zhou, the Nicholas E. Madonna Chair in Sustainability, Connecticut Clean Energy Fund Professor of Sustainable Energy, director of C2E2, and professor of chemical and biomolecular engineering, materials science and engineering, and mechanical engineering at UConn.

"The DOE ARPA-E program is immensely competitive and has been highly lauded by the National Academies, academia and industry to push the technology to market," says Subhash Singhal, a member of the National Academy of Engineering (NAE), and Battelle Fellow Emeritus at the Pacific Northwest National Laboratory.

Phase I of the project began in August 2020, when the U.S. Department of Energy first awarded $33 million in funding to 17 projects as part of the ARPA-E REEACH program. Zhou, who worked at the University of Louisiana at Lafayette at the time, received $2,263,000 in funding to develop a concept that uses innovative fabrication techniques for high-performance, ultra-low weight, and low-cost solid oxide fuel stacks. Fuel cell stacks generate electricity through an electrochemical process, rather than combustion.

The Phase I study showed that SOFCs and batteries have now progressed enough to consider fuel cells to power future long-range commercial airplanes with no harmful emissions or performance degradation. Unlike traditional batteries, which store energy and must be periodically recharged, fuel cells can continuously generate electricity if the SAF or renewable liquid natural gas and an oxidizer (air) are continuously supplied.

For Phase II, the team of researchers will refine their initial airplane design and fuel cell integration concepts to make them easier to commercialize.

"You have to consider that very high development costs result in commercial airplane designs that are typically produced for 50-some years," Daggett says. "Incorporating some changes now will enable that future airplane to possibly morph into an all-electric airplane within its likely 50-year design life."

In this UConn study, the team is using solid oxide fuel cells, which operate at high temperatures, as opposed to proton exchange membrane (PEM) fuel cells that operate at lower temperatures. SOFCs can use a turbine downstream to recover high quality heat energy.

"This results in more efficient utilization of the fuel than today's low temperature PEM fuel cells as well as future turbine engines," Scott Swartz, chief technology officer and co-founder of Nexceris, explains.

Other members of the C2E2 research team at UConn include Wilson Chiu, professor of mechanical engineering; Yudong Wang, assistant research professor of mechanical engineering; Stoyan Bliznakov, associate research professor; and Nengneng Xu, assistant research professor.

Once the designs are finalized, Nexceris will work to manufacture and commercialize the SOFC stack technology. UConn and Nexceris have had discussions with potential SOFC-based aviation system integrators, such as Boeing, General Electric, Rolls-Royce, Pratt & Whitney, and others, to secure licensing arrangements.

"This project, led by Professor Zhou and his outstanding team, will benefit UConn's research innovation efforts while contributing to carbon neutrality," says UConn President Radenka Maric, Connecticut Clean Energy Fund Professor of Sustainable Energy in the departments of chemical and biomolecular engineering and materials science and engineering. "Building a more sustainable future for our university, our nation, and the world is the great challenge of our lifetime. UConn must always be at the forefront of that effort."

UCONN, PARTNERS INVESTIGATING THE IMPACT OF WIND FARMS ON MARINE LIFE

(Sean Flynn/UConn Photo)

By Loretta Waldman, for the Office of the Vice President for Research

UCONN, ORSTED, AND EVERSOURCE LAUNCHING IMPACT STUDY ON PROJECT POWERING 350,000 HOMES

On Tuesday, Nov. 14, stakeholders in Connecticut's first-ever wind farm project gathered at UConn's Avery Point campus to announce a collaborative, multi-year fisheries program to study the relationship between offshore wind farms and marine life.

UConn will lead the study and a variety of related programs funded through a $1.25 million grant from developers Orsted and Eversource. The groundbreaking clean energy project is expected to generate enough electricity to power 350,000 homes in Connecticut and Rhode Island, starting in 2025.

Campus dean and Chief Administrative Officer Annemarie Seifert called the project and partnership a "potential game-changer" for Connecticut. She noted that in addition to funding cutting-edge research, the grant will support opportunities for students, and related educational programs that include a community lecture series. Speaking on behalf of Pamir Alpay, UConn's Vice President for Research, Innovation, and Entrepreneurship, Seifert underscored UConn's commitment to combatting the devastating effects of climate change and securing a sustainable future powered by clean energy.

"It is critical that we balance our research and advancement into new wind energy with our commitment to stewardship of the environment," she said, quoting a statement by Alpay. "UConn researchers, including our superb students, have a unique opportunity to help advance sustainable and renewable technologies and study the potential impact directly from Connecticut's shoreline."

The 704-megawatt project known as Revolution Wind will be located 32 miles southeast of Connecticut, 15 miles south of Rhode Island, and 12 miles southwest of Martha's Vineyard. The wind farm will have a total of 65 turbines that will be assembled and shipped from the State Pier in New London. Construction is expected to be completed in 2024, with commercial operation set to begin in 2025. UConn is working with Orsted to identify the specific focus of the research, which will involve the trophic dynamics of fish habitat, particularly the interaction between the wind farm and marine life, said Evan Ward, professor and head of UConn's Avery Point-based Marine Sciences Department.

UConn is Connecticut's flagship oceanographic institute, and the Avery Point campus is home to multiple marine-related programs and the school's 90-foot research vessel R/V Connecticut. While marine science is a critical component of the study, researchers from the Department of Geography and other social science programs will also be involved, probing topics such as the social and economic impact of the project.

The partnership with UConn Avery Point builds on Orsted and Eversource's multi-year research partnership with Mystic Aquarium. Announced in 2022, it is one of the nation's first comprehensive studies of the potential effects of offshore wind turbines on marine mammals and sea turtles.

MEET THE RESEARCHER

LIISA KUHN

Professor of Biomedical Engineering, UConn School of Dental Medicine

By Olivia Drake - UConn College of Engineering

Professor of Biomedical Engineering Liisa Kuhn credits Willy Wonka's Everlasting Gobstopper for inspiring her work on designing bone grafts, growth plate repair gel, and—most recently—breast prosthetics.

"The Gobstopper candy has all these layers, and each layer lets them experience a different course of a meal," says Kuhn, who has a dual appointment with the School of Dental Medicine and the College of Engineering. "Similarly, in my own research, I'm working with multilayered structures that provide timed release of multiple factors to improve bone and cartilage healing."

Now in her 22nd year at UConn, Kuhn is directing the Beekley Lab for Biosymmetrix, where she's developing a patent-pending process for using a 3D bioprinter to "print" personalized breast prosthetics for cancer survivors. The multi-layered structure of the prosthetic will improve the quality and comfort of people's lives after breast cancer.

"I'm in the School of Dental Medicine, and I know dentists are taking digital images of patients' teeth and using computer aided design and computer aided manufacturing to create a crown, sized exactly to the exact shape and size needed," she says. "So why couldn't we apply the same idea and create customized prosthetics?"

Kuhn learned to take 3D photos of a woman's chest and worked with a CAD designer to convert the images to a file that could be 3D printed.

Professor of Biomedical Engineering Liisa Kuhn is director of the Beekley Lab for Biosymmetrix.

Unlike a regular 3D printer that fabricates objects using a solid plastic filament, the bioprinter used by Kuhn extrudes an elastomer gel that results in a lightweight, flexible, and porous product with an open cell foam design. She coined the name of the process, "Biosymmetrix."

Kuhn, whose other research interests focus on drug delivery and bone regeneration, including developing customized bone grafts with controlled drug release to rejuvenate bone healing in older women, hopes the prosthetics are another way to help women live more comfortable lives.

"Women's positive response to the prosthetics makes all the hard work worthwhile," Kuhn says. "I feel so lucky to have found a meaningful way to use my engineering skills to help these women."

Professor Kuhn shows the difference between a standard, non-implanted breast prosthetic and her 3D printed model. (Lab photos courtesy of UConn Today)

FIVE FACULTY NAMED HIGHLY CITED RESEARCHERS

(Tom Rettig/UConn Photo)

By Mike Enright '88 (CLAS), University Communications

HIGHLY CITED RESEARCHERS RANK IN TOP ONE PERCENT OF CITATION FREQUENCY

Five University of Connecticut professors are repeat selections on a list of the world's most highly cited researchers.

The 2023 Highly Cited Researchers list, released recently by Clarivate and the Web of Science index, uses both quantitative and qualitative analysis to identify individuals from around the world who have demonstrated significant and broad influence in their chosen field or fields of research.

The list of Highly Cited Researchers is drawn from the highly cited papers that rank in the top one percent by citations for field and publication year in the Web of Science citation index over the past decade.

The list also identifies the research institutions and regions where they are based.

The methodology that determines the "who's who" of influential researchers draws on the data and analysis performed by bibliometric experts and data scientists at the Institute for Scientific Information at Clarivate.

The data is taken from 21 broad research fields within Essential Science Indicators. The fields are defined by sets of journals and exceptionally, in the case of multidisciplinary journals such as Nature and Science, by a paper-by-paper assignment to a field based on an analysis of the cited references in the papers. This percentile-based selection method removes the citation advantage of older papers relative to recently published ones, since papers are weighed against others in the same annual cohort.

Web of Science Group, a Clarivate Analytics company, organizes the world's research information to enable academia, corporations, publishers and governments to accelerate the pace of research. It is powered by Web of Science, the world's largest publisher-neutral citation index and research intelligence platform.

The UConn faculty on the list are:

Robin Chazdon, professor emeritus of ecology and evolutionary biology in the College of Liberal Arts and Sciences, and a member of the Center for Environmental Sciences and Engineering.

Yangchao Luo, associate professor in the Department of Nutritional Sciences in the College of Agriculture, Health and Natural Resources.

Vijay A. Rathinam, associate professor of immunology and director of the Graduate Program in Immunology at the UConn School of Medicine.

The late **George Weinstock**, professor of genetics and genome sciences at the UConn School of Medicine.

Zhe Zhu, associate professor of remote sensing in the Department of Natural Resources and the Environment in the College of Agriculture, Health and Natural Resources

Rathinam was named to the list for the fifth year in a row; Chazdon, Weinstock, and Zhu were named for the fourth year in a row; while Luo was named for the fourth time in the past five years.

POSITIVE BEHAVIORAL INTERVENTIONS CENTER RECEIVES $21 MILLION TO REVOLUTIONIZE K-12 EDUCATION

By Mac Murray

THE CENTER ON PBIS HAS BEEN CHANGING THE WAY KIDS LEARN FOR OVER 20 YEARS – AND COUNTING

Brandi Simonsen can skillfully sum up the fundamental tenets of the school behavioral support system of Positive Behavioral Interventions (PBIS), to which she has devoted her research career: "The idea is setting every kid up for success, and directly teaching the social, emotional, and behavioral skills they need in school and beyond."

In the classroom, Simonsen explains, this translates to teachers and students explicitly teaching and learning shared positive behavior expectations, like being kind, and recognizing students for modeling these values, "instead of waiting for a kid to make mistakes and then correcting them."

Simonsen co-directs the National Technical Assistance Center for Positive Behavioral Interventions & Supports (Center on PBIS), along with Kent McIntosh of the University of Oregon and Heather George of the University of South Florida. Other UConn faculty and research associates affiliated with the Center on PBIS include Jen Freeman, Susannah Everett, Katie Meyer, Karen Robbie, and Nicole Peterson.

The US Department of Education has recently awarded $21 million to the Center to support its programming over the next five years, representing a substantial federal investment in the continuance and expansion of the program.

"For many of my mentors, PBIS as an approach came out of the experience that they were often being called in to work with individual students who were struggling. And there was a missing piece where folks were not understanding that the kids were struggling because the system wasn't working for them," says Simonsen, who is a professor of special education in the Neag School of Education. "This mentality affects the kid. The approach that we have been advocating for, instead, is how do we fix the environment to be more supportive of students?"

Brandi Simonsen at the Neag School of Education on March 27, 2019. (Sean Flynn/UConn Photo)

Researchers at the Center believe that the PBIS model is uniquely suited to respond to the challenges of K-12 education in the twenty-first century, especially following the multiyear classroom disruption of the COVID-19 pandemic. PBIS integrates cutting-edge research on best practices in education with a focus on equity and cultural competence. To date, it has been implemented at more than 27,000 US schools.

The PBIS model integrates many different elements to support positive outcomes for all people involved in an educational system, including students, faculty, and staff.

When PBIS systems are implemented with fidelity, schools report marked benefits – greater wellbeing for both students and teachers, increased academic performance, decreased incidences of bullying and student-reported drug/alcohol abuse, and decreased reliance on exclusionary discipline measures like principal's office visits and suspensions. Following the framework means that students are more able to remain a part of the classroom community, as behavioral challenges are understood holistically and addressed with empathy.

For Simonsen, the most important part of her work with the Center is not how many papers it publishes or how much funding it receives (though the numbers are impressive on both fronts), but "how I can make sure that kids actually experience better days in their classroom contexts." She is a parent of two school-aged children herself, and says that she's been able to chart the effects of PBIS implementation on her kids as more local schools have adopted the framework.

"As a family member, it has all been really positive to watch," she says. "My kids are having the benefit of these experiences, and their schools are making efforts to support all students' social, emotional, and behavioral needs through PBIS."

With the latest round of funding, Simonsen will continue her work solidifying UConn as a hub for PBIS research and support for the entire Northeast, where it supports a regional network of state leaders.

NEW & NOTABLE FACULTY AWARDS

RESEARCH AWARDS >$1 MILLION, OCTOBER 2023 - JANUARY 2024

PI: Abhinav Upadhyay
CAHNR
Enhancing Microbial Safety and Production Efficiency in Organic Poultry Farming: An Interdisciplinary Investigation of Innovative Strategies
$3,340,000

PI: Jamie M. Vaudrey
CLAS
2023-2024 CT NERR Operations Award
$1,017,113

PI: Inge-Marie Eigsti
CLAS
Ready to CONNECT: Conversation and Language in Autistic Teens
$2,519,129

PI: Jason Chang
CLAS
UConn Hartford Transformation, Equity, Access, and Sense of Belonging (TEAS) Project
$1,958,724

PI: Kenneth T. Barone
CLAS
Program to Monitor and Prohibit Racial Profiling in Connecticut
$1,199,677.02

PI: Jonathan E. Ward
CLAS
Avery Point Offshore Wind
$1,250,000

PI: Xiuling Lu
PHARM
Investigating the Impact of API Purity, Lipid Source and Manufacturing Process on Performance and Quality of Complex siRNA Lipid Nanoparticles
$1,530,889

PI: Diane J. Burgess
PHARM
Impact of API CQAs on In Situ Forming Implants and Understanding In Vitro and In Vivo Performance Differences
$1,103,886

PI: Kimberly M. Estep
SSW
Arizona – Tiered Care Coordination and MRSS Implementation Project
$3,479,525

PI: Kimberly M. Estep
SSW
Texas Wraparound Training
$1,196,093

PI: Daniel D. Burkey
ENG
Community, Identity, Competence: Supporting Low-Income and First-Generation Students in Computing and the Data Sciences at the University of Connecticut
$2,499,411

PI: Wilson K. Chiu
ENG
CFA-23-28941 Multiple Uranium Complexes in Chloride Fast Reactor Molten Salt Properties
$3,340,000

PI: Rainer J. Hebert
ENG
Weldment Research and Prototyping for Hypersonic Air-Breathing Weapons and Advanced Material Manufacturing Research
$10,398,708

PI: Kay Wille
ENG
Long-Term Risk Management and Mitigation Strategies of Crumbling Foundation
$4,000,000

PI: Xiao-Dong Zhou
ENG
High Performance Metal-Supported SOFC System for Range Extension of Commercial Aviation
$4,500,000

PI: Junbo Zhao
ENG
Proactive: Predictive Community Outage Preparedness and Active Last Mile Visibility Feedback Autonomous Restoration
$2,250,000

PI: Alexander Russell
ENG
Specification and Evaluation of Electronic Pollbooks
$1,160,001

PI: Thanh Nguyen
ENG
Single-Administration Self-boosting Microneedle Platform for Vaccines
$1,979,682

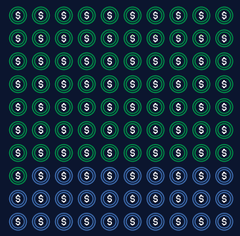
PI: Emmanouil N. Anagnostou
ENG
The UConn OPM- Enhancing Prediction Accuracy and Supporting the Emergency Response Team with Real-Time Outage Forecasts
$ 2,443,629

RESEARCH BY THE NUMBERS

FISCAL YEAR 2023 TOTALS

NEW AWARDS BY CAMPUS

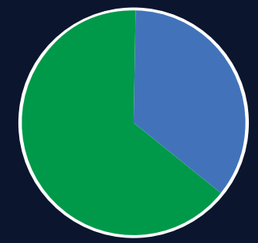
Each $ Is Equivalent To 1%



STORRS/REGIONAL	UCONN HEALTH
$229,559,035	$91,970,081

TOTAL OF NEW AWARDS
$321,529,116

EXPENDITURES BY CAMPUS



STORRS/REGIONAL	UCONN HEALTH
$206,428,785	$115,880,569

TOTAL EXPENDITURES
$322,309,354

CHEMIST UNLOCKS PLASTIC ALTERNATIVES USING PROTEINS AND CLOTHING SCRAPS

By Anna Zarra Aldrich '20 (CLAS), Office of the Vice President for Research

Challa Kumar, professor emeritus of chemistry, in his lab. (Contributed photo)

Every year, 400 million tons of plastic waste are generated worldwide. Between 19 and 23 million tons of that plastic waste makes its way into aquatic ecosystems, and the remaining goes into the ground. An additional 92 million tons of cloth waste is generated annually.

Challa Kumar, professor emeritus of chemistry, "fed up" with the tremendous amount of toxic waste people continually pump into the environment, felt compelled to do something. As a chemist, doing something meant using his expertise to develop new, sustainable materials.

"Everyone should think about replacing fossil fuel-based materials with natural materials anywhere they can to help our civilization to survive," Kumar says. "The house is on fire, we can't wait. If the house is on fire and you start digging a well – that is not going to work. It's time to start pouring water on the house."

Kumar has developed two technologies that use proteins and cloth, respectively, to create new materials. UConn's Technology Commercialization Services (TCS) has filed provisional patents for both technologies.

"Chemistry is the only thing standing in our way," Kumar says. "If we understand protein chemistry, we can make protein materials as strong as a diamond or as soft as a feather."

The first innovation is a process to transform naturally occurring proteins into plastic-like materials. Kumar's student, Ankarao Kalluri '23 Ph.D., worked on this project.

Proteins have "reactor groups" on their surfaces which can react with substances with which they come into contact. Using his knowledge of how these groups work, Kumar and his team used a chemical link to bind protein molecules together.

Unlike synthetic polymers, because Kumar's material is made of proteins and a bio-linking chemical, it can biodegrade, just like plant and animal proteins do naturally.

Kumar's second technology uses a similar principle, but instead of just proteins, uses proteins reinforced with natural fibers, specifically cotton.

While Kumar's team has only worked with cotton so far, they expect other fiber materials, like hemp fibers or jute, would behave similarly due to their inherent but common chemical properties with cotton.

"The protein naturally adheres to the surface of the protein," Kumar says. "We used that understanding to say 'Hey, if it binds so tightly to cotton, why don't we make a material out of it.' And it works, it works amazingly."

STAFF HIGHLIGHT
MICHAEL INVERNALE

By Joanna Smiley, Technology Commercialization Services

UConn's own Michael Invernale, a senior licensing manager in Technology Commercialization Services was recently honored as one of only three university staff in the U.S. selected for the prestigious Howard Bremer Scholarship, sponsored by the Association of University Technology Managers (AUTM). They will be flying to San Diego in February for a special awards ceremony at AUTM's annual conference.

The scholarship supports future generations of technology transfer professionals who demonstrate exemplary levels of creativity and innovation. Invernale, who has authored more than 18 publications and holds four patents, has tasted both failure and success throughout the course of their esteemed career in science and business. Throughout their career, they've realized "every single perspective is valuable, and everybody's brain works differently," which is an asset.

They believe diversifying technology commercialization isn't only important for equity, but for the economic viability of potentially life changing startup inventions.

"The molecules don't care whether you're black or white or a woman or anything, right," Invernale said. "You're solving problems now that are so complex and across so many different disciplines.

UCONN RESEARCH

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