

Professor Craig Mello's Nobel Prize drew the spotlight to a broader UMass life sciences story.

The University of Massachusetts and the Life Sciences: World-Class Quality and Global Impact



University of Massachusetts

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I was humbled to be chosen to receive the 2006 Nobel Prize in Physiology or Medicine. And I am thrilled to do my work at the University of Massachusetts.

In winning the Nobel Prize with my collaborator Dr. Andrew Fire of Stanford University, I owe much to my exceptional colleagues at the University of Massachusetts Medical School. Without their contributions, this recognition of our role in the discovery of RNA interference (RNAi) would not have happened. I'm proud that RNAi is already changing the scientific landscape, offering new tools in the effort to better human health.

With continuing University, government and societal support, I believe that we can do much more. In new experiments, we are capitalizing on the strengths of RNAi. I am encouraged to see that we at UMass are working with leading life sciences firms, especially RNAi therapeutics companies, to realize this tremendous promise.

UMass Medical School is one of the leading academic medical centers in the country. We have the ingredients to make a difference for Massachusetts, the nation and the world. I am proud to be a part of UMass. I hope you'll join us as well. — **CRAIG MELLO**, NOBEL LAUREATE

UMass and the life sciences

Ideas are the foundation of progress. Faculty at all five University of Massachusetts campuses **generate knowledge** in the life sciences, offering powerful hope to improve quality of life around the globe and economic development at home. Of more than \$400 million in total annual research expenditures at UMass, nearly \$250 million are in the life sciences, placing it behind only Harvard in that category among Massachusetts universities.

UMass is constantly developing technologies to **convert research** into outcomes and moving innovations into the commercial sector to help **advance discoveries** from bench to bedside. In 2005, UMass ranked 11th in the nation among universities in technology licensing income; in Massachusetts, only MIT earned more.

UMass campuses **produce talent** for the life sciences industry. In fact, UMass produces more undergraduates in the life sciences than any other institution in Massachusetts. Without UMass, the industry would lack the supply of talent it requires.

In short, UMass is a full and reliable partner with industry, an essential component of the Commonwealth's economic infrastructure and a player on the global life sciences stage.

Craig Mello's Nobel Prize in 2006 put the bright spotlight on the quality of UMass research. While excited about the potential of RNAi, UMass knows it's merely one example of excellence. New discoveries are already moving from generation to trials and eventual product. Others are yet to be conceived.

This is an exciting time for the life sciences at UMass. And it is an exciting time for the industry to partner with us.



UMass research generates breakthroughs

Before the press reports of medical miracles, before the startup is announced, and long before products are available, researchers are generating and developing ideas in fields from vaccines and therapeutics to biodefense and bioenergy. At all five UMass campuses, tomorrow's breakthroughs are today's experiments.

Promising approaches to cancer

UMass Medical School has established itself as a world-class academic medical center.

Representative is the work of Professor Dario Altieri, director of the UMass Cancer Center. His research offers a promising new approach to cancer therapy through shepherdin, a novel molecular, anti-cancer agent that selectively kills tumor cells while sparing normal cells nearby.

At UMass Boston, a research team headed by Professor Gopal Rao is exploring new approaches to analyze mammograms, which could enhance the early detection of breast cancer.

UMass Boston is also using an NIH grant to partner with the Dana-Farber Cancer Institute to research cancer and other health disparities in Boston neighborhoods.

Unlocking fundamental mysteries of disease

Also at the leading edge is the Pioneer Valley Life Sciences Institute (PVLSI), with scientific leadership from UMass Amherst Professor Lawrence Schwartz. The institute, a joint venture between the campus and Baystate Medical Center in Springfield, has received funding for the

Center for Excellence in Apoptosis Research. Apoptosis, or programmed cell death, is a key feature of an organism's life cycle and defective apoptotic pathways are implicated in almost all diseases.

UMass Amherst Professor Lila Gierasch, a PVLSI research affiliate, works on protein folding, another fundamental biological process. One of 13 recipients in 2006 of the NIH Director's Pioneer Award, her program has implications for a broad range of diseases, including Alzheimer's, cystic fibrosis, bovine encephalitis, a form of emphysema, and even certain cancers.

Strengthening the biodefense shield

At UMass Dartmouth, Professor Bal Ram Singh and collaborators at Tufts University are leading the federally funded National Botulinum Research Center. The center seeks better ways to detect and treat botulinum neurotoxins, one of the world's most toxic substances, in order to help bolster the nation's biodefense capacity.

Research. Implications. At the University of Massachusetts, they are a team.

Even before the Nobel Prize, UMass had emerged as a leading research university in the life sciences. It has become a critical piece of the state's R&D infrastructure.

—HENRI TERMEER, CHAIRMAN, PRESIDENT AND CEO OF GENZYME





Microbes clean environment, produce power

Time magazine had good reason to list UMass Amherst Professor **Derek Lovley** as a “planet protector.”

Lovley’s discovery of the *Geobacter* family of microbes has important implications for cleaning up toxic and other wastes, as well as for renewable energy.

Because of its novel electron transfer capabilities, *Geobacter* can be used in the bioremediation of contaminated environments. In the process, *Geobacter*, which Lovley first isolated from the Potomac River in 1987, generates electricity from waste organic matter.

No wonder Lovley’s work has attracted world-

wide attention, as well as public and private sector support, including \$22 million in U.S. Department of Energy funding, which helped expand his Amherst lab from five scientists to nearly 50.

Among other successes, Lovley discovered how to coax *Geobacter* to not only “clean” uranium waste but to consume petroleum by-products, making it effective at cleaning oil spills.

Recently, Lovley significantly boosted the power output of microbial fuel cells by allowing bacteria to congregate in a biofilm. This helps advance the utility of bio-based fuel cells, expanding the options for renewable energy.

Cell block technology developed by Andrew Fischer will be available as product this fall.

CONV



UMass research is basis for new Cytyc medical device

Cytyc Corporation, a leading medical technology company in Marlboro, MA, saw potential to convert UMass Medical School Professor **Andrew Fischer's** research on preparing pathology specimens into a product.

The company moved very rapidly after licensing his technology, ramping up its design and manufacturing process, and expects to have a product ready to sell by the fall of 2007.

Cell blocks are a preparation method that allows individual cells or small tissue samples to be processed for histological examination. After developing a cell block preparation method

that is much less labor-intensive and time-consuming than traditional methods, Fischer received funding from the University's technology development fund.

Based on Fischer's work, Cytyc developed the Cellient™ Automated Cell Block System, a fully automated, closed system that virtually eliminates operator dependence and provides standardized, consistent preparations in less than an hour, compared to the day it can now take.

Cytyc sees a potential \$60 million annual U.S. market and an additional \$40 million in international sales for this cell block system.

vert



UMass **converts** discoveries to tested product



From better treatments for cancer to boosting the Massachusetts medical device sector, UMass works closely with established companies, such as Boston Scientific and Sepracor, and start-up companies to advance laboratory breakthroughs toward product.

Supporting startups and small firms

A successful research program at UMass Lowell presented such an opportunity that a resulting start-up company was able to raise \$7.5 million in January 2007 in its first major round of financing, a significant sum in the current venture capital market. Encapsion plans to leverage innovations of UMass Lowell Professors Stephen McCarthy and Robert Nicolosi to create a technology platform that will support a range of pharmaceutical and consumer product applications.

The technology Encapsion licensed from the University of Massachusetts and its ongoing collaboration provides the company with a strong product pipeline that has great market potential. UMass' contributions figured positively into our decision to invest.

—**GEOFF SMITH**, MANAGING PARTNER, ASCENT BIOMEDICAL VENTURES; ENCAPSION INVESTOR AND BOARD MEMBER

Two UMass campuses — Lowell and the Medical School — are partners in the Massachusetts Medical Device Development Center (M2D2). To help companies, especially smaller firms, move medical devices to market, M2D2 offers a range of assistance, from prototyping to animal and human clinical trials to workforce training.

Developing disease-fighting technologies

UMass Lowell Professor Susan Braunhut and Triton BioSystems, a Chelmsford, MA, life sciences firm, have teamed up to convert a process initially developed for military use into a new, cancer-fighting nanotechnology.

The treatment involves attaching magnetic bioprobes to antibodies that are injected into the patient. The bioprobes, which seek out and attach to cancer cells, are then heated up, destroying the malignant cells while leaving healthy, surrounding cells unharmed.

Also helping convert research to product is Professor Lloyd Semprevivo at UMass Amherst. BioVeris Corp. has licensed one of his discoveries, giving the firm exclusive rights to a vaccine candidate for chlamydia, the nation's most frequently reported bacterial sexually transmitted disease.

The company is funding up to \$600,000 of research in his laboratory, which has already resulted in discovery of another possible vaccine candidate.

UMass: converting powerful research to actual outcome.



UMass facilities, expertise **advance** science to market

UMass generates life sciences ideas and, through licensing and other collaboration, helps convert them into application. But another stage in closing the life sciences circle is also embedded in the UMass culture: advancing products and technologies to doctors' offices, bedsides and pharmacy shelves.

To help achieve such advances, UMass offers a range of value-added, user-friendly assistance to industry and other partners.

UMass increasingly active in clinical trials

UMass Medical School is an increasingly major destination for industries seeking to conduct clinical trials. The Office of Clinical Research and the school's clinical partner, UMass Memorial Medical Center, have seen new industry clinical trials increase by 60 percent since 2003. More than 800 human studies are currently active.

Providing specialized bioanalytical services

Also at the Medical School, core facilities provide proteomics services, from mass spectrometry and other advanced analytical techniques for protein identification and characterization to fractionation of highly complex protein mixtures to accelerate drug discovery and development.

Partners include local companies, such as ImmunoGen and Matritech, for which UMass identified antigens that serve as diagnostic markers to specific diseases. Other partners include global pharmaceutical firms, such as Eli Lilly, and biopharmaceutical equipment manufacturers, such as BioMachines.

At UMass Amherst, the genomics laboratory worked with Danvers-based Millipore to help the firm make its mouse cell culturing techniques more efficient and productive. Using gene expression analysis of marker genes from cultures grown on different substrates and then performing benchmarking studies, the lab provided results to support selection of optimal substrate materials and morphologies.

A global partnership for product formulation

In another collaboration, the Medical School's Massachusetts Biologic Laboratories (MBL) and the Serum Institute of India are collaborating to make available within two years a safer, lower cost treatment for rabies. Based on a monoclonal antibody created by scientists at MBL and the U.S. Centers for Disease Control, the treatment is being jointly tested and manufactured, bringing a leading-edge biologics technology to India for the first time.

Advancing life sciences. A UMass advantage.

UMass has been an invaluable resource in helping biotech companies transition from R&D to manufacturing here in Massachusetts. And it's poised to do even more in the future. We are very pleased to support this fine institution.

— H. MICHAEL KOPLOVE, VICE PRESIDENT, TECHNOLOGY AND ENGINEERING, WYETH BIOTECH



BioManufacturing Center advances research to production

One final challenge facing life sciences firms is the transition to manufacturing. Meeting this challenge can put a company on the road to success, while creating a positive economic impact.

The BioManufacturing Center at UMass Lowell, directed by Professor **Carl Lawton**, has already helped 20 companies bridge biotech research to manufacturing.

Through an array of research, education, process development and other services, the center offers hands-on assistance, including laboratories and other facilities in which firms can culture and validate their products for eventual production.

One life sciences firm turned to the center for help in making materials to characterize membranes and to test their performance and develop materials for next-generation purification.

Students from the center's Graduate Certificate Program in Biotechnology and Bioprocessing are in demand by leading firms, including Genzyme and Wyeth, as well as by small startups.

"We have a tremendous opportunity to demonstrate that life sciences firms can make the leap from research and development to manufacturing operations in Massachusetts," said Lawton.

UMass and the center are making that opportunity real.



Carl Lawton directs the BioManufacturing Center at UMass Lowell.



UMass fuels the pipeline for life sciences **talent**

World-class scientists make life sciences breakthroughs, but world-class talent at all levels is needed for companies to advance those breakthroughs through development and production to actual use. UMass produces such talent at all levels.

With five campuses and 59,000 students, UMass is the largest university in the state, graduating 11,500 students a year, including nearly 700 with degrees in the life sciences. UMass accounts for nearly one in every five bachelor's degrees in the life sciences — more than any other institution in the state and as many as the next two largest combined.

Bristol-Myers Squibb cites quality of talent

Guided by world-class research faculty, UMass students learn necessary skills to become active players in the life sciences industry. Equally important for Massachusetts industry, up to 80 percent of UMass alumni stay in Massachusetts immediately after graduation; over time, more than 60 percent choose to live and work in the state.

Indeed, Bristol-Myers Squibb cited the state's pool of life sciences graduates as a key factor in its 2006 decision to locate a manufacturing plant in Devens, MA. UMass, working with community colleges and other universities, such as Worcester Polytechnic Institute, was deeply involved in state efforts to recruit that firm.

New interdisciplinary program

Just as the life sciences is ever-changing, so too is UMass expanding its talent efforts.

In just one example, the Lowell, Boston and Dartmouth campuses and the Medical School jointly offer a Ph.D. in Biomedical Engineering and Biotechnology, an interdisciplinary graduate program that emphasizes the development of new technologies and the application of research to contemporary health problems.


Honors for research mean a lot; so does the ability to convert ideas from research into products and advance them into the marketplace.

UMass fuels the pipeline of talent the life sciences industry needs to make it all happen.

The Massachusetts Biotechnology Council looks to UMass for leadership in working with industry, state government and other academic institutions to meet the talent needs of our life sciences industry in the years ahead.

—MICHAEL WEBB, PRESIDENT AND CEO OF ASCENT THERAPEUTICS, INC.
AND CHAIR OF THE MASSACHUSETTS BIOTECHNOLOGY COUNCIL

talent



Elizabeth Connor is developing better ways to prepare students for life sciences careers.

New ways to teach the life sciences

As science becomes increasingly interdisciplinary, UMass Amherst is responding by redesigning undergraduate courses and training and research opportunities to better meld the teaching of biology with the physical and quantitative sciences.

Using a \$1.6 million grant from the Howard Hughes Medical Institute, a team of UMass Amherst faculty and scientists will improve the quantitative and analytical skills of students by integrating principles of physics, chemistry, math

and bioinformatics into the biology classroom and lab.

“Students often enter college believing that the physical and life sciences are separate,” said UMass Amherst Professor **Elizabeth Connor**, who directs the project. “Through this interdisciplinary approach, we are transforming life sciences education for undergraduates so that they now leave UMass better prepared for careers in research, medicine and science teaching.”



MESSAGE FROM THE PRESIDENT:

Building for the future

Nearly 150 years ago, what would become the University of Massachusetts was created as a land-grant institution to serve the Commonwealth by educating young people and bolstering the economy by advancing agriculture and the mechanical arts.

Today, that mission continues not only through agriculture and engineering, but in the social sciences, the arts and the humanities. UMass's contributions in these areas — and in the life sciences and an array of other fields, such as nanotechnology and renewable energy — enhance economic development and the quality of life.

As this partial overview of accomplishments makes clear, UMass research is world-class. But at UMass, the life sciences story is about more than scientific breakthroughs and technological innovation.

It is about rallying as a reliable partner around innovators and entrepreneurs to move brilliant science — whether ours or others — from laboratory to market.

It is about being responsive and realistic on licensing arrangements and working shoulder-to-shoulder with companies to develop prototypes, conduct clinical trials and even to help manufacture the end-product.

It is about providing this growing industry with employees equipped with the right skills and talent.

It is about being the University of Massachusetts.

Like discovery itself, UMass is looking ahead, planning new initiatives for all five campuses to further partner with the life sciences industry.

The Institute for Stem Cell Research, a system-wide, interdisciplinary research program, will enable industry collaborations by

bringing together complementary components in human and animal stem cell research, along with enabling technologies in areas such as cell engineering and bioinformatics.

The Massachusetts BioManufacturing Center, with planned facilities in Lowell and Dartmouth, will evolve into a statewide effort to provide hands-on assistance, from pilot production to small-batch manufacturing to student education programs, to help life sciences firms move from R&D into manufacturing in Massachusetts.

The RNAi Therapeutics Center will conduct clinical and translational research, using RNAi (discussed on the facing page) to test hypotheses about the underlying mechanisms of disease processes and, ultimately, develop the next generation of powerful drugs.

The Massachusetts Life Sciences Talent Initiative, with leadership from UMass, will be a collaborative effort among industry, government and academia to ensure that the life sciences industry's talent needs are effectively met.

Whether based on past achievement or future goals, the world knows that the caliber of the life sciences at UMass rivals that of other prominent universities.

The life sciences industry is learning first-hand that when it needs a reliable and innovative partner, it can call UMass.

The University of Massachusetts is ready and prepared to answer that call.

Jack M. Wilson, President

Background image: Roundworm *C. elegans*, the model organism with which Mello and Fire began their investigations of RNAi.

From the lab to startup, RNAi moves ahead

The Nobel Assembly was right to note that the discovery of the mechanism of RNA interference (RNAi) “heralded the start of a new research field.”

At the University of Massachusetts, that field is entering full bloom, from ongoing research to licensing agreements for RNAi technology, which can be applied to Parkinson’s disease, influenza and other maladies.

At UMass Medical School, Professors Craig Mello, Phillip Zamore, Tariq Rana and Michael Czech continue their ground-breaking research. They are also translating it: Zamore co-founded Cambridge-based Alnylam Pharmaceuticals; Mello, Rana and Czech are co-founders of

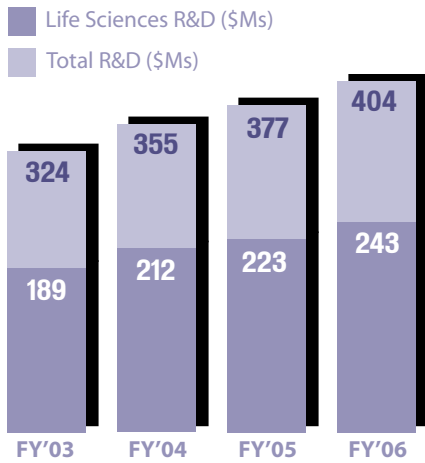
RXi Pharmaceuticals in the Massachusetts Biotechnology Research Park in Worcester.

Both companies seek to develop RNAi-based therapeutics.

The pharmaceutical industry clearly sees promise in RNAi. Last fall, Merck paid more than \$1 billion for Sirna Therapeutics. One reason for that hefty price? In 2003, Sirna reached an exclusive licensing agreement for some of UMass’s RNAi discoveries.

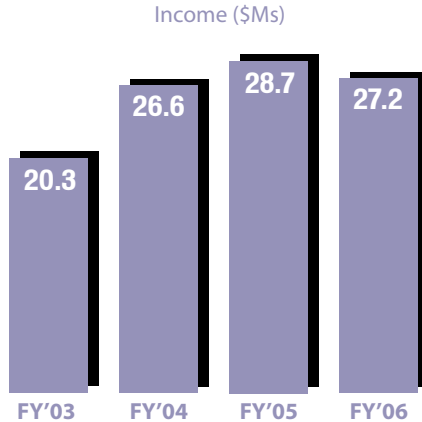
UMass is planning its own RNAi Therapeutics Center to continue research which, as Mello says, could “alter disease-causing genes to let people live healthier lives.”

UMass R&D expenditures



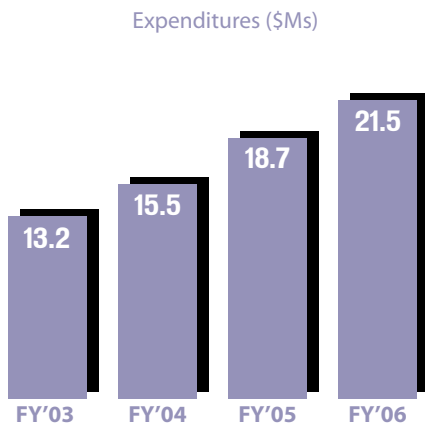
Of more than \$400 million in total annual research expenditures at UMass, nearly \$250 million are in the life sciences. Among Massachusetts universities, only Harvard is higher in that category.

UMass technology licensing income



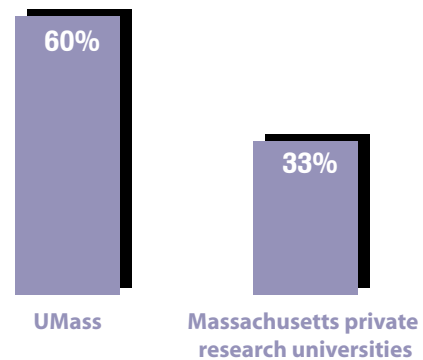
Annual technology licensing income at UMass has been well above \$20 million for four years. In 2005, UMass ranked 11th among U.S. universities and, in Massachusetts, behind only MIT.

UMass industry-sponsored R&D expenditures



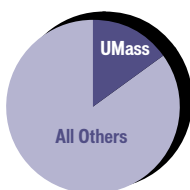
Industry-sponsored R&D expenditures at UMass rose by more than 60 percent between FY 2003 and FY 2006.

Alumni in Massachusetts long-term



More than 60 percent of UMass graduates make Massachusetts their long-term home, which is nearly double the rate for graduates from the state's private research universities.

Massachusetts life sciences bachelor's degrees – 2006



The University of Massachusetts accounts for 18 percent of all bachelor's degrees in the life sciences awarded in the state. That's more than any other academic institution in Massachusetts

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PHOTOS

Generate

Left to right: UMass Amherst Professor of Biochemistry and Molecular Biology Lila Gierasch, UMass Boston Professor of Physics Gopal Rao, UMass Dartmouth Professor of Chemistry and Biochemistry Bal Ram Singh.

Convert


Clockwise, from top left: UMass Amherst Professor of Veterinary and Animal Sciences Lloyd Semprevivo, UMass Lowell Professor of Biological Sciences Susan Braunhut, UMass Lowell Professor of Plastics Engineering Stephen McCarthy.

Advance

UMass Medical School offers facilities and expertise in its Massachusetts Biologic Laboratories and Aaron Lazare Medical Research Building (top right) to the life sciences industry.

Talent

Today's UMass students are tomorrow's life sciences industry talent.



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