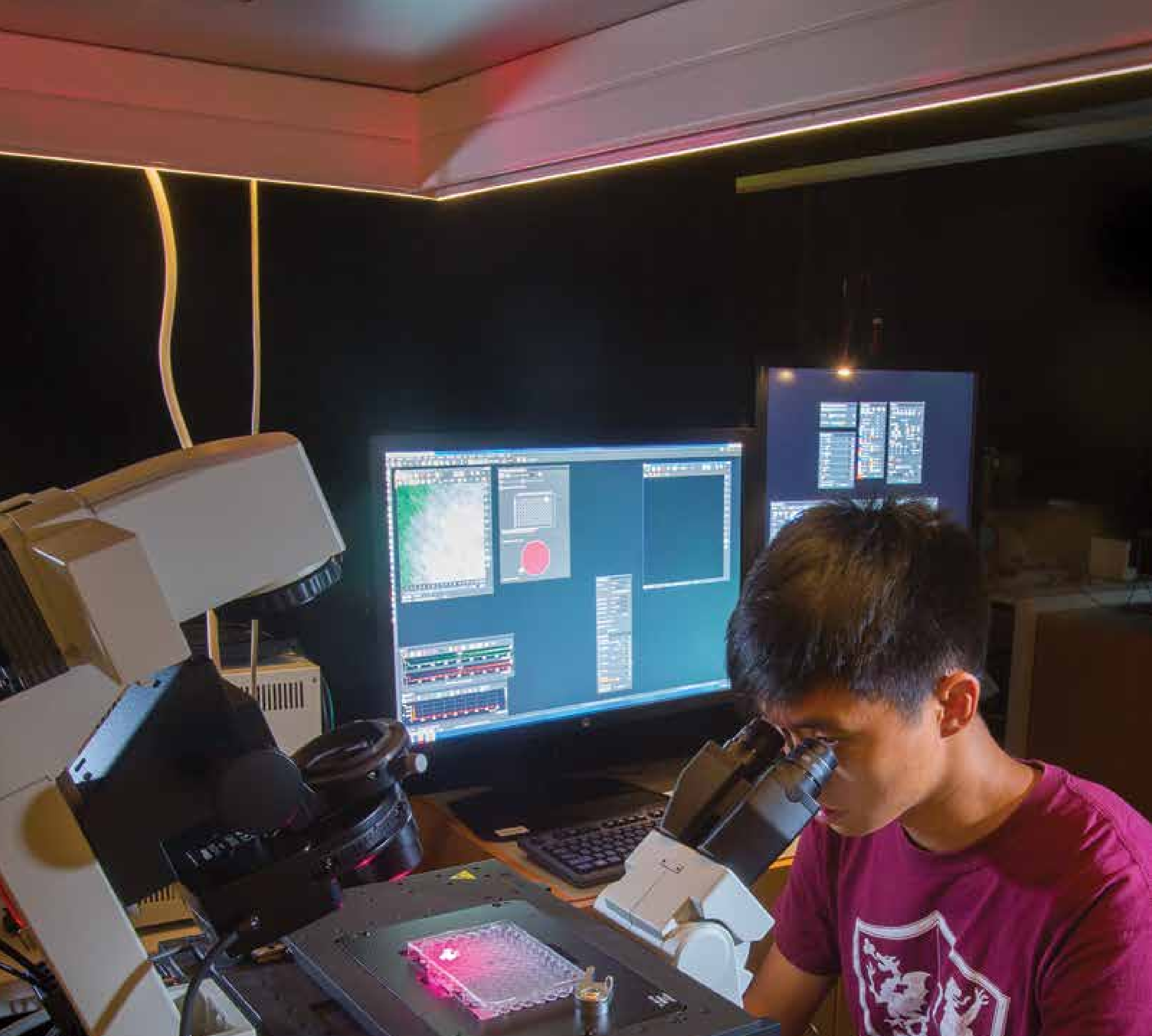
Next:

Frontiers in Applied Life Sciences

University of Massachusetts



Excellence in microscopy

The Massachusetts Facility for High-Resolution Cryo-Electron Microscopy, located at the UMass Medical School, was the first cryo-EM facility in New England. Operated in collaboration with Harvard Medical School and supported by $9 million in grants from the Massachusetts Life Sciences Center and the Howard Hughes Medical Institute, it gives scientists from UMass and almost 100 academic institutions and commercial labs across the country unprecedented images of the inner workings of cells.

The Light Microscopy Core Facility on the UMass Amherst campus is Nikon's only Center of Excellence in New England—and one of only 11 across the country. Funded from a $95 million grant from the Massachusetts Life Science Center, the facility gives academic and industry scientists access to almost every light microscopy imaging modality currently available.

The transformation of laboratory observation into human impact: That is the power of applied life science.

UMass Medical School microbiologist Allan Jacobson has spent his career studying nonsense mutations in yeast cells. His discoveries, in and of themselves, are important contributions to our basic understanding of genetics. But their applications make them revolutionary.

Nonsense mutations contribute to more than 2,000 debilitating and often fatal diseases, including cystic fibrosis, hemophilias, and certain cancers. One drug with the ability to prevent the mutations could potentially treat them all, and in 1998, Jacobson colaunched PTC Therapeutics to find it. The company's first nonsensemutation-suppressing compound is now on the market in Europe, where it is helping boys with Duchenne's muscular dystrophy walk and breath easily for years longer than before.

Massachusetts is justly famous for its dominance in the application and commercialization of life science discoveries. Hundreds of companies flourish in the Commonwealth, producing life-saving pharmaceuticals, medical devices, and more. Their success is grounded in the research being conducted by the state's vibrant community of public and private universities, and in the highly qualified workforce those universities train.

The University of Massachusetts is proud to play a leading role on both fronts. The system's faculty in the applied life sciences work across an astonishing breadth of fields, on topics that promise to transform health care, therapeutics, and more.

These applications, and the basic research that informs them, are heavily backed by partners in industry and government, comprising more than half of UMass's sponsored research dollars in 2019—some $370 million in total. UMass's success in commercializing its discoveries has few rivals; the system ranks third among all US universities in licensing revenue.

The system is also the top producer of applied life sciences graduates in the Commonwealth, awarding more than a third of all the state's diplomas in the field each year.

BIG IDEAS

Many UMass faculty in the applied life sciences are known as thought leaders in their fields. UMass Dartmouth immunologist Erin Bromage has gained national renown for communicating practical, data-backed ways to reduce personal risk of contracting COVID-19. Bromage serves as a CNN correspondent on coronavirus issues and as a consultant to mayors, governors, and other community leaders on COVID-related task forces. His blog post "The Risks—Know Them—Avoid Them" has been read more than 19 million times since May 2020.

In short, UMass is a powerful engine of discovery and of translational applications across all of its campuses, in every region of the state. Driven by our partners, supported by our students, our faculty innovate every day, using their impressive accomplishments in the life sciences to address the pressing issues of today.

Sticky stuff

Testing his theory that the softness of commercial adhesives limits their ability to hold, Alfred Crosby, co-director of UMass Amherst's Center for Evolutionary Materials, turned to gecko feet. With UMass Amherst biologist Duncan Irschick, an expert in animal form and performance, he found that geckos' vaunted clinging capacity depends on both soft and hard structures. Funded by DARPA, Crosby and Irschick created a reusable, fabric-backed super-adhesive that supports tremendous weight and releases quickly without residue. CNN Money dubbed Geckskin™ a top-five science breakthrough of 2012.

Geckskin's innovation: mimicking minute hairs on gecko toe pads that conform to surfaces *and* stiff tendons that amplify adhesive force.

Today's strengths

The UMass system's strength in the applied life sciences is wide ranging, from sustainable aquaculture at UMass Boston to biomanufacturing at UMass Lowell, from pharmaceutical development at UMass Medical School to bone biomechanics at UMass Dartmouth. UMass Amherst's Institute for Applied Life Sciences alone connects more than 200 research groups, led by founding director Peter Reinhart and faculty from 29 different departments. Across the system, UMass researchers are on the leading edge of innovation in these five areas in particular.

RNAi and gene therapy

Gene therapy and RNA interference (RNAi) therapy—which harnesses the body's genetic processes to control the production of disease-causing proteins—are at the forefront of drug development today. By blocking genetic diseases at their source, researchers are working to revolutionize treatment for wide range of currently incurable conditions, including ALS, cystic fibrosis, and muscular dystrophy.

The UMass system leads the field in both the development and delivery of these therapies. Craig Mello, distinguished professor in the UMass Medical School's **RNA Therapeutics Institute** (RTI), effectively launched the RNAi field in 1998, when he co-published a paper describing the RNA interference mechanism, a discovery for which he was awarded the Nobel Prize in 2006.

UMass Medical School molecular biologist Craig Mello won a Nobel Prize for discovering RNAi, a fundamental gene-editing mechanism.

RTI Chair Phillip Zamore, a world-renowned expert in gene regulation networks, developed the first RNAi drug approved for use by the FDA. His discovery transforms the lives of the 50,000 people diagnosed with hATTR amyloidosis each year. Guangping Gao, director of UMass Medical School's **Horae Gene Therapy Cente**r—which is housed with RTI in UMass Medical School's **Advanced Therapeutics Cluster**—is harnessing viruses to deliver genetic material, an advance that jumpstarted the gene therapy field. Faculty at the **Center for Bioactive Delivery**, part of UMass Amherst's Institute for Applied Life Sciences are creating new technologies for delivering RNA therapies to their intended targets.

Biomimetic polymers and advanced biomaterials

Across the UMass system, researchers are taking inspiration from nature to create new materials that solve human problems.

These efforts combine many of UMass's strengths in materials-related fields, such as UMass Amherst's world-class expertise in polymers and soft materials; UMass Lowell's top-tier programs in materials science and nanotechnology; UMass Dartmouth's **Bone Biomechanics Laboratory**, renowned for its expertise bone structure and the mechanics of bone growth and breakage; and UMass Medical School's **Biophysics and Chemical Biology Departments**, which are revealing the structures of bioactive molecules.

With more than 200 scientists and students and over $24 million in instrumentation, the **Polymer Science and Engineering Department** at UMass Amherst is one of the largest academic centers for polymer research in the world. (The university is also home to the **Center for UMass/Industry Research on Polymers**, the longest-running National Science Foundation Industry/University Cooperative Research Center in the nation.) Researchers in the department's **Center for Evolutionary Materials** focus on unpacking the essential design principles powering exceptional animal abilities, with the goal of applying those principles to a range of biomimetic materials.

Another area of system-wide strength is in biomaterials, materials designed to replace or support damaged tissue or improve a function in the body. IntelliGels—nanoscale particles of polymer gel that can encapsulate drug molecules and deliver them to the parts of the body where they are needed—is an example developed by UMass Amherst chemist Thai Thayumanavan.

The IntelliGels platform has many potential applications; it is currently being commercialized by Cyta Therapeutics to help clear fat from the livers of people suffering from nonalcoholic steatohepatitis, a leading cause of liver transplants. Thayumanavan and team have evolved IntelliGels to tackle the more challenging task of delivering

The UMass Center for Microbiome Research at UMass Medical School investigates how the microbes that live in and on us influence our lives, our health, and our environment.

biologics, such as therapeutic proteins, antibodies and RNA molecules, inside cells.

Food safety, nutrition, and microbiome

Beyond simple sustenance, food undergirds and undermines human health and well-being in ways that still aren't fully understood. Research shows that poor diet, for example, is implicated in chronic diseases affecting 17 million adults in America today—but the physiological mechanisms connecting diet and disease are unclear.

The relationship between nutrition and health is a major research focus of UMass Lowell's **Biomedical and Nutritional Sciences Department** and of UMass Medical School, at both the dietary level—in the medical school's **Center for Applied Nutrition**—and at the biochemical level.

It is also a one of many topics studied by the **Department of Food Science** at UMass Amherst, which was one of the first food science programs in the country and today boasts the #1 PhD research program in the nation. The department's **Food Safety** group conducts research addressing pathogens and contaminants in the food industry, including the development of sensitive and rapid detection methods, creating mathematical models to assess and predict microbiological hazards, uncovering potential toxicological effects of eating food-grade nanoparticles, and the use of natural products to control bacterial growth.

Trillions of bacteria of different kinds live in our stomachs and intestines, outnumbering our own cells many times over. In 2014, the **Center for Microbiome Research**—a collaboration between UMass Medical School, UMass Amherst's **Life Sciences Laboratories** and the UMass Dartmouth **Center for Scientific Computing and Data Visualization Research**—was created by UMass Medical School bacteriologist Beth McCormick as a system-wide effort to design microbiome-based medical treatments.

Center researchers were the first in the world to discover probiotic assemblies that inhibit multidrug resistant germs, as well as microbiome "signatures" (particular compositions of species of gut microbes) that predict dementia status, including in Alzheimer's disease. These kinds of findings open up exciting new avenues for disease prevention and treatment.

UMass Dartmouth's **Cranberry Health Research Center** is studying the impact of the Commonwealth's largest crop on the microbiome, and on health issues ranging from urinary tract infections to cancer treatment.

Another key focus for UMass food researchers is creating sources of nutritious food for the future. The **Sustainable Marine Aquaculture program** at UMass Boston is dedicated to securing future seafood supply, and the UMass Amherst **Food Science Department** is developing plant milks, nutritionally complete plant-based "meats," and lab-grown meat. These "future foods" offer health, ethical, and environmental advantages, including reducing the chances of animal-to-human disease transmission, like the infection that launched the coronavirus pandemic.

Disease preparedness

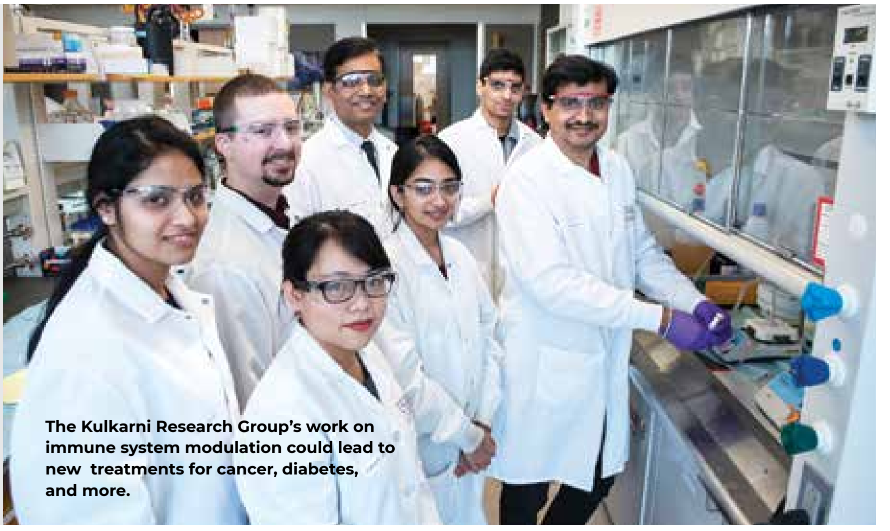
When the COVID-19 virus struck, the federal and state government enlisted the University in mobilizing to fight the pandemic. The UMass Medical School/UMass Lowell **Center for Advancing Point of Care Technologies** (CAPCaT) received an $80 million grant from the National Institutes of Health to join the nationwide Rapid Acceleration of Diagnostics (RADx) initiative, which is working to create fast, point-of-care COVID tests. (CAPCaT was established within UMass's biotech and medical device incubator, the **Massachusetts Medical Device Development Center**, with a $7.9 million grant from the NIH. It is one of four centers across the country in the NIH Point-of-Care Technologies Research Network.)

UMass Lowell's **Fabric Discovery Center** used a $130,781 grant from the Commonwealth to buy industry-standard performance-testing instruments for personal protective equipment. Staff and researchers are now testing PPE daily for the Massachusetts Emergency Management Agency, hospitals, doctors, dentists, and area companies. The center is also working to increase the available supply of PPE by helping first-time PPE manufacturers improve their products to pass government certification.

Researchers from the **Center for Personalized Health Monitoring**, **Models to Medicine Center**, and the **Center for Bioactive Delivery** at UMass Amherst are using a NSF grant

Lighting up cancer cures

After immunotherapy begins, patients face an anxious wait of weeks until the tumor shrinks enough (or doesn't) to show whether it is working. UMass Amherst chemical engineer Ashish Kulkarni has developed a bioluminescent marker molecule that slashes that wait to hours. These injected "sentinels" light up when they detect the enzymes immune cells release to kill cancer. If imaging reveals lit sentinels in the tumor, the therapy is working. If not, the oncologist can immediately try another approach, losing no time in the cancer fight.



The Kulkarni Research Group's work on immune system modulation could lead to new treatments for cancer, diabetes, and more.

to develop a rapid and generalized detection of viruses for handling future pandemics. The **Institute for Applied Sciences** at UMass Amherst established a new CLIA-certified **Clinical Testing Center** initially used for COVID-19 testing but adaptable to a wide variety of laboratory-developed clinical tests. The center's resources are available to all UMass researchers developing new clinical tests and to industry partners needing to validate new sensors, biomarkers, and even therapeutic candidates in a validated clinical test laboratory.

Faculty across the system have pivoted existing research in the direction of COVID. For example, UMass Boston engineer Kimberly Hamad-Schifferli, who has patented rapid-response paper-based tests that use existing disease biomarkers to test for emerging diseases, began adapting her tests to detect COVID-19.

UMass Medical School biochemists Katherine Fitzgerald and Anastasia Khvorova won COVID-19 Rapid Response Initiative awards from the Harrington Discovery Institute in Cleveland, Ohio—two of only 12 recipients chosen from applications from 122 US-, UK-, and Canada-based institutions. Fitzgerald is investigating therapies for lung injury related to COVID and other inflammatory diseases; Khyorova is developing RNAi-based therapies that would slash the replication rate of COVID and other pandemic-causing viruses.

Disease-preparedness research and development is not just a COVID-era initiative at UMass. Bringing life-saving therapeutics to market is the mission of **MassBiologics**. Founded by the medical school, it is the only university-based, FDA-licensed vaccine manufacturer in the United States. The MassBiologics team has brought more than 20 licensed products to market, including some critical vaccines. The medical school also operates the **Institute for Drug Resistance**, the only organization in the world focused on spurring collaborative, cross-disease research to speed the delivery of resilient medicines that can short-circuit drug resistance.

Cancer immunotherapy

Conventional cancer therapy is an exercise in managing collateral damage: flooding the system with enough toxic drugs to kill cancer cells without killing too many healthy ones. Emerging cancer immunotherapies activate the patient's own immune system to attack and kill specific tumors, not the whole body—an approach that's gentler and can eradicate certain cancers within weeks.

UMass has strength in cancer research across the system, including in many avenues of immunotherapy. In 2008, UMass Boston was awarded $10 million from the Massachusetts Life Science Center to support the **Center for Personalized Cancer Therapy**, a collaboration with the Dana-Farber Harvard Cancer Center. UMass Medical School's **Cancer Center of Excellence** is a collaborative venture with UMass Amherst that takes a personalized approach to cancer treatment, centering research on the premise that the molecular underpinnings of every tumor are distinct.

One exciting area of immunotherapy research—the use of nanoparticles to deliver drugs directly to tumors and to enhance the effectiveness of radiotherapy—draws on the system's strength in cancer research and the wealth of polymer and medical physics expertise at UMass Amherst and UMass Lowell. This site-specific delivery would create a nearly side-effect-free therapy, eliminating the dangerous system-wide immune storm that is the major risk of immunotherapy. UMass Dartmouth bioengineer Steven Zanganeh is also taking a nanoparticle approach, studying whether iron oxide nanoparticles can inhibit tumor growth by provoking an immune response.

Tomorrow's frontiers

UMass's strengths in applied life sciences today are setting the stage for big impacts in medicine and materials tomorrow. Faculty, post-docs and students at all stages are hard at work developing the research frontiers of tomorrow. There are hundreds of possibilities, many of which have life-transforming applications. Here are five we think are going to be particularly important over the next five to ten years.

Next frontier 1:

Addressing genetic diseases, Alzheimer's disease, and aging through gene therapy

RNAi and gene therapeutics have great potential. Theoretically, these treatments can be designed to act on any gene in the human (or microbial or viral) genome, even those controlling "undruggable" proteins impervious to conventional medicines. And they act upstream of today's medicines, controlling the flood of disease-causing proteins by turning off the tap rather than mopping up the floor.

Today, RNAi and gene therapeutics are still in their infancy, product-wise. But UMass is positioned to create state-of-the-art nucleic-acid based drugs for patients suffering from a range of genetic diseases, as well as Alzheimer's and other diseases of aging in the next five to ten years. Our next steps? Moving into the translational, toxicity, and dosing studies that precede clinical trials and creating the next generation of lipid nanoparticles for delivering RNAi and gene therapies.

Next frontier 2:

Creating self-repairing, self-correcting, and self-regulating artificial systems

Many biological processes are completely autonomous. Our immune systems, for example, are programmed to neutralize attacks without conscious control. In artificial materials, however, that capability is very limited. At UMass—drawing on UMass Amherst's strength in polymer chemistry, material science and technology expertise at UMass Lowell, biomechanics at UMass Dartmouth, and the medical school's biological and translational knowledge—we are working to design self-repairing, self-correcting, and self-regulating artificial systems.

This is a frontier with potential for enormous technological impact, from pothole-resistant self-healing pavement to personalized and responsive biomedicine. UMass researchers are working toward drug-delivery systems that deploy only when autonomously self-regulating nanoparticles sense a disease biomarker, dispensing precisely the right dose in precisely the right place. Chemotherapy patients, who at present must live with drug-related toxicities circulating through their entire bodies, may be able to say goodbye to those risks—all with minimal human intervention.

Next frontier 3:

Managing microbiomes to optimize health, address antibiotic resistance, and combat disease

It is clear from our field-leading research to date that the composition of the vast population of microorganisms living in our bodies has profound implications for our health. Manipulating microbiomes to create health-associated inner ecosystems could be key to helping patients stay healthy and manage a wide range of conditions.

Biomedical scientists at UMass are working to develop microbiome-based interventions for cancer, obesity, diabetes, chronic diseases such as inflammatory bowel disease, and neurodegenerative diseases like Alzheimer's, Parkinson's, and multiple sclerosis. This approach has the potential to impact elder health and aging; mental illness; and addiction.

Building on the UMass discovery that engineering of novel probiotics can inhibit multidrug-resistant organisms, we will also continue to investigate how the microbiome can be used to address the growing problem of antibiotic resistance.

Shrink-wrapped proteins

Researchers at UMass Amherst's Center for Autonomous Chemistry have developed a polymer "shrink wrap" that surrounds proteins, ferries them through cell walls, and then dissolves completely, depositing the protein unscathed inside a cell. The shrink-wrap method is designed to be versatile, and the team has used it successfully on a variety of proteins. As many human diseases are caused by protein malfunction, this delivery system for healthy proteins—notoriously difficult to get into cells—could form the basis of a wide array of therapies.

Clearing the protein-delivery hurdle opens the door to many potential applications, says center director Sankaran "Thai" Thayumanavan.

Next frontier 4:
Preparing for future pandemics

As faculty across the UMass system pivot their research to address the COVID-19 crisis, in fields from manufacturing to communications to medicine, they are living through a real-time crash course in contending with global infectious disease pandemics. While tragic, the coronavirus has revealed research avenues and programs that are particularly important and effective in the context of a global health crisis.

This includes significant needs in public health training and education. One example that proved invaluable: the consistently accurate multi-model flu forecasting methodology of UMass Amherst biostatistician Nicholas Reich, which led the Centers for Disease Control and Prevention to establish one of the nation's two **CDC Influenza Forecasting Centers of Excellence** at UMass. Using the same approach, Reich created COVID-19 forecasts that were used by both the CDC and the White House Coronavirus Task Force.

Through the remainder of this pandemic and beyond, we will look back at our hard-won knowledge and derive best practices for pandemic response, with particular focus on rapidly evolving strategies to test for pathogens and generate antibodies against them. We will also continue to follow promising leads for treating existing communicable diseases, like UMass Amherst chemist Jeanne Hardy's work on enzyme-blocking therapies to short-circuit Zika and dengue virus.

Next frontier 5:
Programming the immune system to identify and eradicate cancer

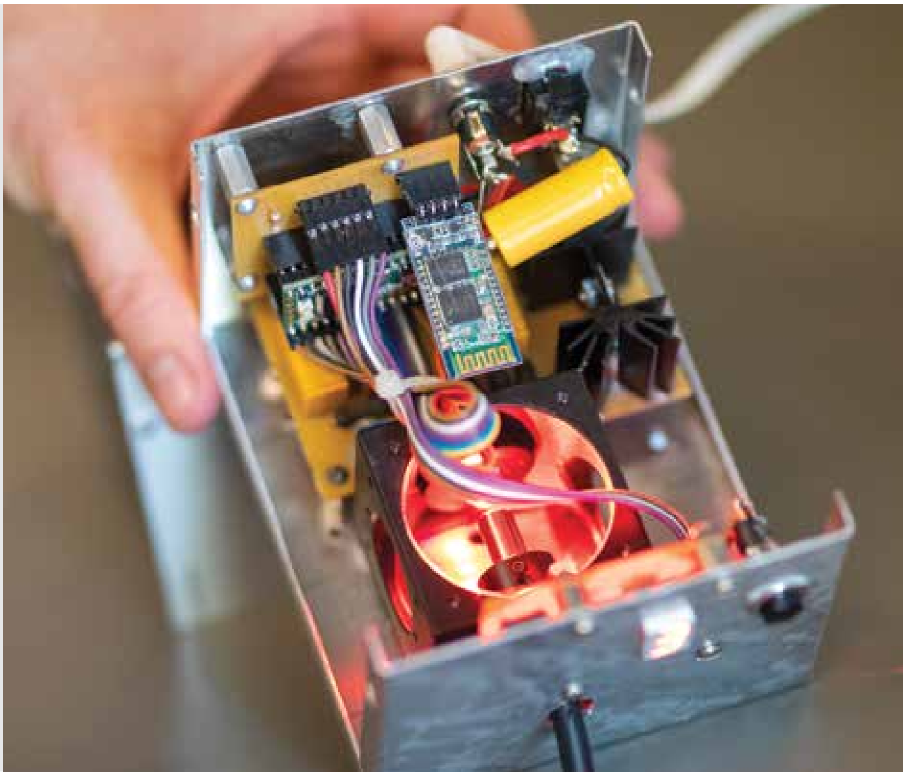
Cancer immunotherapy as it is practiced today is still in its infancy, and many questions remain. Can we create immunotherapies that work for all cancers, even those impervious to it today? Are there better ways to wake up the immune system?

Continued research in cancer immunology over the next five to ten years will focus on increasing our ability to activate the immune system to home in on cancer selectively and precisely, for example, through the use of polymer-based delivery systems that are already in development at UMass. These systems might also offer a promising approach to protein therapy, delivering antibodies into cells to block the disrupted RAS pathway that triggers the uncontrolled cell growth underlying all cancers.

An RAS-based therapy would be revolutionary not just in cancer but also in other RAS-related diseases, including multiple sclerosis and diabetes. UMass Amherst immunologists and polymer chemists have already gotten antibodies into cells—a difficult feat, given their relatively large size—opening the door to bringing protein-based drugs to tumors formerly considered undruggable.

Portable cancer therapy

Chewing tobacco use is widespread in India, and so, unfortunately, is oral cancer. Approximately 77,000 Indians develop oral cancer each year—a third of the global caseload—and 52,000 die from it, most often in rural areas far from treatment facilities. Physicists in UMass Boston's Celli Lab and engineers in the Cuckov Lab have developed an easy-to-use, low-cost, portable system that takes treatment to the patient. Their AA-battery-powered, LED-based device administers photodynamic therapy—which uses light and light-sensitive dye to kill cancer cells—with a smartphone camera attachment for imaging. The prototype was tested in a clinical study at India's Aligarh Muslim University, which found it to be an effective option for early-state oral cancer treatment.



Powering the Commonwealth's life science economy

Massachusetts is the hub of the US life sciences industry. According to the Massachusetts Life Sciences Center, the Commonwealth ranks first in the nation in industry R&D investment per capita, first in venture investment in biotech and medical device companies per capita, and was home to $4.1 billion in venture capital investment in 2018. Massachusetts researchers receive just under 10 percent of all NIH funding—the second highest share in the nation—and operate 35.2 million square feet of lab space, up by 91 percent in the last 10 years.

UMass excels in the translation of research advances to consumer products. The system ranks third among US universities in licensing revenue, and has launched an impressive roster of spin-off companies, including:

- Alnylam Pharmaceuticals
- ApicBio
- Arret
- Aspa Therapeutics
- Atalanta
- Bacainn biotherapeutics
- Fulcrum Therapeutics
- PTC Therapeutics
- RXi Pharmaceuticals
- CRISPR Therapeutics
- Cyta Therapeutics
- Ernest Pharmaceuticals
- Felsuma
- Generation Bio
- Intellia Therapeutics
- Villaris Therapeutics
- Voyager Therapeutics

Today, 463,500 people in the Commonwealth work in the life sciences. Over the next ten years, employment in that industry is expected to grow by more than 7 percent—nearly double the state's projected overall employment growth. Massachusetts life science employers will need to fill more than 46,000 jobs by 2030.

Where will workers qualified to fill these positions come from? In the Commonwealth, the majority will be graduates of the University of Massachusetts. In 2019, UMass awarded almost a quarter of all life-sciences degrees conferred in the state, making the system the top producer of degree-holders in our region.

Curing Canavan disease

Children with the devastating neurodegenerative disorder Canavan disease suffer from seizures, blindness, intellectual disability, and an inability to move their bodies. But the research team of UMass Medical School microbiologist Guangping Gao have developed a virus-delivered gene therapy that cures the disorder in young mice—so completely that the medical fellow who injected the first mouse with the treatment thought he had mislabeled a cage when he returned to find his formerly immobile subject up, moving, and apparently healthy. The treatment is now under development at Aspa Therapeutics. A toddler given the therapy in an expanded access trial in 2018 saw improvements in vision and motor control; for newborns, the treatment could alleviate symptoms completely.

UMass degree completions in fields related to applied life sciences

4,637
UMass degree completions in 50 related fields in 2018–2019

#1
UMass rank in degree completions among MA institutions

23%
UMass percent of all degree completions in related fields (2018–2019)

Massachusetts employment data in occupations related to applied life sciences

46.2k
Projected estimated MA annual job openings (2020–2030)

463.5k
Current MA employment in 119 related fields in 2020

7.4%
Projected growth in MA employment over next ten years (2020–2030)

As the University of Massachusetts looks to the near-term future, we are ready to mobilize our scientists, engineers, medical researchers, and the robust core facilities they enjoy to solve some of the most pressing problems in the applied life sciences.

We look to industry as partners to bring these discoveries to market and enable millions of people to benefit from their life saving capabilities. Crossing the well-known "valley of death," which basic science must traverse before a new therapy can attract sufficient funding to complete the arduous process of clinical trials remains a critical problem for everyone in the field. Yet we are confident that the quality of the research and the potential it holds for disease eradication and management, justifies the significant investment we have made in the applied life sciences.

We know that government (especially the National Institutes of Health, but other institutions as well) is there to amplify the importance of the work we do, and to help us support the next generation of scientists who will execute on these grand challenges. And what better location could there be than Massachusetts to bring these ideas to fruition? Its vast human resources dedicated to scientific discovery and practical application make it the most advanced state in the union for this kind of work. The University of Massachusetts is proud to serve as a vital backbone for these advances.

Parkinson's-microbiome connection

In 2017, the NIH awarded UMass Lowell epidemiologist Natalia Palacios $2.1 million for a five-year investigation of the connection between gut microorganisms and Parkinson's disease. Research has shown that gastrointestinal issues often precede Parkinson's, which affects almost 1 million Americans today, and that proteins associated with the disease appear in the gut before they are found in the brain. Palacios will use gene sequencing to compare the intestinal fauna of people with and without early-stage Parkinson's to see if any significant differences in bacteria populations exist. The team will also investigate whether bacteria composition can explain why smokers and coffee drinkers have lower Parkinson's risk.

Dig deeper

Applied life sciences research is happening in labs and centers across the UMass system. You can find out more about UMass's research and the researchers conducting it at these links.

Institute for Applied Life Sciences (Amherst)
www.umass.edu/ials

RNAi and gene therapy
RNA Therapeutics Institute (Worcester)
umassmed.edu/rti

Horae Gene Therapy Center (Worcester)
umassmed.edu/gtc

Center for Human Genetics and Evolution (Worcester)

Center for Bioactive Delivery (Amherst)
umass.edu/cbd

Massachusetts Facility for High-Resolution Cryo-Electron Microscopy (Amherst)
www.umass.edu/ials/electron-microscopy

Biomimetic polymers and advanced biomaterials
Center for Autonomous Chemistry (Amherst)
autonomouschemistry.umass.edu

Center for UMass/Industry Research on Polymers (Amherst)
www.umass.edu/cumirp

Center for Advanced Materials (Lowell)
www.uml.edu/research/cam

Bone Biomechanics Lab (Dartmouth)
www.karimlab.org

Department of Biochemistry and Molecular Pharmacology (Worcester)
www.umassmed.edu/bmp

Light Microscopy Core Facility (Amherst)
www.umass.edu/ials/light-microscopy

Food safety, nutrition, and microbiome
Food Industry Consortium (Amherst)

Cranberry Health Research Center (Dartmouth)
www.umassd.edu/chrc

Biomedical and Nutritional Sciences Department (Lowell)
www.uml.edu/health-sciences/biomedical-nutritional

Center for Microbiome Research (Worcester)
www.umassmed.edu/microbiome

Center for Applied Nutrition (Worcester)
www.umassmed.edu/nutrition

Disease preparedness
IALS Clinical Testing Center (Amherst)
www.umass.edu/ials/ials-clinical-testing-center

Massachusetts Medical Device Development Center (Lowell)
www.uml.edu/research/m2d2

Institute for Drug Resistance (Worcester)
www.bio.umass.edu/biology/riley/node/78

MassBiologics (Worcester)
www.umassmed.edu/massbiologics

Cancer immunotherapy
Center for Personalized Cancer Therapy (Boston)
www.umb.edu/cpct

Cancer Center of Excellence (Worcester)
www.umassmed.edu/research/basic-research-departments/departments-programs-centers-institutes/cancer-center-of-excellence

Rays of Hope Center for Breast Cancer Research (Amherst)
pvlsi.org/rays-of-hope

Radiation Lab and Medical Physics (Lowell)
www.uml.edu/research/radlab

University *of* Massachusetts

Our thanks to the members of the applied life sciences faculty committee, who generously contributed their time and expertise to the creation of this report:

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