We are happy to present the 2021 Research Report for the University of Maine. This has been a remarkable year for research and scholarly achievements at Maine’s land, sea, and space grant university, despite the continuation of a global pandemic and the significant difficulties that have resulted from it. Through this annual report, we celebrate the great achievements of our talented and resilient faculty, staff, and students. Their high level of accomplishments has been exemplary and has enabled the university to reach new heights as Maine’s flagship research university of global impact and local relevance.

In fiscal year 2021, among the major accomplishments, the university community set a new record by generating $133.6 million in external funding in support of research and development activities, as compared to $56.9 million in fiscal year 2017, corresponding to a 135% increase over the given five-year period, and an all-time high record by the university. In fiscal year 2021, research and development expenditures also reached a new all-time high record of $179.3 million as compared to $99.5 million in fiscal year 2017, corresponding to an increase of 80.2% over the given five-year period. Moreover, with respect to graduate enrollment, in spring 2021 doctoral student enrollment for the first time in the university’s history exceeded 500, and in fall 2021, both overall graduate student enrollment and doctoral student enrollment reached new all-time highs for the university at 2,542 and 532, respectively.

These accomplishments stem from the university’s pursuit of growth and advancement in research and graduate studies, as part of a strategic roadmap that has been pursued for the realization of a modern 21st century research university, with close alignment and connection between academic and research programs, removal of barriers to collaboration, and investment in people and infrastructure. Through these efforts and as shown by the examples highlighted in this annual report, major university-wide programs and initiatives have been realized in diverse areas, ranging from artificial intelligence, marine sciences, and forest economy, to visual and performing arts, health and life sciences, and medicine.

To learn more about the impactful research and scholarly achievements realized at the University of Maine, we invite you to visit our research website, or contact us at research@maine.edu.

Joan Ferrini-Mundy
President

Kody Varahramyan
Vice President for Research and Dean of the Graduate School
Top 20% of universities for National Science Foundation (NSF) Funding

$179.3 Million
Total research and development expenditures

$133.6 Million
Total research and development funding

$199.5 Million
2021 ALL-TIME HIGH

2018 FISCAL YEAR
$129.9 MILLION
2019 FISCAL YEAR
$137.7 MILLION
2020 FISCAL YEAR
$157.1 MILLION
2021 FISCAL YEAR
$179.3 MILLION

106% Increase in federal funding over five years

100% Increase in awards greater than $1 million over 5 years

Total Federal Awards

87% of all university research in Maine

150+ research institutes, centers, and labs

87% of Ph.D.s conferred in Maine*

44 new faculty hired

*Reported on the 2020 NSF Survey of Earned Doctorates

A Modern 21st Century Research University
A new Portland Gateway for the University of Maine has been established to provide a one-stop connection and point of access to the vast array of innovative research, education and outreach resources, programs and services at the state’s research university headquartered in Orono and its facilities statewide. The Portland Gateway offers opportunities for tailored partnerships to advance specific business or corporate needs, outreach and community engagement opportunities, and professional career in connection with the UMaine Research enterprise. Alice “Pips” Veazey is the inaugural director of the Portland Gateway. She joins UMaine from the University of Alaska Fairbanks, where she was the principal investigator and project director of the Alaska National Science Foundation Established Program to Stimulate Competitive Research (NSF EPSCoR).

“We are delighted that Dr. Veazey has returned to her native Maine to direct efforts at the University of Maine Portland Gateway, ” says UMaine President Joan Ferrini-Mundy. “This will be the front door to university research engagement in Portland and beyond, comprehensively serving the R&D and business needs, preparing the knowledge and innovation workforce, and being a major contributor to societal advancement and economic development.”

Veazey received a bachelor’s degree in psychology from Bates College, and holds a master’s degree in oceanography and Ph.D in team science leadership, both from the University of Alaska at Fairbanks. Her research focuses on fostering the development of large interdisciplinary initiatives. Over the past decade, she has led numerous teams of students, educators, scientists, decision makers and community partners to increase research competitiveness, promote economic development efforts and expand statewide workforce programs.

“I am eager to bring my collective experiences to the UMaine Portland Gateway and to dive into the exciting work that is taking place across the state,” Veazey says. “We have a unique opportunity to help shape a sustainable future for Maine by collaborating across disciplines, organizations, and economic sectors, addressing our shared challenges and creating opportunities for all Mainers.”

Veazey currently serves on the Board of Directors of the Arctic Research Consortium of the United States (ARCUS). In addition to being an ARCUS board member, she is an executive board member and founding member of the International Network of the Science of Team Science (INSciTS).
Graduate School Sets Records

I n spite of the continuing pandemic, the University of Maine’s graduate enrollment has consistently increased over the past few years, setting records in the 2020-21 academic year, and then breaking those records this fall term. A total of 2,542 graduate students were enrolled in classes for the 2021 fall semester, an increase from the previous year’s enrollment. This is the largest enrollment in the 103 years of graduate education at the University of Maine, which celebrated its centennial in 2021. The number of students enrolled rose by about 100 students.

Enrollment increases were seen in all degree categories (certificate, master’s and doctoral) with doctoral enrollment also setting an all-time high of 532 students. The reasons for success in graduate enrollment differ by degree type. In doctoral programs, the University of Maine’s success in attracting more external funding as it strives to attain Carnegie R1 status has greatly contributed to UMaine’s doctoral numbers. At the master’s level, the enrollment growth has been focused on online programs with the MBA and IT-related master’s and certificate programs, demonstrating significant growth. A common contributing factor to the graduate enrollment growth at all levels is the Graduate School’s success in attracting the applicants. Between 2019 and 2021, total graduate applications increased from 1,789 to 2,659, nearly 50% increase. Three new graduate initiatives have helped to increase the number of students entering UMaine graduate programs, including waivers for application fees and GRE, and the use of a holistic application review process rather than employing hard cutoffs. This has increased access to graduate education and presented opportunities to a wider group of students.

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The progress in improving access to graduate education has strengthened UMaine’s research and graduate mission, and helped advance the university’s diversity, equity and inclusion goals. This is reflected in the number of applications from students of color, which increased from 353 to 750 (127%) between 2019 and 2021, while admission and enrollment of minority students in graduate programs also demonstrated significant increases of 97% and 64%, respectively in 2021, while admission and enrollment of minority students in graduate programs also demonstrated significant increases of 97% and 64%, respectively in 2021, while admission and enrollment of minority students in graduate programs also demonstrated significant increases of 97% and 64%, respectively in 2021. This year the Graduate School’s success in attracting the applicants. Between 2019 and 2021, total graduate applications increased from 1,789 to 2,659, nearly 50% increase. Three new graduate initiatives have helped to increase the number of students entering UMaine graduate programs, including waivers for application fees and GRE, and the use of a holistic application review process rather than employing hard cutoffs. This has increased access to graduate education and presented opportunities to a wider group of candidates.

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Advanced Research Learning Center for Undergraduate Research

T he Center for Undergraduate Research’s primary mission is to increase, improve, and enhance undergraduate student participation and experiences in research, scholarship and creative activity. Undergraduate research allows motivated and interested students to become critically engaged in a culture of independent learning and participate in the creation of new knowledge. Through student-faculty collaborations and mentoring partnerships, students develop the tools and resources needed to achieve an authentic understanding of the research endeavor, the pinnacle of an educational experience.

Undergraduate research, broadly defined and understood, incorporates current students into the fabric of UMaine and attracts prospective students who want to be active participants in their education. Undergraduate research also provides an opportunity for faculty to expand their own research programs and enhance mentoring skills through training new members of their disciplines. CUGR achieves its mission by providing leadership, coordination and support for research activities across campus. It builds upon UMaine’s strengths and strategic goals as the state’s leading research university, taking advantage of the hundreds of faculty and graduate students involved in research and creative projects who can teach and mentor undergraduate researchers and scholars.

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Supported by the Office of Vice President for Research and Dean of the Graduate School, CUGR provides several fellowship programs in collaboration with the UMaine Institute of Medicine, UMaine Artificial Intelligence and Maine Space Grant Consortium (MSGC). This year CUGR named seventy-five undergraduate award winners, with projects spanning various disciplines, including history, art, new media, climate science, biochemistry and various fields in engineering. Each undergraduate proposal was awarded $1,500. Four winners of MSGC graduate research fellowships were also announced. The purpose of the MSGC fellowship and scholarship programs is to provide research opportunities to undergraduate and graduate students in aerospace technology, space science, human exploration/space development, Earth science and other science- or engineering-related fields. The focus of proposed projects must be aligned with the research priorities of NASA and Earth and space science strategic enterprises. Each MSGC project was awarded $6,000.

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The University of Maine Arts Initiative (UMAI) brings together faculty, administrators, staff and students committed to the principle that the arts play an integral role in public research institutions. The primary purpose of the new initiative is to increase resources and support for the arts, reinforce their significance, and enhance visibility on campus and beyond through strategic collaborations.

UMAI is founded on the principle that the arts play a fundamental role in public research institutions. The new initiative will advance this role of the arts in enriching the lives of individuals and communities through the creation, experience, research and enjoyment of art.

Through innovative and interdisciplinary collaborations, UMAI seeks to build a diverse, inclusive, sustainable, and equitable community of art researchers, practitioners, supporters and promoters. The new initiative is dedicated to societal well-being and enriching the lives of individuals and communities in the state of Maine and beyond.

“The UMaine Arts Initiative is part of a series of recently launched university-wide initiatives that are strategically linked to University of Maine System’s Research and Development Plan, and are supporting the realization of an innovation-driven Maine economy for the 21st century and, as part of this, addressing the workforce, and social and economic needs,” says Kody Varahramyan, vice president for research and dean of the Graduate School.

George Kinghorn, the executive director and curator of the Linda G. and Donald N. Zillman Art Museum–University of Maine, and Laura Artesani, chair of the Division of Music both serve as co-chairs, leading a steering committee composed of representatives from the visual, literary, and performing arts sectors from across UMaine and the University of Maine at Machias.

“In recent months the UMAI steering committee has developed a thorough framework for this new initiative that will advance UMaine’s creative research and visibility for the arts through innovative and collaborative projects,” says Kinghorn.

Through collaborations across multiple academic units, centers, museums and galleries, the UMaine Arts Initiative addresses the social and ecological challenges facing our world, while providing students with hands-on experience in the arts, a deeper understanding of arts research, and opportunities to learn from exhibitions, performances, programs and events.

“This exciting initiative will provide new opportunities and recognition for our thriving and vibrant arts community,” says Artesani.

The new effort will serve to bring greater visibility to the ways that the arts at the University of Maine can serve, enrich, and empower the people of the state of Maine, and work to provide funding for innovative and collaborative arts programming and research initiatives that foster a diverse, inclusive, and equitable arts community.

Marking the launch of the new initiative, the University of Maine Arts Initiative Seed Grant has been established. Grants will range from $5,000 to $15,000 and are intended to support new collaborations, with priority given to applicants from arts-oriented units.

For more detailed information about the initiative visit the UMaine Arts Initiative website.

UMaine Arts Initiative
Enriching lives through the arts

Student dancers participate in UMaine's International Dance Festival.
Bernie Vinzani, professor of art and book arts at the University of Maine at Machias, working with students Mirielle Uwase, left, and Praise Maker, right, in the book arts studio.

Creating an Impression in Machias and Beyond

By Bernie Vinzani’s love of teaching the art of printmaking began when he delivered a hands-on lesson to his peers in an undergraduate speech class at Indiana State University. He demonstrated how to make a print using a piece of cardboard and a potato.

Now, Vinzani is a professor of art and book arts at the University of Maine at Machias, where he continues to teach, as well as conduct research and refine his papermaking and printmaking skills. And, while at home on sabbatical during the pandemic, he added building a printing press to his repertoire.

Vinzani moved Down East in the early 1980s. He was ready for a change in scenery after earning a bachelor’s and a Master of Fine Arts in printmaking at Indiana State University, setting up a printmaking program at Vincennes University in Indiana, and working as a papermaker at Turner’s Handmade Paper.

“I had two places that I really wanted to live; that was upper Minnesota and Maine. It was one of those things as a kid, I just loved the North Woods, everything about it,” he says.

According to papermaking legend, if fireflies float around a water source, it’s a good omen for papermakers. Vinzani saw fireflies while looking at property near Machias, so Maine won out.

He has gained an audience both in Machias and far beyond. Vinzani’s pieces have been featured in “The Book of Fine Paper,” Hand Papermaking, American Craft magazine, and The Boston Globe. And his work has been exhibited at The VI International Print Biennial in Cracow, Poland, and at the Maine Experimental in Portland.

In 1993, Vinzani and a few other papermakers were chosen to curate paper for a Library of Congress collection. “It was quite an honor to know that our paper had been tested at that point, it was really sound paper and they could use it,” he says.

It was one of those things as a kid, I just loved the North Woods, everything about it,” he says.

In the age of electronic media, we are still a culture dependent on paper and print as elements of communication. Both are crucial elements to graphic design, which is a very strong communicative medium we depend on to get our ideas out to others,” he says.

The history of printmaking, including the beginnings of printing in the Western world, is of great interest to Vinzani. That includes Johann Gutenberg’s press, which had movable type and, for the first time, could relatively inexpensively print a large number of books.

He thought it would be beneficial for UMaine Machias students to print on a handpress, similar to Gutenberg’s. So, he began building one.

Vinzani studied dozens of different presses online, examined photographs, and contacted people who built presses. And he systematically critiqued each one. “Out of all of them, I came up with what I would do for consideration in building the press and what I probably would not do.”

The new “Common Press” press currently sits in Powers Hall, where he and students can create prints on it. It has 3¾-inch thick maple barn beams, which are heavy enough to exert sufficient pressure so the type is solid and the print turns out correctly.

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Vinzani is interested in the history of presses and papermaking, including how early currencies were printed, how stamps were made, and how fine books were made and printed. His research uncovers a deeper story. Vinzani says historical aspects offer insights into current use of printmaking and papermaking, and often can expand our understanding of contemporary innovation. “Throughout his home and shop, he has archives of pieces of paper; the oldest piece dates back to the 1500s.”
The University of Maine has established the FORest Economy, Sustainability and Technology (FOREST) initiative, a university-wide multidisciplinary effort to bring together university, industry, government, and community collaborators for the advancement of the forest-based economy in Maine.

Comprised of representatives from more than two dozen departments, colleges and organized research units within UMaine, FOREST is working to coordinate, communicate and collaborate across the University of Maine System (UMS) with local, state, federal and international partners to develop and deliver integrated research, education and outreach solutions that enhance the economic and ecological sustainability of forest-based communities.

"UMaine FOREST is part of a series of recently launched university-wide initiatives that are strategically linked to the University of Maine System’s Research and Development Plan, and are supporting the realization of an innovation-driven Maine economy for the 21st century and, as part of this, addressing the workforce, and social and economic needs," says Kody Varahramyan, vice president for research and dean of the Graduate School.

Maine’s forest resource is unique in many ways. Measuring over 17 million acres and covering nearly 90% of the state, it forms the largest contiguous block of undeveloped forestland east of the Mississippi. Largely privately owned and naturally regenerated, this economic keystone for many of our rural communities has been continually managed for wood products since before our nation’s founding. Maine remains the highest percent forested state in the country through resource management and sustainable harvesting practices rooted in prevailing scientific understanding.

Understanding, quantifying and optimizing the increasingly complex and interconnected relationship between resource management, harvesting practices, utilization, forest health, wildlife habitat and rural economic prosperity is a concept known as the forest bioeconomy. It bridges current forest-based businesses and policies with visionary thinking on sustainability, product applications and resource utilization.

To further advance this transformation, a better understanding of the trends and drivers within the global forest bioeconomy is needed. A combined knowledge of technological advances in concert with economic, social, political and environmental aspects of forest resource usage are paramount to the long-term success and prosperity of Maine’s forest bioeconomy.

For more detailed information about the initiative, visit the UMaine FOREST website, umaine.edu/forest.

The Dwight B. Demeritt Forest located in Orono and Old Town, Maine spans 1,478 acres of mixed forest stands, fields, and water. Leased and then deeded to the university to be managed by the Forestry Department in 1939, the land is used for education, demonstrations, research, and recreation.

The School of Forest Resources and Environment
Marine Aligned Research, Innovation, and Nationally-recognized Education (MARINE) Initiative
Advancing the Blue Economy in Maine and beyond

The state of Maine has 5,300 miles of beautiful coastlines and many other inland waterways. And8 throwing spaces for outdoor recreation and tourism. Maine’s marine environment is also home to an essential fishing and aquaculture industry. The UMaine MARINE Initiative pulls together researchers from across the University of Maine System, industry, government, and community collaborators to engage in innovative and interdisciplinary research, education, and outreach related to the marine area. These efforts are designed to enhance the social, environmental, and economic well-being of the state of Maine.

The initiative was started with regular convenings of the leadership of the School of Marine Sciences, Maine Sea Grant, the Lobster Institute, Aquaculture Research Institute, Center for Cooperative Aquaculture Research, Cooperative Extension, Darling Marine Center, and UMaine Machias, among others.

These schools, centers, and institutes are working on a diverse array of marine-related topics, including lobster populations and marine ecosystem responses to climate change, assessments of collaborative models to enable fisheries and climate change action partnerships, and the social dimensions of aquaculture.

One of the initiative’s objectives is to identify ways to exchange information between researchers across UMaine to discuss the work that is being done on marine-related issues. The University of Maine MARINE initiative serves as a forum of open conversations and meetings between researchers across UMaine to discuss the work that is being done on marine-related issues.

The University of Maine MARINE initiative began as a series of conversations and meetings between researchers across UMaine to discuss the work that is being done on marine-related issues.

To the university to help ensure that what scientists, researchers, and educators are doing is applicable to the people of the state. And it is important to ensure that the University’s network of expertise and facilities statewide reaches the communities that need it.

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The Blue Economy

The Blue Economy is vital to Maine’s being and initiatives like UMaine MARINE are essential to maintaining them. By connecting and working with government, industry, the public and other stakeholders, UMaine is able to provide the necessary resources and expertise to cultivate thriving coastal communities that engage with the Blue Economy.

Sustainability in Land-based Salmon Aquaculture

The University of Maine Aquaculture Research Institute (ARI), in collaboration with the University of Maryland Baltimore County (UMBC), has been awarded a $10 million U.S. Department of Agriculture (USDA) grant to research land-based salmon aquaculture.

The Sustainable Aquaculture Systems project, or SAS, brings together several academic and federal research institutions and nine industry partners from the U.S., Iceland and Norway as part of a National Institute of Food and Agriculture (NIFA) program, which provides funding to advance sustainability in agriculture. The project is led by the University of Maine, funded at $3.1 million, and is one of three projects designed to network stakeholders and develop a strategic roadmap for Atlantic salmon RAS in the U.S. UMaine plays a leadership role in both projects.

Recirculating Aquaculture Systems (RAS) have the potential to expand production and add resilience to domestic fish aquaculture. These land-based systems decrease reliance on coastal ecosystems, support a sustainable U.S. Atlantic salmon RAS industry that expands the domestic production of this critical seafood, reduce the environmental impacts, increase enhanced biocare, improved control of pathogens, and better disease management. SAS integrates research, education, and outreach to address the major challenges and roadblocks to RAS as defined by industry partners and community stakeholders.

Affiliated ARI faculty in engineering and marine sciences will concentrate on design, technology, and operational development for RAS systems; Affiliated ARI faculty in biology and marine sciences will focus on hatchery and wild salmon; Affiliated ARI faculty in marine and land sciences will lead the educational objectives of the project. Working with Maine Sea Grant, ARI will lead the outreach objectives.

The Sustainable Aquaculture Systems Supporting Atlantic Salmon project, or SAS 2, will advance the outreach objectives.

The Sustainable Aquaculture Systems Supporting Atlantic Salmon program as well as the workforce development and community outreach efforts for the project. This new funding is key to helping prioritize sustainability and the inclusive values that are important to advancing equitable rural development in Maine. UMaine is

The Sustainable Aquaculture Systems Supporting Atlantic Salmon project, or SAS 2, is supported by a $10 million U.S. Department of Agriculture (USDA) grant to research land-based salmon aquaculture.

The Sustainable Aquaculture Systems program, or SAS 1, is supported by a $10 million U.S. Department of Agriculture (USDA) grant to research land-based salmon aquaculture.

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Experiential Programs Innovation Central (EPIC)

Cutting-edge student-centered undergraduate education is the key focal point of the University of Maine Experiential Programs Innovation Central, or UMaine EPIC.

EPIC takes experiential learning to new heights. It is indicative of UMaine's commitment to excellence in undergraduate education, where learning goes beyond the classroom, and undergraduates from their first year through senior year have the opportunity to experience a unique and highly effective student-centered learning environment, getting in-depth learning and gaining highly desirable skills and experiences, which prepare them well to succeed after graduation.

Participating EPIC units provide integrated high-impact experiential learning through exposure to research, interdisciplinary experiences, new technologies, innovation, and design and prototyping. These centers include:

- Center for Undergraduate Research
- Advanced Manufacturing Center
- Center for Innovation in Teaching and Learning
- Foster Center for Innovation
- Innovative Media Research and Commercialization Center
- EPIC offers a Certificate in Research, Innovation, and Strategy (CRIS) for undergraduate students, designed to complement a student's core curriculum, and provide them with tangible skills to meet the needs of employers throughout Maine and across the world.

EPIC students create affordable crop monitoring system for small farms

A team of students making up the first cohort at the UMaine Experiential Learning Innovation Central (EPIC) engineered a low-cost monitoring system for local farmers. Guided by mentors Peter Schilling, Sean Taylor, and professor Ali Abedi, the multidisciplinary team included junior in civil and environmental engineering Kettie Cormier, first-year mechanical engineering student Camden Sayer, and Walter Lange, a junior studying finance.

According to the students’ research, current crop monitoring systems are catered toward larger industrial farms. But for start-up farms and small business owners, these systems are costly and not suitable for their scale of production. The team is solving the need to have low-cost systems as the “locally grown” movement highlights the importance of small agriculture businesses. The demand for locally sourced agricultural products is likely to increase as the environmental impact of shipping long distances continues to grow.

Cormier explains that small farms like orchards and woodlots struggle to compete with the expensive technology of industrial agriculture. “Small agricultural businesses need inexpensive technology solutions to monitor their fields, forests, orchards, and greenhouses,” says Cormier.

The team studied two technologies for prototypes: a wireless temperature monitoring system that scans crops with an infrared sensor, and a Wireless Sensor Network (WSN). WSN technology is used in agriculture to provide remote monitoring of temperature, humidity, soil moisture, and luminosity. Infrared temperature monitoring is a non-contact measurement of plant temperature. Both of these technologies were incorporated into the team’s proposal.

The proposed system is made up of four major parts that retrieve the variable data from the plants and then store it into computer software. Solar panels and a generator power the system while the sensors do their work capturing plant data. A router using an Arduino board then pushes up all the sensor data to a computer database where it can be analyzed by the farmer.

“The system is important for small farms because it would even the playing field,” says Sawyer. “It can provide insight to let farmers know when to water their crops, when to harvest, or just to check the plant’s health and environmental conditions.”

Future development of the team’s proposal includes a predictive data model designed to forecast conditions for crops. The students are also looking at developing a mobile application that displays the sensor information for farmers to use in the field.

Morgan Oehler, civil and environmental engineering major and 2021 MSGC Summer Undergraduate Fellowship awardee.
In 2021, Maine EPSCoR continued its mission to enhance the state’s research and development capacity and competitiveness through execution of the NSF EPSCoR RII Track-1 grant, Maine-eDNA. The Maine-eDNA project is a statewide, multi-institutional initiative aimed at establishing Maine as a national leader in environmental monitoring, ecological understanding and sustainability of coastal ecosystems. Maine-eDNA executed a successful field season in 2021, collecting thousands of water samples along Maine’s coastal ecosystems, and developing new bioinformatics pipeline analysis capabilities to process these samples, leveraging national supercomputing resources. The project continues to gain momentum, exhibited by securing more than $15.8 million of follow-on funding. Serving to develop workforce capacity in Maine, this grant supported 30 faculty, 22 graduate students and 20 undergraduate students in 2021.

EPSCoR programming engages stakeholders and develops partnerships through public outreach, including workshops and conferences. For example, Maine-eDNA led an eDNA session at the 2021 Maine Sustainability and Water Conference, involving diverse academic, agency, non-governmental organization and industry participants.

Maine Innovation Economy Advisory Board (MIEAB) oversees EPSCoR activities in Maine to ensure that project activities align with the specific needs of the jurisdiction. With guidance from MIEAB, Maine EPSCoR provides support and resources that enable researchers to engage the complex questions that face the state, such as climate change resilience of the Gulf of Maine ecosystems.

Harsh Environment Wireless Sensor DOE EPSCoR Award

The next generation of harsh environment materials and wireless sensor techniques are the focus of a $2.34 million Department of Energy (DOE) EPSCoR award for research led by University of Maine researchers Mauricio Pereira da Cunha and Robert Lad. The DOE award was one of nine initiatives funded nationwide for a total of $22 million. The UMaine research project received a DOE EPSCoR implementation grant in 2019.

Pereira da Cunha, professor of electrical and computer engineering, and Lad, professor of physics, will lead an interdisciplinary, multi-institution team of researchers. They include eight UMaine faculty members and other researchers from the University of New Hampshire, Bates College and the University of Southern Maine. The research will employ the Frontier Institute for Research in Sensor Technologies (FIRST) facilities and equipment, which is the university’s premier research center for conducting nanotechnology and advanced sensor research.

Their primary goal is to address the pressing need for a new generation of sensor materials, devices and systems that can operate under extreme temperatures (up to 2000° F) and harsh environments that may consist of erosive particles and oxidizing, reducing or corrosive gases. These types of conditions are often found in the rapidly expanding energy sector, such as power plants, gas turbine generators, renewable power generation and advanced manufacturing.

Cost savings and overall efficiency and safety improvements can be achieved with advanced sensor devices and packaging materials, such as those proposed for this project, according to the researchers. Those sensor devices and packaging materials must meet a demanding set of operational requirements, which will be extensively researched over the life of the project.

In the past two decades, Pereira de Cunha and Lad have collaborated on similar projects and are nationally recognized leaders in the research and development of harsh environment wireless sensor technology. This latest DOE award will allow the research team to advance new technology in harsh environment and wireless sensor research, and make UMaine a go-to hub for this expanding technology.

The Established Program to Stimulate Competitive Research (EPSCoR) is intended to improve geographic distribution of federal research and development funding, strengthen research capabilities in underserved regions of the country, and enable institutions in those regions to better compete for federal funding. Maine is one of 28 jurisdictions designated under EPSCoR.
The Innovative Media Research and Commercialization (IMRC) Center is an interdisciplinary research and experiential learning facility located in Stewart Commons at the University of Maine. The Center builds and supports emerging projects and programs that reflect intersections among the arts and humanities, sciences, and technology. The IMRC Center workspaces encompass research and prototyping laboratories, maker spaces, adaptive presentation environments, and classrooms. The high-performance research, design, media production, and prototyping tools offered in these spaces, along with access to knowledgeable technical training, mentorship, and vocational guidance, are available to welcome, support, and engage all learners.

The Center builds and supports emerging projects and programs that have updated diversity, equity, and inclusion practices into operating guidelines, support and showcase opportunities for diverse and interdisciplinary experiences, and applied and navigated successful change and relationship management alongside affiliate constituencies to strengthen the alignment of IMRC Center processes and goals with those of the greater university body. The IMRC Center is a unit under the Coordinated Operating Research Entities (CORE) and the Office of Research Development. This positions the IMRC Center in a thriving community of research, art, media, commercialization, entrepreneurship, and creative innovation.

Christine Closson, an undergraduate IMRC Center laboratory technician, completed the 3D modeling for a prototype Cube Satellite, which was constructed from polylactic acid plastic on the TAZ Extrusion 3D printer in the IMRC Center Prototyping Lab. The rapid prototyping model was used by the electrical and computer engineering team at the WiSe-Net Lab to build the flight model enclosure. The units set to be launched to the polar orbit in June 2022, in collaboration with NASA and Nanoracks, and Firefly launch vehicle, are given to several K-12 schools in Maine for commercial projects with access to resources and services. The 2021-22 academic year, has seen a 100% increase in IMRC Center lab and resource access by undergraduate and graduate students, as well as faculty, staff, and community members.

Drivers for this growth in usage include:

- Streamlined pathways to both assisted and self-service activities.
- Expanded hours of access to resources.
- Increased integration with undergraduate and graduate coursework.
- New pathways to facility usage for Center for Undergraduate Research (CUGR) fellows.
- Expanded opportunities for Coordinated Operating Research Entities vouchers recipients.

IMRC Center event space usage has also grown by approximately 50%, providing increasing support for various campus-based activities, including student organization meetings such as academic capstone, critiques, thesis presentations, and departmental exhibitions, event series, and new coordination with the Center for Student Involvement. Upcoming events include a symposium for the Institute of Arts in Medicine, the Intermedia Master of Fine Arts Program Visiting Artist Lecture Series, and the Middle Atlantic Planetarium Society Conference.

In addition to growing the facility usage, IMRC Center has also developed new opportunities to support research. For example, students in the first cohort of UMaine’s Experiential Learning Innovation Central program used physical computing to propose a smart climate control system for buildings. The course is led by Al Abdi, IMRC Center operations manager Drew Hiko, and IMRC Center project manager Sean Taylor. The student team included Noah Lambert, an incoming first-year student in computer engineering. Lambert went on to win a CUGR fellowship to continue the team’s research and will begin gathering data for the project at the IMRC Center this spring.

Another research highlight is the SunRule sundial prototypes printed in the IMRC Center Prototyping labs. This project was undertaken in collaboration with the Department of Art Sculpture Studio, the Advanced Structures and Composites Center, the Maine Innovation and Economic Development, the Institute of Arts in Medicine, the Intermedia Master of Fine Arts Program Visiting Artist Lecture Series, and the Middle Atlantic Planetarium Society Conference.
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small brain changes start to happen around middle age. Currently focusing her own research on physical exercise and its impact on cognitive function, what we know is the unfortunate part, which is that by the time you start to see symptoms of Alzheimer’s disease, the actual disease process in the brain has been going on for quite some time. So, the main goal of the HAL Lab is to advance science on these modifiable risk factors,” Ahmed says. Ahmed is also collaborating with Gareth Howell, an associate professor at the Jackson Laboratory, or JAX. Together they have started working on a project that looks at not only the impact of exercise on cognitive function, but also the genetic expression of certain key proteins of interest among humans, “Ahmed says. Ahmed is running the same experiment with middle-aged humans. “We’re actually doing a pilot project right now where I’m looking at human adults in terms of overlap in research across both labs places Wain in a unique position to serve as a liaison,” McMillan says. 

Lisa Karp-Boss, professor of oceanography in the School of Marine Sciences, completed a month-long research cruise in the western South Atlantic Ocean as part of Tara Ocean Foundation’s Mission Microbiomes project. Tara, a French nonprofit that conducts ocean expeditions using its titular research schooner, launched the project in December 2020 to learn more about how marine microbiomes, or assemblies of microorganisms in a given ocean environment, function. The organization also aims to understand how climate change and plastic pollution affect marine microbiomes. Microbiomes make up two-thirds of marine biomass, support an extensive food chain and play important roles in biogeochemical cycles, yet little is known about their inner workings, according to Tara. 

Examining Health Factors on Cognitive Function

Members of the Health, Aging and Lifestyle (HAL) Lab are, left to right, Fayeza Ahmed, Taylor McMillan, Ethan Lowell, Jordan Heineaud, Amanda Wain, Lindsey Largent and Jennifer Thompson. Not pictured: Sarrah Marcotte. 

Advancing Understanding of Marine Microbiomes

Lee Karp-Boss, professor of marine sciences, working in the wet lab aboard the Tara.


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Fostering Peacebuilding and Conflict Resolution Around the World

Bill Farrell looks at the dynamics of conflict and violent extremism. He has conducted field research in countries across Central Asia, the Caucasus, and Africa. He has met with government officials, community leaders, stakeholders, and an array of people who have had family members and friends mobilize to violent extremism.

His doctoral research comparatively examined mobilization patterns and orientation of local violent extremist organizations in the countries of Central Asia and the Caucasus, noting the change in their focus, once engaged in traditional jihad theatres, such as Afghanistan and Syria.

Farrell’s research is rooted in an ethnographic approach. He spends time interviewing and gaining insights into different types of lived experiences, perspectives, and thought processes.

In doing this research, you learn an awful lot about people’s minds,” he explains. “You suddenly recognize that it’s not as black and white as you might otherwise think. It’s not simply terrorist versus non-terrorist. It’s perhaps somebody who thinks they’re a freedom fighter or they’re doing something heroic to save their families. “

Navigating the details of these cases is challenging. “It can be eye-opening trying to clinically understand their story,” says Farrell. “In doing this research, you learn an awful lot about people’s minds.”

In addition to his work at UMaine, Farrell is also principal consultant at Overseas- based Sombrillo Consulting International, LLC. At Sombrillo he works globally on situation analysis, strategy formulation, and influence mapping in fragile or transitioning countries. He uses his expertise in conflict and violent extremism to help guide strategy and analysis with government, multilateral, and private sector clients.

Farrell has been focusing on topics of violence and instability for the majority of his professional and academic career. He is interested in what orients people toward violence and ways in which countries can form policy on interventions of his professional and academic career. He is interested in what orients people toward violence and ways in which countries can form policy on interventions to prevent the spread of violence or help to roll it back. For example, he has just returned from the Caucasus, where he worked with Georgian and Abkhazian civil society organizations on enhanced conflict transformation and peacebuilding skills.

Improving Access to Bioinformatics Research Tools through Cloud Computing

Bill King, professor of bioinformatics at the University of Maine, envisions that his project will improve access to research tools and infrastructure, and ultimately increase collaboration among researchers.

At smaller research institutions it can be hard to build what King calls analysis environments, which are powerful computers that are installed and datasets are available.

“Bioinformatics is a transformative and coordinated community of collaborating researchers and educators that in partnership with health care providers and other stakeholders are dedicated to the advancement of human health and wellbeing in the state of Maine and beyond, through discovery and learning in health and life sciences, from basic and translational research, to clinical practices and healthcare workforce development.

The goal of the project is to develop training materials for bioinformaticians to be able to utilize high performance computing systems for bioinformatics research using the Google Cloud platform. Bioinformatics applies computational methods to extract knowledge from biological data. King developed a proposal for the project with his colleagues at MDIBL, Joel Graber and Jim Coffman, that was funded by the National Institute of General Medical Sciences (NIGMS) in August. Using cloud computing technologies, researchers can more easily analyze genomics data and develop insight into factors that lead to disease.

Cloud computing solves this problem. “They can build that same environment at any point later on, and then continue on from what they were doing at a workshop,” King says. “And part of that is a demonstration project that builds a training module to analyze data from what we call RNA sequencing. It’s something where we can walk users through the analysis workflow, but as they’re doing that, they’re learning about cloud computing in that process.”

RNA-sequencing allows researchers to understand the biology of a cell by measuring differences in the expression of all genes under different conditions. For example, RNA-sequencing was used to study the immune response to influenza A virus infection.

Demand for collaborative research at the University of Maine is increasing, while the opportunities presented by cloud computing provide the needed technological prowess to make large-scale collaborative research happen.

Bill Farrell is an assistant professor at the University of Maine School of Policy and International Affairs, where he teaches and conducts research on issues of stability and violent extremism, with a particular interest in Salafi-jihadist organizations.

Farrell has worked with international donor agencies, non-governmental organizations, and the United States Government for more than two decades. In addition to his work at UMaine, Farrell is also principal consultant at Overseas-based Sombrillo Consulting International, LLC. At Sombrillo he works globally on situation analysis, strategy formulation, and influence mapping in fragile or transitioning countries. He uses his expertise in conflict and violent extremism to help guide strategy and analysis with government, multilateral, and private sector clients.

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2021 NSF CAREER Award Recipients

For the first time, four faculty members at the University of Maine were selected in the same year for the prestigious National Science Foundation (NSF) CAREER Award. This is NSF’s premier early career funding mechanism, which is intended to support enduring success in scholarship, teaching, and public service. It is a prominent award that recognizes the exceptional potential of the faculty and their research. This year’s UMaine awardees are Sheila Edalatpour, Danielle Levesque, Lauren Ross, and Thomas Schwartz.

Sheila Edalatpour, an assistant professor of mechanical engineering at the University of Maine, is studying how the emission of heat changes when the materials involved are quantum-sized, or when they are separated by a gap of the same size as one or multiple atoms. The proposal earned her $526,858 from a National Science Foundation CAREER Award.

According to Edalatpour, optical and electronic properties can differ between bulk and quantum materials, and therefore, so can how they transfer radiated heat. Determining how material size affects thermal radiation, energy emitted from heated bulk and quantum materials, and therefore, so can how they transfer radiated heat. “My research lies at the intersection of comparative physiology, ecology and evolutionary biology,” Levesque says. “As an evolutionary and ecological physiologist, I am primarily interested in comparative energetics and evolution of mammalian temperature regulation.” The proposed project will fill a void in the scientific knowledge of mammalian thermoregulation, as much of the previous work has been conducted with northern hemisphere species who live in latitudes with low temperatures and a great degree of seasonality. Levesque’s work, by contrast, takes place in the consistent equatorial conditions of Borneo.

Danielle Levesque, a University of Maine assistant professor of mammalogy and mammalian health, will use a National Science Foundation (NSF) CAREER Award of nearly $920,000 to study temperature regulation in diurnal and nocturnal equatorial mammals. Her research provides less insight into estuaries with complicated topographies like the Penobscot River Estuary, which experiences moderate river input and tides; the Gironde Estuary in southwest France, which has large river input and small tides, and the Reloncavi Fjord in the Chilean Patagonia, which has large river input and tides. Ross, therefore, will use on-site data and numerical model simulations to quantify the mixing processes in more complex estuaries from across the world.

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Thomas Schwartz, an associate professor of chemical engineering at the University of Maine, received a $513,995 NSF CAREER Award to advance his ongoing dissection of the Lebedev process. The well-known, multistep chemical reaction is used to make butadiene from biomass-derived ethanol. However, little research has been conducted on the Lebedev process at the molecular level. Understanding the intricacies of the process would help researchers create new catalysts, which are necessary for the chemical reactions to make goods from both petroleum and biomass, that would increase butadiene yield. The emergence of improved catalysts could help grow the development of bio-based, renewable chemicals. “Synthetic rubber is used in all sorts of consumer products, from car tires to paper coatings. Our goal is to enable production of synthetic rubber from renewable resources,” Schwartz says.

Lauren Ross, a University of Maine assistant professor of mammalogy and mammalian health, will use a National Science Foundation (NSF) CAREER Award of more than $600,000. This project will improve understanding of how orally-stimulated estuaries influence fresh and saltwater mixing.

Previous studies into the dynamics of fresh and saltwater blending focus primarily on partially-mixed estuaries, meaning they experience moderate freshwater inflow from rivers, and estuaries with basic dimensions, Ross says. As a result, current research provides less insight into estuaries with complicated topographies like the Penobscot River Estuary, which experiences moderate river input and tides; the Gironde Estuary in southwest France, which has large river input and small tides, and the Reloncavi Fjord in the Chilean Patagonia, which has large river input and tides. Ross, therefore, will use on-site data and numerical model simulations to quantify the mixing processes in more complex estuaries from across the world.

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