The MISSION of the University of Massachusetts is to provide affordable, accessible, high-quality education and to conduct programs of research and public service that advance knowledge and improve the lives of people in the commonwealth, the nation, and the world.

The data in this report reflects activities from July 1, 2016, to June 30, 2017. For additional copies, contact University Relations Whitmore Administration Building University of Massachusetts Amherst, MA 01003 (413) 545-9586 or visit www.umass.edu/research-report/

ON THE COVER: Memristors, New Devices that Emulate Biological Synapses
This image illustrates the first synaptic emulator based on a newly developed diffusive memristor (tiny electrical resistance switch), created in Professor J. Joshua Yang’s lab in the Department of Electrical and Computer Engineering. The device is a first step toward faithfully simulating biological synapses, where signals pass from one nerve cell to another in the human brain. Memristors can store and process information while offering several key performance characteristics that exceed conventional integrated circuitry.

I am delighted to provide this report on UMass Amherst research and scholarly activity.

Our campus strategic plan, Innovation and Impact, includes an emphasis on continued excellence in our disciplines as a means to innovate, as well as an emphasis on impact through a focus on the engagement of external stakeholders. This year, we highlight some of these areas, many with a strong interdisciplinary aspect. This strategy has enabled continued progress toward our goal of being the “investment of choice” for many of our stakeholders in both government and industry.

Thank you for your interest and Go UMass!

Sincerely,

Mike Malone
Michael F. Malone ’78PhD
Vice Chancellor for Research and Engagement, Ronnie and Eugene Isenberg Distinguished Professor of Engineering
Local to GLOBAL IMPACT

Our research is felt around the corner, around the world, and from pole to pole.

UMASS AMHERST is committed to investing in research that makes a difference in the world. We’ve partnered with the World Universities Network (WUN) to bring our researchers and resources to bear on a number of global challenges whose solutions require an international approach. WUN has identified four global challenges and four cross-cutting research themes that form the key pillars of WUN-supported research. Since the partnership began in 2015, UMass Amherst faculty and students have participated in global-challenge projects ranging from developing inexpensive and easy-to-configure air-pollution sensors for at-risk communities to developing climate-resilient crops that will enable essential foods to grow under increasingly extreme environmental conditions.

1 SPRINGFIELD, MASS. – Faculty and students in the School of Public Health and Health Sciences study the social and economic impacts of casino gambling on behalf of the Massachusetts Gaming Commission. The city is the site of a new casino currently under construction by MGM.

2 CAPE COD, MASS. – The Laboratory of Medical Ecology offers Cape Cod communities free testing for tick-borne diseases. Since 2006, the lab has tested thousands of ticks from 40 U.S. states and Canada.

3 WISCONSIN – Northeast Climate Science Center researchers are investigating ecological vulnerability and species response to climate variability and change in Wisconsin, Michigan, Minnesota, and elsewhere.

4 CALIFORNIA – Geoscientist Michelle Cooke and her students have developed mechanical and 3-D models of active faults in Southern California, revealing important information about localized earthquake hazard risks.

5 NETHERLANDS – UMass Amherst engineers are working with Vryhof, a world leader in producing offshore anchoring systems, in developing a new mooring system for floating offshore wind turbines.

6 RUSSIA – Alexander Suvorov, assistant professor of environmental health sciences, is leading an international team to increase Russia’s awareness of new toxicology testing techniques that eliminate the use of laboratory animals.

7 MEXICO – In collaboration with the Mexican government, UMass Amherst led the construction and subsequent utilization of the Large Millimeter Telescope (LMT) on the summit of Volcán Sierra Negra. The largest telescope of its kind, LMT is used by international teams to explore the formation and evolution of planetary systems, stars, black holes, and galaxies.

8 BRAZIL – Contributing to urgent worldwide efforts to track and slow the spread of the Zika virus, UMass Amherst students in the Agricultural Sciences Concentration in Science program (iConS) developed new models to predict health and economic consequences of increasing Zika infections in several South American nations, particularly Brazil.

9 AFRICA – The UMass Amherst chapter of Engineers Without Borders has worked for 10 years to bring potable, yearlong water supplies to villages in Kenya and Ghana, where clean, sustainable water has dramatically improved villagers’ lives.

10 ITALY – Classics professor Anthony Tuck directs excavations of the Etruscan settlement Poggio Civitate, near Siena. Since 2007, Tuck and his students have worked to uncover and interpret the secrets of the rise and fall of this ancient civilization.

11 INDIA – Environmental health scientists studying air quality in Kathmandu, Nepal, have discovered that inexpensive cloth masks worn by people who hope to reduce their exposure to air pollution may not be as effective as previously believed.

12 AUSTRALIA – Elena Carbone, nutritional collaborates with Australian colleagues to conduct maternal health literacy research that will lay the foundation for joint grant proposals to determine how mothers globally develop the skills, knowledge, confidence, and capacity to maintain their health and that of their family.

13 ANTARCTICA – Geoscientist Robert DeConto, an international expert in global climate modeling, studies past conditions on the East Antarctic Ice Sheet and other areas of Antarctica in order to predict what effect future climate change may have on sea-level rise worldwide.

Local to GLOBAL IMPACT

UMASS AMHERST is committed to investing in research that makes a difference in the world. We’ve partnered with the World Universities Network (WUN) to bring our researchers and resources to bear on a number of global challenges whose solutions require an international approach. WUN has identified four global challenges and four cross-cutting research themes that form the key pillars of WUN-supported research. Since the partnership began in 2015, UMass Amherst faculty and students have participated in global-challenge projects ranging from developing inexpensive and easy-to-configure air-pollution sensors for at-risk communities to developing climate-resilient crops that will enable essential foods to grow under increasingly extreme environmental conditions.

1 SPRINGFIELD, MASS. – Faculty and students in the School of Public Health and Health Sciences study the social and economic impacts of casino gambling on behalf of the Massachusetts Gaming Commission. The city is the site of a new casino currently under construction by MGM.

2 CAPE COD, MASS. – The Laboratory of Medical Ecology offers Cape Cod communities free testing for tick-borne diseases. Since 2006, the lab has tested thousands of ticks from 40 U.S. states and Canada.

3 WISCONSIN – Northeast Climate Science Center researchers are investigating ecological vulnerability and species response to climate variability and change in Wisconsin, Michigan, Minnesota, and elsewhere.

4 CALIFORNIA – Geoscientist Michelle Cooke and her students have developed mechanical and 3-D models of active faults in Southern California, revealing important information about localized earthquake hazard risks.

5 NETHERLANDS – UMass Amherst engineers are working with Vryhof, a world leader in producing offshore anchoring systems, in developing a new mooring system for floating offshore wind turbines.

6 RUSSIA – Alexander Suvorov, assistant professor of environmental health sciences, is leading an international team to increase Russia’s awareness of new toxicology testing techniques that eliminate the use of laboratory animals.

7 MEXICO – In collaboration with the Mexican government, UMass Amherst led the construction and subsequent utilization of the Large Millimeter Telescope (LMT) on the summit of Volcán Sierra Negra. The largest telescope of its kind, LMT is used by international teams to explore the formation and evolution of planetary systems, stars, black holes, and galaxies.

8 BRAZIL – Contributing to urgent worldwide efforts to track and slow the spread of the Zika virus, UMass Amherst students in the Agricultural Sciences Concentration in Science program (iConS) developed new models to predict health and economic consequences of increasing Zika infections in several South American nations, particularly Brazil.

9 AFRICA – The UMass Amherst chapter of Engineers Without Borders has worked for 10 years to bring potable, yearlong water supplies to villages in Kenya and Ghana, where clean, sustainable water has dramatically improved villagers’ lives.

10 ITALY – Classics professor Anthony Tuck directs excavations of the Etruscan settlement Poggio Civitate, near Siena. Since 2007, Tuck and his students have worked to uncover and interpret the secrets of the rise and fall of this ancient civilization.

11 INDIA – Environmental health scientists studying air quality in Kathmandu, Nepal, have discovered that inexpensive cloth masks worn by people who hope to reduce their exposure to air pollution may not be as effective as previously believed.

12 AUSTRALIA – Elena Carbone, nutritional collaborates with Australian colleagues to conduct maternal health literacy research that will lay the foundation for joint grant proposals to determine how mothers globally develop the skills, knowledge, confidence, and capacity to maintain their health and that of their family.

13 ANTARCTICA – Geoscientist Robert DeConto, an international expert in global climate modeling, studies past conditions on the East Antarctic Ice Sheet and other areas of Antarctica in order to predict what effect future climate change may have on sea-level rise worldwide.
The Future of Electronics

As our world becomes ever more connected, the need for new materials with advanced sensor and electronic capabilities grows. Our campus is host to the NextFlex Manufacturing Innovation Institute, an academic and industry consortium tasked with developing a national ecosystem for research and development of flexible hybrid electronics. We are also a founding member of the Advanced Functional Fabrics of America (AFFA), headquartered in Cambridge, Massachusetts, with members across the commonwealth. Both are part of the national Manufacturing USA network.

Our researchers strive to answer such questions as how high-performance computing and communications or energy-storage, analysis, and generation capabilities can be embedded in comfortable, wearable clothing and devices and whether smart new materials can help patients avoid costly, time-intensive tests by having a simple patch monitor, collect, and analyze health data.

Power-Generating Clothes

A lightweight, comfortable jacket that can generate the power to light up a jogger at night may sound futuristic, but UMass Amherst materials scientist Trisha Andrew could make one today. She and her colleagues have found a way to apply breathable, pliable, metal-free electrodes to fabric and off-the-shelf clothing so that it feels good to the touch, yet transports enough electricity to power small electronics. “We aim to build up the materials science so that you can give us any garment you want—any fabric, any weave type—and we can turn it into a conductor,” says Andrew.

Read the full story online: www.umass.edu/research-report/power-generated

Spotting Stressed-Out Soldiers

Scientists at UMass Amherst are developing next-generation wearable devices that can gauge real-time stress and fatigue among military personnel in order to help them perform better in the field. “Any time you’ve got someone making a command decision, you want to make sure they’re in the right frame of mind—that they’re alert, that they’re well rested,” says James Watkins, who directs UMass Amherst’s Center for Hierarchical Manufacturing (CHM). Its research has helped establish that such devices are feasible, and projects underway at the new Center for Personalized Health Monitoring (CPHM) should soon lead to prototypes being developed and tested for commercialization.

Watkins says that hospitals and insurance companies wanting to get people home from the hospital sooner and collect anonymous data to help improve care are forming a growing market in remote monitoring and personalized health care. “It all comes down to making a very small, light, and flexible smart device that is relatively inexpensive to manufacture,” he notes. “We’re getting close to that.”

Undermining ‘Killer Cells’

UMass Amherst researchers have for the first time shown how a microRNA molecule known as Lethal-7 (let-7) serves as a molecular control hub to direct the function of cytotoxic T lymphocytes (‘killer cells’) by putting the brakes on their cell killing.

Assistant Professor Lesniv Pobeznitsky, PhD student Alexandra Wells, UMass Amherst molecular biologist Michele Markstein, and UMass Medical School immunologist Raymond Welsh have found that when let-7 levels are low or absent, the body’s T cells can potentially turn into “super killers.” Their discovery is a significant advance in the quest to enlist the body’s own immune defenses to combat disease.
Neuromorphic Computing

The future of computing is anything but conventional, says J. Joshua Yang, UMass Amherst professor of electrical and computer engineering. He believes that processes in the human brain—called neuromorphic computing—hold promise for taking computing far beyond its current energy-efficiency and processing limitations. Yang and his colleagues have developed a diffusive memristor, a tiny electrical resistance switch that can faithfully emulate synapses—the place where signals pass through from one nerve cell to another in the human brain. “We are looking at how human brains do information processing and storage,” says Yang. “We want to build something with real intelligence, computers that can really think and learn, not just use software and human-programmed algorithms.”

Read the full story online: www.umass.edu/research-report/neuromorphic-computing

The Neuroscience of Math

At a quick glance, without counting, people can tell the difference between 8 and 10 apples. “It’s called number sense, and it’s evolutionarily ancient,” says UMass Amherst cognitive neuroscientist Joonkoo Park. He was awarded a $751,000 prestigious faculty early career development (CAREER) grant from the National Science Foundation to address basic research questions about how our brains process numbers and magnitude and how such processes give rise to more complex mathematical thinking.

It has long been established that humans share this primitive numerical ability with other animals and even with invertebrates, but the brain basis of that ability has been largely unknown, says Park. His current findings suggest that the coarse, primitive numerical ability shared across many species stems from the subcortex, an evolutionarily older brain structure. Park plans to further study the nature of this skill. Understanding mathematical ability is of interest not only to basic neuroscience but to educators who want to improve math education, he says. Similar to language development, the creation and use of mathematics is uniquely human, yet little is understood about the cognitive and neural processes that support it. “The ultimate goal of our research,” Park says, “is to advance our theoretical understanding of the nature of human knowledge and help develop new pedagogical approaches for improving an important academic skill set for future generations.”

Cultivating Capacity through Digital Storytelling

Can telling our stories—communicating our life experiences and challenges—help develop our capacity as citizens to change our circumstances for the better? A community-engaged program offered by faculty in UMass Amherst’s School of Public Health and Health Sciences works to accomplish that. Called “Hear Our Stories: Diasporic Youth for Sexual Rights and Justice,” it brings together a team of social science researchers, young parenting women, sexual- and reproductive-justice advocates, and strategic communications experts to create alliances for community mobilization, leadership, and policy development.

The program uses digital storytelling to examine sexual and reproductive health disparities among young parenting Latinas in Holyoke, Massachusetts. The project, which involves local, state, and national partners, prioritizes uprooted young women and aims to reframe public conversations on young motherhood and sexuality, health, and reproductive rights across generations by building sexuality research. Through videos, trainings, workshops, and conferences, these young women are able to help shape policies and media narratives about young parents and parenting.

INTERDISCIPLINARY RESEARCH THEMES

Digital Heritage

UMass Amherst researchers are using 3-D scanning technologies to digitally preserve some of the commonwealth’s historically significant human structures. Led by Duncan Irschick, biology, Marla Miller, history, and Copper Giloth, art, the group has created specialized 3-D photo gear for capturing historic—and in some cases endangered—Massachusetts structures. Thanks to a Creative Economy Fund grant from the University of Massachusetts Office of the President, the team is developing techniques to create accurate, high-resolution 3-D representations of three Massachusetts buildings: the Hockanum schoolhouse in Hadley, the Boardman House in Saugus, and the Cisco Homestead in Grafton. In the process, the team will develop a tool to advance the documentation, preservation, and interpretation of historic buildings and landscapes. Their results will be shared with the stakeholders charged with preserving these structures.

COGNITIVE SCIENCE

Human cognition is one of the most challenging and exciting of scientific frontiers. All voluntary and involuntary actions, perceptions, feelings, and thoughts are controlled by the brain and nervous system, yet fundamental questions about how these events occur remain unanswered. Our campus has considerable strength in the study of human cognition from the perspectives of linguistics, psychology, neuroscience, philosophy, and computer science. The campus’s new MRI/S creates a unique niche for partnering with industry and positions the campus for research opportunities in clinical technologies and methodologies.

Creative Economy

Massachusetts has recognized the creative industries as a significant component of its statewide economic development strategy, providing a conduit for social and cultural engagement between UMass Amherst and its host environment. The campus has broad strength in business and the arts, as evidenced by historic and new programs designed to ignite such engagement. Our Arts Extension Services have been connecting campus cultural and educational resources with the community, stimulating the growth of arts and culture across Massachusetts and New England since 1973.

Neuromorphic Computing

The future of computing is anything but conventional, says J. Joshua Yang, UMass Amherst professor of electrical and computer engineering. He believes that processes in the human brain—called neuromorphic computing—hold promise for taking computing far beyond its current energy-efficiency and processing limitations. Yang and his colleagues have developed a diffusive memristor, a tiny electrical resistance switch that can faithfully emulate synapses—the place where signals pass through from one nerve cell to another in the human brain. “We are looking at how human brains do information processing and storage,” says Yang. “We want to build something with real intelligence, computers that can really think and learn, not just use software and human-programmed algorithms.”

Read the full story online: www.umass.edu/research-report/neuromorphic-computing

The Neuroscience of Math

At a quick glance, without counting, people can tell the difference between 8 and 10 apples. “It’s called number sense, and it’s evolutionarily ancient,” says UMass Amherst cognitive neuroscientist Joonkoo Park. He was awarded a $751,000 prestigious faculty early career development (CAREER) grant from the National Science Foundation to address basic research questions about how our brains process numbers and magnitude and how such processes give rise to more complex mathematical thinking.

It has long been established that humans share this primitive numerical ability with other animals and even with invertebrates, but the brain basis of that ability has been largely unknown, says Park. His current findings suggest that the coarse, primitive numerical ability shared across many species stems from the subcortex, an evolutionarily older brain structure. Park plans to further study the nature of this skill. Understanding mathematical ability is of interest not only to basic neuroscience but to educators who want to improve math education, he says. Similar to language development, the creation and use of mathematics is uniquely human, yet little is understood about the cognitive and neural processes that support it. “The ultimate goal of our research,” Park says, “is to advance our theoretical understanding of the nature of human knowledge and help develop new pedagogical approaches for improving an important academic skill set for future generations.”

Cultivating Capacity through Digital Storytelling

Can telling our stories—communicating our life experiences and challenges—help develop our capacity as citizens to change our circumstances for the better? A community-engaged program offered by faculty in UMass Amherst’s School of Public Health and Health Sciences works to accomplish that. Called “Hear Our Stories: Diasporic Youth for Sexual Rights and Justice,” it brings together a team of social science researchers, young parenting women, sexual- and reproductive-justice advocates, and strategic communications experts to create alliances for community mobilization, leadership, and policy development.

The program uses digital storytelling to examine sexual and reproductive health disparities among young parenting Latinas in Holyoke, Massachusetts. The project, which involves local, state, and national partners, prioritizes uprooted young women and aims to reframe public conversations on young motherhood and sexuality, health, and reproductive rights across generations by building sexuality research. Through videos, trainings, workshops, and conferences, these young women are able to help shape policies and media narratives about young parents and parenting.
**INTERDISCIPLINARY RESEARCH THEMES**

### DATA AND COMPUTATIONAL SCIENCES

We live in an age of ubiquitous data. Vast amounts are produced each day from sources as diverse as online interactions among people, wearable health monitors, and sensor networks measuring weather and traffic. Tools for data science and students trained to wield and extend those tools are in high demand because these techniques have the power to increase productivity, develop insights into patterns of human behavior, transform existing business practices, and spawn new industries.

Our campus’s approach to data and computational sciences is interdisciplinary: faculty members from disciplines as varied as physics, journalism, political science, and public health work in data science–related research. Our commitment to data and computational sciences research and education runs deep: at least 17 research groups and laboratories affiliated with our College of Information and Computer Sciences focus on various facets of data and computational sciences. The campus’s Computational Social Science Institute is a diverse, interdisciplinary community using computational models and methods to help us understand the social world. With its 75 faculty affiliates in 26 departments across campus, it is the largest, most diverse academic institute of its kind.

### Expanding Deep Learning

Deep-learning research uses neural network algorithms to analyze large data sets. With a new cluster of 400 specialized graphics processing units (GPUs), our campus has a powerful new tool for big data analysis and is poised to attract the nation’s next crop of top PhD students and researchers in deep-learning fields. Housed at the Massachusetts Green High Performance Computing Center in Holyoke, Massachusetts, the cluster is the result of a five-year, $5 million capital grant to the campus from the Baker administration and the Massachusetts Technology Collaborative. The grant leverages a $15 million gift supporting data science and cybersecurity research from the MassMutual Foundation of Springfield.

Unusually large for an academic cluster, the GPUs are critical for modern computer science research because of their enormous computational power. According to computer scientist and project lead Erik Learned-Miller, they can address extreme computational needs, solving problems 10 times faster than conventional processors.

**Read the full story online:** www.umass.edu/research-report/expanding-deep-learning

### Measuring Social Bias in Software

Data-driven software can shape human behavior by shaping the products we view and purchase, the news articles we read, the social interactions we engage in, and ultimately, the opinions we form. So says Professor Alexandra Meliou, a National Science Foundation CAREER award winner in the College of Information and Computer Sciences. She believes that the increased use of software to decide such things as who will get a loan, who should be denied bail, and how patients in hospitals should be treated—and the potential impact that these decisions have on people’s lives—makes software fairness a critical priority.

With that in mind, Meliou, Professor Yuriy Brun, and PhD student Sainyam Galhotra have developed “Themis,” a technique for automatically testing software for discrimination. They hope Themis will empower stakeholders to better understand software behavior, judge when unwanted bias is present, and ultimately improve the software. “Unchecked biases in data and software run the risk of perpetuating biases in society,” says Brun.

### DIVERSITY, EQUITY, AND INCLUSION

As a public land-grant institution, UMass Amherst is deeply committed to providing access and opportunities for all people, especially historically underrepresented groups. The university has been a leader in promoting equality and inclusion through much of its history, with respected research and student success programs for and about ethnically diverse, first-generation, and nontraditional students. Research in this area spans social science, economics, public policy, public health, education, history, women’s studies, literary and cultural studies, and the arts. In partnership with state, regional, and federal agencies, we are working to determine the root causes of inequality and identify sound solutions.

### Health Equity

UMass Amherst is a leader in the Western Massachusetts Health Equity Network, which seeks regional strategies and opportunities to create conditions in which communities are able to attain the highest level of health for all residents. Its research community, focused in the School of Public Health and Health Sciences, assists in enabling cross-sector collaboration and meaningful data collection about health care and health care disparities for use in creating a regional policy voice for western Massachusetts cities and towns. The school recently organized, cosponsored, and hosted the second Western Mass Health Equity Summit, which brought practitioners and community leaders together to take steps to advance health equity in the region by working, learning, and taking action together. It encouraged attendees to take information back to work in their own communities and join the network to address positive and lasting change.

### STEM Diversity

Social psychologist Nilanjana (Buju) Dasgupta is part of an ongoing group advising the National Science Foundation on strategies to promote diversity in the nation’s education system and workforce in science, technology, engineering, and mathematics (STEM). Her most recent study found that early in their undergraduate years, young women in engineering majors felt more confident about their ability, a greater motivation and sense of belonging in engineering, and less anxiety if they had a female peer mentor. At the end of the first college year, a remarkable 100 percent of female students mentored by advanced female peers were still in engineering majors.

**Read the full story online:** www.umass.edu/research-report/stem-diversity
Systems Innovation Network for Sustainable Small Water solving pressing water issues are endless our daily consciousness. The challenges of societal priorities—have become part of to it, and conflicts between it and other The political ramifications of water—its implementation of treatment, information, and innovation, development, demonstration, and small water systems to foster state-of-the-art brings together a national team of experts transformation for drinking-water treatment for innovations that can be altered to benefit technologies designed for or particularly apt headwaters-to-ocean approach to create more resilient watersheds in our region that are impacted by population growth and climate change. After five years of building successful partnerships, the center continues to broaden its relationships, finding new ways to understand and meet the needs of our natural-resource partners.

Water Innovation

The political ramifications of water—its cleanliness and availability, who has access to it, and conflicts between it and other societal priorities—have become part of our daily consciousness. The challenges of solving pressing water issues are endless and of great social relevance. The Water Innovation Network for Sustainable Small Systems (WINSSS), based at UMass Amherst, brings together a national team of experts to transform drinking-water treatment for small water systems to foster state-of-the-art innovation, development, demonstration, and implementation of treatment, information, and process technologies, in part by leveraging existing relationships with industry through the Massachusetts Water Cluster.

WINSSS researchers are investigating novel approaches to treating grouped contaminants, such as organic carbon, trace organics, disinfection by-products, and nitrogenous compounds. Research programs focus on four distinct areas: implementing innovative technologies designed for or particularly apt for small water systems; non-treatment process innovations that can be altered to benefit small systems; the evaluation of technologies that will allow small water systems to meet water quality standards for disinfection by-products in a sustainable way; and methods for biological management of nitrogenous chemicals in small systems.

Actionable Climate Science

The federal government selected UMass Amherst to lead a consortium of seven universities and host the Northeast Climate Science Center (NECSC), funded with a $7.5 million grant from the U.S. Department of the Interior. Since its inception in 2012, the center has continued to produce actionable science on a wide range of topics. NECSC researchers provide tools to managers and planners that support their goals of helping species and ecosystems adapt to climate change. Sample projects include an investigation of the biological thresholds of species response to climate change and the evaluation of a headwaters-to-ocean approach to create more resilient watersheds in our region that are impacted by population growth and climate change. After five years of building successful partnerships, the center continues to broaden its relationships, finding new ways to understand and meet the needs of our natural-resource partners.

INTERDISCIPLINARY RESEARCH THEMES

ENERGY, CLIMATE SCIENCE, SUSTAINABILITY

Sustainability issues pervade public debate and private-investment decisions at every level. UMass Amherst makes significant contributions in areas such as renewable energy, water treatment technologies, environmental and climate science, and public policy. Large-scale national centers such as the Northeast Climate Science Center (one of eight national centers established by the U.S. Department of the Interior), the National Science Foundation’s competitively awarded offshore-wind Integrative Graduate Education and Research Traineeship (IGERT) program, and the Water Innovation Network for Sustainable Small Systems are at the intersection of research excellence and federal priorities.

INSTITUTE FOR APPLIED LIFE SCIENCES

The Institute for Applied Life Sciences (IALS) supports the translation of fundamental discoveries made on campus into novel candidate medical devices, biomolecules, and delivery vehicles that benefit human health. Its 65,000-square-foot site supports 10 core facilities for use in life sciences research and development. It is advancing the university’s educational and economic development missions through training researchers skilled in the discovery, development, and manufacture of medical devices and biomolecules and in life science entrepreneurship. IALS works in close collaboration with industry partners to combine the best academic research and innovation with a goal-directed focus on partnerships that enable the development of commercially significant products, services, and technologies.

DESIGN BUILDING

The opening this year of the new Design Building continues UMass Amherst’s commitment to sustainability and innovation. At 87,000 square feet, it is the largest modern wood building in the Northeast. One of the first and most advanced institutional buildings in the region to employ cross-laminated timber construction, it annually saves the equivalent of more than 2,300 metric tons of carbon when compared to a traditional steel-and-concrete building—demonstrating why timber construction is gaining new favor these days.

By bringing together the departments of architecture, building and construction technology, and landscape architecture and regional planning, the Design Building creates opportunities for interdisciplinary research and learning. Students and faculty across those disciplines can collaborate under one roof.

PHYSICAL SCIENCES BUILDING

Currently under construction and set to open in early 2018, the new Physical Sciences Building will provide state-of-the-art laboratory, office, and conference spaces for faculty and students conducting work in chemistry and physics. It occupies approximately 100,000 square feet and 82,500 gross square feet of new construction on three levels, and is linked to the rehabilitated West Experiment Station.

The Physical Sciences Building project includes a flexible planning module that can accommodate a wide range of research pedagogies, including physics laboratories, computational laboratories, and synthetic chemistry research laboratories. The interior labs are designed to provide the greatest possible flexibility. Office spaces and lab-support spaces closely adjoin each other to enable the free flow of activity and personnel.
INNOVATION has always been at the core of how we contribute to society. It’s part of our land-grant roots. As a learning organization, our entrepreneurial spirit is driven by curiosity and creativity.

BERTHAUME CENTER FOR ENTREPRENEURSHIP

The Berthiaume Center for Entrepreneurship promotes entrepreneurship and innovation across the UMass Amherst campus and throughout the region and state. Winner of the 2016 Outstanding Emerging Entrepreneurship Program Award from the United States Association for Small Business and Entrepreneurship, it has established itself as the hub of a cross-campus network of scholars, innovators, and entrepreneurs with a threefold mission of supporting research, education, and practice to transform ideas into business realities. The center serves roughly 1,500 students and faculty per year through mentoring services, accelerator programs and space, a speaker series, and wide-ranging events, including the campus-wide Innovation Challenge, Idea Jam sessions, Social Entrepreneurship Day, the Hult Prize @UMass, and ULaunch, at which aspiring entrepreneurs meet business owners, engineers, coders, and graphic designers to create teams and launch start-ups.

UMASS INNOVATION INSTITUTE

The UMass Innovation Institute accelerates connections between the advanced science and technology available in our campus laboratories and private business in order to grow industrial-sponsored research. Its streamlined processes enable industry collaborations to launch quickly and responsively to market and business cycles while maximizing benefits to all parties. In 2017, industrial-sponsored research awards rose 33% to $16.9 million.

In 2017, industrial-sponsored research awards rose 33% to $16.9 million.

START-UP COMPANIES

GENOVERDE BIOSCIENCES INC.

Using biotechnology to make plants with improved genetic traits, Genoverde is developing lobolly pine trees with 20 percent more wood density than conventional crops. This translates to enhanced wood production and increased revenues for farmers, as such trees provide more wood pulp for paper, saw timber for lumber, and wood pellets for energy than currently harvested trees. Tees with this patented cell-wall technology also sequester more carbon dioxide from the atmosphere, thus helping to combat climate change. The company was founded by Professor Sam Hazen and Michael Harrington, a former senior research fellow. Harrington, Genoverde’s CEO, is developing one of the company’s products in “co-laboratory” space made available for start-ups by the UMass Amherst Institute for Applied Life Sciences and is supported by an NSF Small Business Innovative Research Program grant.

BIOCURRENT TECHNOLOGIES LLC

Smaller and smaller components are increasingly needed to meet the demand for ever smaller, more capable electronic devices. The future of miniaturization lies with ultra-thin wires known as nanowires for making components like transistors and sensors. Most nanowires are made of carbon or silicon nanotubes, and are expensive and environmentally undesirable to make. Professor Derek Lovley, Research Associate Professor Kelly Nevin, and colleagues have shown that the bacteria geobacter, readily found in soil, produces biological nanowires that can be harvested. Production of these natural nanowires is expected to be inexpensive, and the bacteria are self-sustaining. They perform as well as conventional nanowires and have comparatively long fibers and controllable conductivity levels. Mark Miller is CEO, Lovley and Nevin continue to develop sensors that take advantage of the unique properties of natural nanowires.

TREATY LLC RELEASES FOGKICKER

Treaty LLC has released its first product. Fogkicker, a highly effective, long-lasting antifog treatment for snorkeling and scuba-diving masks. The company was founded by Professor Ken Carter, postdoc Yingyong Li, and Marc Gammell ‘16, who serves as CEO. Fogkicker is an advanced biopolymer developed by Carter and Li; its patent rights have been licensed to the company. The product is already being sold in over 100 dive shops around the world as well as on Amazon.com. The company is developing customized formulations for preventing fog on sunglasses, motorcycle-helmet face shields, bathroom mirrors, and car windshields. Treaty LLC also plans to develop the antifog agent for use in more critical applications, such as preventing fogging on medical imaging devices such as endoscopes.

AUTOMATED CONTROVERSY DETECTION LLC

Professor James Allen and Shiri Dori-Hacohen ‘17G have developed an artificial intelligence system for analyzing social media and digital news streams in order to automatically detect controversies and crisis situations. Automated Controversy Detection LLC (AuCoDe) was founded to commercially develop this technology, with Dori-Hacohen serving as CEO. An initial application is to improve automated stock trading. Many computer trading systems automatically buy and sell stocks based on price and market trends but don’t take business-related controversies into account. Big and small controversies regarding companies, products, and customers can quickly make stock prices rise or fall. AuCoDe’s system will serve as an additional input in automated stock trading so that its customers can use these insights in complex trading strategies.

LICENSE FOR ANTICATARACT EYE DROPS

UMass Amherst recently licensed a new technology to Janssen Pharmaceuticals Inc. that promises to revolutionize the treatment and prevention of cataracts and presbyopia, which necessitate the use of reading glasses as we age. The technology is based on early-phase discoveries by polymer physicist Professor Murugappan Mathukumal and Ben Mohr ‘13G. It provides a simple way to interrupt the aggregation of lens proteins, a key player in the development of cataracts and presbyopia.

The TECHNOLOGY TRANSFER OFFICE

moves technologies beyond the lab bench to become commercially viable products, processes, and services. It licenses campus technology to corporate partners and supports the development of new businesses derived from UMass Amherst technology.

INNOVATION AND ENTREPRENEURSHIP

Total revenue received $792,700

16 Patents issued

11 License and option agreements executed

57 New patent applications filed

3 New start-ups

74 Invention disclosures received
Bright Leaf: Books that Illuminate

Notable Awards

James E. Young: The Stages of Memory: Reflections on Memorial Art, Loss, and the Spaces Between was honored with the National Council on Public History’s book award.

Young’s book is a volume in the series Public History in Historical Perspective and was edited by Marla Miller of the UMass history department. The prize marked the fourth time that UMass has won the top honor.

William E. O’Brien: Landscapes of Exclusion: State Parks and Line in the Americas won the 2017 Award of Merit, selected by the Leadership in History Awards Committee of the American Association of State and Local History. The book was also awarded the J. B. Jackson Book Prize from the Foundation for Landscape Studies.

The launch of its new imprint, Bright Leaf, the University of Massachusetts Press, 2017.

Alexandra S. Schroyer, coauthor, Fundamen-


Kristine Smith, coauthor, Faculty Development in Developing Countries: Improving Teaching Quality in Higher Education (Routledge, 2017).


Muzzo S. Uyay, coauthor, Co-creation in Tourism Experience (Routledge, 2017).

Muzzo S. Uyay, coauthor, Island Tourism: Sustain-


Nicholas Kemp, coauthor, Fugitive Democracy and Other Essays (Princeton University Press, 2016).

Bechara King, coeditor, Engineered Nanoparti-


44

titles published

15%
of sales from e-books


Marian Mesrobian MacCurdy, Sacred Jus-


Edie Medavoy, Kingdom of the Young (Sara-


Sabina Murray, Valiant Gentlemen (Grove Press, 2016).


Max Page and Maria R. Miller, editors, Bendi-


Anna Nagourney, coeditor, Dynamics of Disasters: Key Concepts, Models, Algo-


Fareen Parvez, Policing Islam: The Islamic Revival in France and India (Oxford Univer-


Shahsan Pasha, coauthor, Mirror on the Veil: A Collection of Personal Essays on Hijab and Veiling (Critical, Cultural, and Communica-


Alasdair Roberts, Four Crises of American Democracy: Representation, Mastery, Disci-


Baoshan Xing, coeditor, Engineered Nanoparti-


Aja Aksamija, Integrating Innovation in Archi-

tecture: Design, Methods and Technology for Progressive Practice and Research (John Wiley & Sons, 2016).

Audrey Altstadt, Frustrated Democracy in Post-Soviet Azerbaijan (Wilson Center/Colum-


Angelica Maria Bernal, Beyond Origins: Re-


Madeleine Blais, To the New Owners: A Mar-

tha’s Vineyard Memoir (Grove Atlantic, 2017).


Donal Corbally, coauthor, Reporting Cultures on 60 Minutes: Mixing the Foreign Line in an American Newsreel (Routledge, 2017).


The University of Massachusetts Amherst is the flagship public campus in the Commonwealth of Massachusetts. Founded in 1863, it is the largest public research university in New England, distinguished by the excellence and breadth of its academic, research, and community outreach programs.

Each year, UMass Amherst spends more than $200 million on research, demonstrating its contribution to the nation’s position as a technological and economic leader. The campus works in conjunction with academic, government, and private partners to translate new knowledge and scientific discoveries into technical innovations and scholarly works that create opportunity for students, faculty, and the public.

### Academic Programs

Our NINE schools and colleges offer:
- 118 bachelor’s degree programs
- 6 associate degree programs
- 76 master’s degree programs
- 48 doctoral programs

### Students

- 23,373 undergraduate students
- 6,664 graduate students
- 30,037 total students

### Faculty

- 1,300 full-time instructional faculty

### By the Numbers

- Sponsored research awards: **$146.3M**
- Doctoral degrees awarded: **337**
- Annual research expenditures: **$214.6M**
- Technology patent and licensing revenue: **$792.7K**

* FY2016 (most current data)

** AY2015–16 (most current data)

### Distribution of Awarded Dollars Accepted from Federal Agencies – FY2017

- Total Costs - $84,668,427

### Distribution of Awarded Dollars from the Private Sector – FY2017

- Total Costs - $44,991,681

### Distribution of Awarded Dollars by Sponsor Category – FY2017

- Total - $146,272,120

* A significant portion of these awards are prime federal funds
Above: Beastcam is a multicamera system created by evolutionary biologist Duncan Irschick and his team of students to create fast, accurate 3-D models at low cost. The technology is part of the Digital Life initiative, which aims to preserve the heritage of life on Earth through creating and sharing high-quality and accurate 3-D models of living organisms. From left to right: Cory Zeng ’17, Irschick, Atreyi Mukherji ’18.