BIOMEDICAL SCIENCES

2010–2012

CATALOGUE

Graduate School of Biomedical Sciences

University of Massachusetts Medical School

Advancing the health and well-being of the people of the Commonwealth of Massachusetts and the world through pioneering education, research and health care delivery.

Thank you for taking time to learn about the Graduate School of Biomedical Sciences at the University of Massachusetts Medical School. In this catalogue, you'll find information on our graduate programs and the distinctive way in which we prompt our students to discover the wonders of the biomedical sciences as they launch themselves into a lifetime of exploration as scientists. In addition to this presentation of opportunities available within the Graduate School of Biomedical Sciences, we encourage you to visit our Web pages listed at right for additional detailed information. Our online application is also accessible through our main site. Please feel free to contact us if there are questions that you have about our school or the admission process.

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Graduate School of Biomedical Sciences Main Site:
www.umassmed.edu/gsbs

University of Massachusetts Medical School Research and Publications:
www.umassmed.edu/research

Graduate School of Biomedical Sciences Academic Program Listings:
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Graduate School of Biomedical Sciences Laboratory Rotation Options:
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Program in Clinical & Population Health Research:
www.umassmed.edu/cphr

Master of Science in Clinical Investigation Program:
www.umassmed.edu/msci

MD/PhD Program:
www.umassmed.edu/mdphd

City of Worcester:
www.umassmed.edu/gsbs/futurestudents/worcester.aspx

The University of Massachusetts Medical School (UMMS), comprising the School of Medicine, the Graduate School of Biomedical Sciences and the Graduate School of Nursing, is firmly committed to an environment free of all forms of discrimination, harassment, intimidation, uncivil behavior or other acts of intolerance. UMMS will not discriminate on the basis of race, color, religion, gender (including pregnancy, childbirth or related medical conditions), sexual orientation, age, national origin, ancestry, disability, covered veteran status or any other characteristics protected by law. The Diversity and Equal Opportunity Office (DEOO) is charged with oversight for the University's affirmative action and equal opportunity policies and for monitoring practices, procedures and programs designed to reach this goal. The DEOO works with all departments and services of the University to reasonably accommodate persons with disabilities or specific religious convictions if such accommodations do not present an unreasonable burden for either the institution or the program of study. Disabled or impaired persons who need assistance to access the information in this catalogue should contact the DEOO at 508-856-2179; TDD: 508-856-6395. This catalogue is intended to provide academic and nonacademic information about graduate study at UMMS to persons who work and study here, to persons who may be interested in applying for admission and to the general public. UMMS is fully accredited by the Liaison Committee on Medical Education and the New England Association of Schools and Colleges.

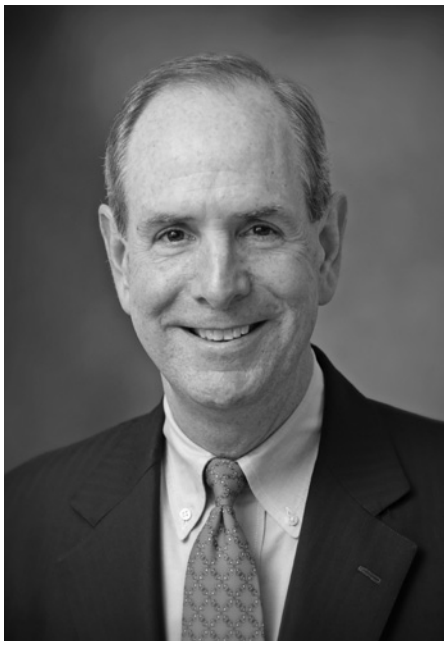
Message from the Chancellor

There has never been a more exciting time to be a part of the University of Massachusetts Medical School, the commonwealth's only public academic health sciences center. UMass Medical School brings together an extraordinary community of faculty, students and staff who provide state-of-the-art education, conduct ground-breaking research and take the lead in public service initiatives in Massachusetts and around the globe. GSBS students benefit from studying at an institution at the forefront of scientific advancement, one that attracts more than $245 million in research funding annually and consistently produces breathtaking advances in basic and clinical research.

The 10-year, $1 billion Massachusetts Life Sciences Bill enacted in 2008 casts our institution in a critical role in research, discovery, development and education in Massachusetts, most notably through the establishment of the Advanced Therapeutics Cluster (ATC). The ATC will be housed in the Albert Sherman Center, a state-of-the-art research and education facility that will more than double the institution's research capacity and create an ideal learning environment. With the Albert Sherman Center about to rise on the campus, the promise of the commonwealth's forward-thinking life sciences initiative is unfolding at UMass Medical School. Through three integrated research programs—the Center for Stem Cell Biology and Regenerative Medicine; the RNA Institute; and the Gene Therapy Center—the ATC brings together some of the best minds in the world focused on creating new therapies for debilitating diseases. Among them is researcher Craig Mello, PhD, a Howard Hughes Medical Institute Investigator who was awarded the 2006 Nobel Prize in Medicine with colleague Andrew Fire, PhD, of Stanford University for their discovery of RNA interference (RNAi). Since their seminal paper published in *Nature* detailed gene silencing by double-stranded RNA, the technology of RNAi has revolutionized biomedical research. Scientists realize that if RNAi is used to shut down disease-causing genes, then promising new therapeutics can result. Recognized as a global center for RNA-related research and collaboration, UMass Medical School boasts a growing cadre of internationally renowned experts in this field.

The Ambulatory Care Center (ACC) is another new facility on the UMass Medical School campus that exemplifies our commitment to education, research discovery and clinical translation. The ACC offers a unique complement of state-of-the-art patient care clinics and education and translational research programs. For example, the seven-story, 258,000-square-foot building is home to the Department of Quantitative Health Sciences, established in 2008. The department, which fosters collaboration among existing clinical and basic science entities with the goal of shortening the time between laboratory breakthroughs and clinical applications, is integral to UMass Medical School's education and research vision, and aligns with recently identified priorities of the National Institutes of Health.

At the same time UMMS advances scientific innovation, it continues to be a leader in educating the health care providers of the future. Our goal is to prepare graduates to become compassionate healers. As our nation sorts through the implications of the historic health care reform law passed in March 2010, UMass Medical School will continue to educate the care givers who will be able to meet their patients' health care needs in a new way. Our special emphasis on primary care, coupled with



affordable tuition that lowers the obstacles for working in general practice, will allow our academic health sciences center to serve the public interest both locally and globally.

Amid all these exciting new developments, including the promise of universal access to health care for all Americans, our guiding principles remain unchanged and unwavering. In all that we do, we place the highest priority on respect for the dignity and diversity of every member of our community and remain fully committed to supporting our students' professional, intellectual and emotional growth so they may have the opportunity to fulfill their potential and achieve their professional goals. It is my pleasure to welcome you as you explore how joining our community can help you fulfill your dreams.

Michael F. Collins, MD
Chancellor
University of Massachusetts Medical School

Senior Vice President for the Health Sciences
University of Massachusetts

GSBS

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Message from the Dean

We are delighted that you are interested in doctoral study at the Graduate School of Biomedical Sciences (GSBS) at the University of Massachusetts Medical School. As you browse through this catalogue, you will discover that our outstanding faculty provide a comprehensive, modern biomedical sciences curriculum and pre-thesis and thesis research opportunities encompassing an extensive range of leading-edge, biomedical sciences disciplines.

The accomplishments of our faculty and students tell this story more completely. GSBS faculty are engaged in groundbreaking research that has increased our externally funded research portfolio from $98 million in 2000 to $242 million in 2009. During that same period, GSBS research faculty have expanded from 131 researchers to 324, and UMass Medical School GSBS faculty have been recognized with a Nobel Prize in Physiology or Medicine and an Albert Lasker Basic Medical Research Award, and include five Howard Hughes Medical Institute (HHMI) Investigators, two HHMI early career scientists and two National Academy of Sciences members.

Since our first student graduated in 1984, more than 1,700 research papers have been published by 499 graduates and the existing student body. During the past nine years, the student body has grown from 215 doctoral students to 480, and five GSBS students have received the Harold M. Weintraub Graduate Student Award, which is widely regarded as the highest award that any graduate student in the biomedical sciences can attain. As a result of these extensive research opportunities, GSBS graduates have secured national post-doctoral and industrial research positions, as well as achieved leadership positions in U.S. academic and biotechnology institutions.

GSBS students hail from more than two-thirds of the states in our nation, with international students coming from almost every continent. The quality of our students' research, along with its recognition by internationally renowned scholars, as well as the standing of our faculty and the diversity of our student population, ensure that doctoral study at the University of Massachusetts Medical School Graduate School of Biomedical Sciences offers outstanding opportunities for scientific, cultural and professional advancement.

If you are excited by laboratory research, motivated to undertake a challenging curriculum to broaden and deepen your understanding of contemporary biomedical sciences and determined to make your mark through innovative research in collaboration with faculty widely recognized as international leaders in their fields, we invite you to investigate opportunities for graduate study at our school.

Dean Anthony Carruthers, PhD
Professor of Biochemistry & Molecular Pharmacology

About the University of Massachusetts Medical School

The University of Massachusetts Medical School (UMMS) was founded by proclamation of the governor and an act of the legislature to meet the health care needs of the residents of the commonwealth. Its mission is to advance the health and well-being of the people of the commonwealth and the world through pioneering education, research and health care delivery with its clinical partner, UMass Memorial Health Care. UMMS is one of five campuses that make up the University of Massachusetts. Other campuses are located in Amherst, Boston, Dartmouth and Lowell.

The Learning Community

As of September 1, 2010

Faculty (including voluntary)	2,996
Basic science full- and part-time faculty	320
Clinical full- and part-time faculty	2,513
Nursing faculty	163
School of Medicine	
MD students	439
MD/PhD students	23
Alumni	3,215
Graduate School of Biomedical Sciences	
Basic Biomedical Sciences students	382
MD/PhD students	36
Biomedical Engineering and Medical Physics students	3
Clinical and Population Health Research students	18
Master of Science in Clinical Investigation students	8
Alumni	616
Graduate School of Nursing	
MS students	38
Graduate Entry Pathway students	84
PhD students	23
Doctor of Nursing Practice students	12
Alumni	853

A local, regional and statewide health resource, UMMS comprises the School of Medicine, opened in 1970; the Graduate School of Biomedical Sciences, opened in 1979; and the Graduate School of Nursing, opened in 1986. UMMS also offers dynamic graduate medical education and continuing medical education programs.

Beyond fulfilling its core missions of health sciences education and public service, UMMS is home to a thriving biomedical research enterprise. With major funding from the $1 billion Massachusetts Life Sciences Bill signed into law in 2008, UMMS research programs are central to the Massachusetts Life Sciences Initiative. Federal and private research grants and contracts reached more than $245 million in fiscal year 2010, making UMMS one of the fastest-growing research institutions in the country. In 2006, UMMS Professor Craig C. Mello, PhD, and his colleague Andrew Fire, PhD, of Stanford University, were awarded the Nobel Prize in Physiology or Medicine by the Nobel Assembly at Karolinska Institute for their discoveries related to RNA interference. First published in the journal *Nature* in 1998, their research showed that a particular form of ribonucleic acid or RNA—the cellular material responsible for the transmission of genetic information—can silence targeted genes. This RNAi process offers astounding potential for understanding and manipulating the cellular basis of human disease and for the development of new therapeutics for disease treatment and cure.

Educational Objective

The Graduate School of Biomedical Sciences (GSBS) comprises two divisions —Basic & Biomedical Sciences and Clinical & Translational Sciences—and ten programs of study. The graduate programs train students in their selected specialty area and emphasize a broad background in the basic medical sciences in preparation for research with direct relevance to human biology and disease. Graduates are equipped to collaborate with scientists and physicians involved in basic research and clinical observations, and are prepared to initiate careers as educators in schools of the health professions or in the biotechnology industry.

The programs in the Clinical & Translational Sciences Division address the national need to move health care research from laboratory to bedside and from individual patients and health care sites to systems of care. These programs emphasize translational, clinical and health sciences research skills and provide students the tools to translate discoveries in the laboratory into effective patient outcomes.

The GSBS offers students an exceptional opportunity to obtain a contemporary education in the biomedical and translational sciences through multidisciplinary core curricula, laboratory rotations and advanced elective coursework. With a current enrollment of approximately 450 very select students and 300 faculty members, the graduate school maximizes interaction between faculty and students and emphasizes a personalized educational process.

Consistently ranked by *U.S.News & World Report* as one of the leading medical schools in the nation for primary care education, the School of Medicine has a foremost responsibility to provide our students with an accessible, comprehensive and personally rewarding medical education of the highest quality and one that optimally prepares them to excel as tomorrow's physicians—caring, competent, productive and fulfilled in their chosen career serving a diversity of patients, communities and the health sciences. The school is committed to training in the full range of medical disciplines, with an emphasis on practice in the primary care specialties, in the public sector and in underserved areas of Massachusetts.

The Graduate School of Nursing offers master's, post-master's and doctoral degrees, preparing registered professional and advanced practice nurses within nurse practitioner and nurse educator specialties and for faculty, research and other nursing leadership positions. Subspecialty professional and clinical education is also offered in selected areas. The basis for study includes theoretical foundations of professional and advanced practice nursing, research process and design, societal forces that influence nursing, advanced pathophysiology, pharmacology, health assessment, clinical decision making, specialty content and clinical education.

Our educational program has benefitted in recent years from major investments in state-of-the-art educational technology and medical simulation and will continue to benefit from additional enhancements to be housed in the Albert Sherman Center, a new research and education building on campus slated for completion in late 2012, where teaching and student space will be among the priorities.

The educational mission is further enhanced by 46 accredited residency and fellowship programs; cooperative degree programs with area colleges and universities; diverse community-based education programs across Massachusetts; outstanding achievements in basic and clinical research in the health sciences; and the Commonwealth Medicine division, dedicated to serving the state's broad community of health care and service agencies. As the commonwealth's only public medical school, UMMS places an emphasis on partnerships with the community, creating opportunities for students to learn in and contribute to serving Massachusetts communities and the care of its vulnerable and underserved populations.

The mission of the Office of Ethics is to foster an environment in which all members of the UMMS community are encouraged to recognize the values embedded in human interactions and to develop the skills necessary to respond appropriately. Committed to providing high quality ethical consultation and educational programming, the office maintains a computerized collection of resources relevant to ethical issues in health care, which is available to all members of the UMMS community.

Victor Ambros, PhD
the Silverman Chair in Natural Sciences, co-director of the RNA Therapeutics Institute and professor of molecular medicine

Dr. Ambros is a National Academy of Sciences member whose discovery of microRNAs and their role in gene regulation opened a dramatic new world of investigation into developmental biology. Widely regarded as a central figure in RNA biology, Ambros joined UMass Medical School in February 2008 from Dartmouth Medical School, enhancing the UMMS position as the global center for RNA-related exploration.

The Ambros lab is focused on understanding the genetic and molecular mechanisms that control cell division, differentiation and morphogenesis in animals, in particular how the timing of such developmental events is organized. “This is a terrific environment where students and postdocs can work with people who are the experts in almost anything they can imagine in RNA biology.”

Ambros, a recipient of the Rosenstiel Award, the Newcomb Cleveland Prize, the Genetics Society of America Medal, a Benjamin Franklin Medal in Life Science, the Gairdner Foundation Award and the Lasker Award for Medical Research, received his undergraduate and graduate degrees at MIT and completed his postdoctoral fellowship there. During graduate school, he worked with David Baltimore, PhD, a co-recipient of the 1975 Nobel Prize, and as a postdoc with H. Robert Horvitz, who shared the 2002 Nobel Prize. Ambros continued his research as a faculty member at Harvard before taking his position at Dartmouth in 1992.

GSBS students have been first-authors recently published in:

- *Cell*
- *Science*
- *Nature*
- *Neuron*
- *Genes & Development*
- *Journal of Cellular Biochemistry*
- *Journal of Molecular Biology*
- *Journal of Experimental Medicine*
- *Molecular Cell*
- *Proceedings of the National Academy of Sciences*
- *Molecular Systems Biology*
- *Neuroscience*
- *AIDS*
- *American Heart Journal*

Recent graduates accepted postdoctoral positions at the following academic institutions:

- Dana Farber Cancer Institute
- Duke University
- Harvard University
- Johns Hopkins University
- MIT
- Princeton
- Stanford University
- University of California
- University of Massachusetts Medical School
- University of Pennsylvania
- University of Washington
- Washington University
- Yale University

Public Service Mission

The faculty, students and staff at UMass Medical School are committed to making an impact on the health and well-being of the people of the commonwealth and the world. Every day, in ways large and small, our institutional community is actively and passionately engaged in the communities we serve, undertaking numerous and varied outreach initiatives with partners in the academic, business and philanthropic fields. Collaborations include a new partnership with Special Olympics of Massachusetts to advance its Healthy Athletes initiative; the long-running Worcester Pipeline Collaborative and Regional Science Resource Center, both award-winning programs recognized as national models for K–12 science, technology, engineering and mathematics education outreach; and student-run, faculty-supervised free clinics that provide care for underserved and economically disadvantaged patients.

By working with schools, community groups and social service organizations, UMass Medical School's reach is extended into places where we can make a difference. And by creating and sustaining relationships with the social and cultural fabric of the region—and indeed, much of the world—we provide both real-world help and role models for the next generation of nurses, doctors, researchers and leaders.

The newly established Office of Global Health is the latest method to broaden the Medical School's reach. The office will coordinate and optimize current and future endeavors in global medicine to elevate it to a more visible, high-impact initiative; develop a network of international activities that can inspire UMMS medical, nursing and basic science students as on-site teachers and practitioners; and enhance training of health care providers internationally. The Office of Global Health will also work with the Office of Research to help coordinate specific clinical trials and epidemiological studies as these opportunities arise.

The Commonwealth Medicine division of UMMS works in partnership with numerous state and local agencies in Massachusetts and other states to increase the value and quality of publicly funded health expenditures and to improve access and delivery of care to at-risk and uninsured populations. Drawing on the depth and breadth of UMMS academic, research, management and clinical resources, Commonwealth Medicine assists health care providers in the public sector to optimize efficiency and effectiveness.

Several programs illustrate the scope of Commonwealth Medicine's work in health policy, research, health care service delivery and education. The annual Academic and Health Policy Conference showcases scholarly academic research projects on health care in the public sector with presentations on diverse topics including the future of research-based policymaking, child mental health, health care in the criminal justice system and health information technology. And Commonwealth Medicine's Mini-Grants program makes seed money available to UMMS investigators for innovative projects that address public sector needs, further exemplifying the division's ongoing support of the UMMS research mission.

Commonwealth Medicine facilitates educational opportunities for UMMS students, such as the partnership with the Graduate School of Biomedical Sciences to develop the PhD program in Clinical & Population Health Research, one of the first in the nation to promote graduate study that fosters the analytic skills and methods necessary to conduct both health services and clinical research.

Commonwealth Medicine's expertise in health policy, innovative educational programs, service delivery and applied clinical research is focused on increasing public service and changing public policy; it is helping improve health outcomes for the people of the commonwealth served by public health and human services programs. Indicative of its success, several medical schools and agencies from other states have collaborated with Commonwealth Medicine in order to replicate its unique work.

Research Mission

The research mission of UMMS is to promulgate scientific inquiries that produce groundbreaking discoveries in the basic and clinical sciences. Currently supporting more than 300 investigators, the growing UMMS research enterprise has led to stimulating advances in the treatment of disease and injury, as UMMS scientists undertake research to discover the causes of and cures for the most devastating diseases of our time.

Accomplished faculty members include a Nobel Prize winner, a Lasker Award recipient, two members of the National Academy of Sciences, a member of the Royal Society, five Howard Hughes Medical Institute Investigators, Banting Medal awardees, Pew and Keck scholars, MERIT awardees, a Fellow of the American Association for the Advancement of Science, cancer research award recipients, and many other winners of scientific accolades. Capitalizing on a collaborative environment, UMMS has research expertise in both basic and clinical areas with concentrations in diabetes, molecular genetics, immunology, virology, HIV/AIDS, cancer, signal transduction, structural biology (with attention to innovative drug design), bone cell biology, chemical biology, gene function and expression, neuroscience, imaging, and occupational and environmental health.

Research growth is reflected in increased funding levels. In the past 10 years extramural funding has more than doubled, from $89 million in FY '98 to $245 million in FY '10.

Today, UMMS is proud to be at the forefront of the commonwealth's life sciences initiative, having received funding in 2007 and 2008 to establish an Advanced Therapeutics Cluster (ATC) on campus. The ATC will bring together an interdisciplinary group of research faculty and physician-scientists in three interconnected research clusters—stem cell biology, RNA biology and gene therapy. RNA studies at UMMS are conducted by world leaders in the field; to direct gene therapy initiatives, UMMS recruited an internationally recognized researcher in 2008. And in the realm of stem cell biology, the institution launched the Stem Cell Bank and Stem Cell Registry, two separate, but complementary, infrastructure programs that are fundamental to the advancement of today's cutting-edge biomedical research.

The ATC will be housed in the Albert Sherman Center, a new research and education facility slated for completion in late 2012 that will add approximately 480,000 square feet to a campus that has grown exponentially during the past ten years. The Albert Sherman Center, which will double the campus's research capacity, follows on the heels of the Aaron Lazare Medical Research Building, an innovatively designed research facility that added 360,000 square feet of laboratory space to UMMS when it opened in the fall of 2001.

Campus Features

Situated on Lake Quinsigamond in Worcester, the UMMS campus comprises the Aaron Lazare Medical Research Building and the complex that houses the School of Medicine, Graduate School of Biomedical Sciences, Graduate School of Nursing and the University Campus of UMMS's clinical partner, UMass Memorial Health Care. The entire complex is planned and organized to function as a single, integrated academic health sciences center.

UMW's extended campus includes the Brudnick Neuropsychiatric Research Institute, and labs and offices within the Massachusetts Biotechnology Research Park in Worcester; sites in Shrewsbury and Auburn; the Eunice Kennedy Shriver Center in Waltham; and the New England Newborn Screening Program and MassBiologics in Jamaica Plain and Mattapan.

Aaron Lazare Medical Research Building

The Aaron Lazare Medical Research Building anchors the UMMS campus and the institution's research enterprise. UMMS faced a crossroads in its research direction in the 1990s and, looking to a future in which its scientists would have an even greater impact on the medical research field, determined it must expand its physical facilities to retain and recruit the best investigators. Just 30 months from design concept to occupancy, the Lazare Medical Research Building opened in August 2001.

The facility added 360,000 square feet to the existing 600,000 square feet in on-campus buildings and 83,000 square feet in the Massachusetts Biotechnology Research Park nearby. The Lazare Building comprises nine floors of laboratory and office space configured to accommodate existing disciplines, experimental approaches and emerging programs. The open laboratory design encourages collaboration and interaction among scientists, with 18 lab modules per floor accommodating up to eight people per module. The lab design is also one of the most efficient ever conceived—approximately 70 percent of each floor is "net" usable research space.

Complementing the Cell Biology, Cellular & Molecular Physiology, Immunology & Virology and Molecular Genetics & Microbiology programs located in the main campus building, floors 2 and 3 of the Lazare Research Building are occupied by the Department of Medicine, primarily focusing on gene therapy techniques, such as how to insert new genes into cells, and diabetes and other autoimmune diseases, including new frontiers in immunology.

The Department of Cancer Biology and the UMass Cancer Center occupy the fourth floor, where investigations are conducted into bone marrow transplantation and gene therapy for cancer treatment, as well as new approaches to understanding prostate, breast and ovarian cancer.

The NIH awarded UMMS $2 million through the National Center for Research Resources to construct laboratory space on the fifth and sixth floors of the building that house the Program in Gene Function & Expression, established in 1999 to explore the genetic basis of human disease.

Floor 7 is occupied by the Department of Neurobiology, which was established in 2000 to study neurological development, with implications for disorders ranging from Sudden Infant Death Syndrome to Alzheimer's disease.

The Department of Biochemistry & Molecular Pharmacology researches how biological proteins are shaped and created, leading to drug discovery and drug design, and is located on floors 8 and 9.

The Program in Bioinformatics & Computational Biology, established in 2010, is located on floor 10.

Lamar Soutter Library

The Lamar Soutter Library serves as the National Library of Medicine's New England Regional Medical Library, one of eight such regional libraries nationwide, exhibiting medical information products offered by the National Library of Medicine and providing training seminars and presentations that teach students, faculty, researchers, health professionals and consumers how to gain access to useful information. The library provides many opportunities to learn about utilizing databases and other computer-based resources through free classes offered in the library's computer training lab.

Subscribing to 1,250 print journals and more than 4,900 electronic journals, and offering a number of electronic indexes, abstracts, bibliographic and full text databases and holdings of 215,000 volumes—including numerous rare books—the library's wide variety of resources support education and research. In addition, an extensive reserve collection supplements faculty lecture assignments and readings.

The library's computer area includes more than 100 workstations for computer-assisted instruction, interactive programs, educational databases, desktop productivity tools and Internet browsing. In turn, access to the library is available off campus via the Internet for UMMS students and faculty.

The library provides access to more than 200 electronic books and subscribes to many electronic databases. MEDLINE, PsycINFO and many evidence-based medicine databases are available through Ovid. In addition, the library subscribes to MDConsult, UpToDate, Web of Science, Micromedex, CINAHL and Harrison's Online. The library's membership in the Boston Library Consortium and the

Academic and Research Collaborative of the Central Massachusetts Regional Library System expands student access to academic and medical libraries throughout the state.

The library is continually expanding its outreach to the public and affiliated health care organizations in Worcester and around the commonwealth. This outreach is accomplished in part by grant-funded special projects and by extensive off-campus teaching programs. For example, in 2005, the library launched a new consumer health-oriented project, Go Local Massachusetts, providing access to information about a variety of local health care services and agencies, all linked to the more than 700 health topics covered in MedlinePlus, the National Library of Medicine's Web site for consumer health information.

UMass Memorial Health Care

UMass Memorial Health Care, Inc. is the clinical partner of the University of Massachusetts Medical School and the largest health care system in Central and Western Massachusetts. It is a not-for-profit, integrated health care system designed to provide all levels of health care, from primary to quaternary. UMass Memorial Health Care delivers care through the UMass Memorial Medical Center and its member hospitals (Clinton, HealthAlliance, Marlborough and Wing Memorial) with health care services further enhanced and augmented by UMass Memorial Medical Group, University Commons Nursing Care Center, Community HealthLink, Diversified Visiting Nurses Association and UMass Memorial Home Health and Hospice. The UMass Memorial Centers of Excellence, in cardiovascular disease, cancer, musculoskeletal diseases and diabetes, concentrate expertise, sophisticated technology and the latest advances in medicine to provide patients with a complete continuum of care.

As the tertiary care referral center for Central and Western Massachusetts, UMass Memorial Medical Center offers a full complement of sophisticated technology and support services, providing the region with a broad range of specialists renowned for their work in areas such as cancer, cardiology, emergency medicine, orthopedics, surgery, women's health and children's medical services, including an internationally recognized newborn intensive care unit. UMass Memorial Medical Center is a 781-licensed bed facility on three campuses: University, Memorial and Hahnemann. It also operates a 35-bed mental health unit at Worcester State Hospital. UMass Memorial Medical Center is also the region's transplantation center and provides liver, kidney, pancreas and bone marrow transplantation.

Charisa Cottonham
sixth-year student
Conducting research in the lab of Lan Xu, PhD, associate professor of molecular medicine

Charisa has always been interested in how seemingly normal cells in the body "go rogue" and become cancerous. So, when she was considering potential graduate schools and thesis laboratories, UMass Medical School's Graduate School of Biomedical Sciences—and the lab of Dr. Xu, which investigates cancer etiology—went to the top of the list. But it wasn't just the science that convinced her to come. "I chose the GSBS after attending an open house, where I felt extremely welcome. Of course the research is outstanding, but knowing that I would have a support system here at UMass Medical School made the decision to relocate from California that much easier."

A graduate of the University of California Los Angeles with a degree in molecular, cell and developmental biology, Charisa joined Dr. Xu's lab to study how microRNAs play a role in TGF-beta signaling, which is often deregulated in a variety of cancers. She says the supportive network of students, researchers and administrators plays an important part in her positive experience during her time at GSBS. "A lot of exciting research is happening here and it is great to become a part of that excitement as you conduct research among so many talented investigators."

Upon completion of her PhD, Charisa plans to pursue a postdoctoral fellowship in a laboratory studying the roles that the tumor cell microenvironment play in tumorigenesis.

Services For Students

The Graduate School of Biomedical Sciences Office and the Offices of Student Affairs, Diversity and Equal Opportunity, Financial Aid and Admissions, and the Bursar and the Registrar are on the first floor of the main school building. The Lamar Soutter Library, student laboratories and other student areas are open at night for students who wish to study or work in the building.

Diversity and Minority Affairs

The Office of Diversity and Minority Affairs helps minority students enjoy rewarding academic, professional and social experiences while at UMMS. In addition to individual guidance for academic and personal issues as well as career counseling and mentoring, events organized with the help of other minority faculty and the Diversity and Equal Opportunity Office (DEOO) offer opportunities to socialize and network. The office also assists in supporting gay, lesbian, bisexual and transgendered students.

Americans with Disabilities Act

According to the Americans with Disabilities Act (ADA) of 1990, a disability is defined as an impairment that substantially limits one or more of the major life activities of an individual; a record of such an impairment; or, the perception that one has such an impairment. UMMS is firmly committed to providing full access to individuals with disabilities. In so doing, UMMS intends to fully comply with ADA and EEOC guidelines. Students who avail themselves of the ADA will not be treated with prejudice or adversity. The Office of School Services, working in collaboration with the Diversity and Equal Opportunity Office, coordinates all student disability issues.

The Vice Provost for School Services serves as the ADA Student Coordinator. Once admitted, the student is responsible for notifying the ADA Student Coordinator of his/her disability, requesting academic accommodations in writing and providing appropriate documentation of the disability. A student may request accommodations at any time during matriculation. All requests for accommodations are reviewed and acted on by the Academic Accommodations Committee. It is always the student's choice whether or not to accept any recommended accommodation. Confidentiality is a strict practice of the Academic Accommodations Committee. Students may be referred to the Academic Accommodations Committee by course coordinators or Academic Evaluation Boards for analysis of the academic difficulty and its possible relationship to a disability. Accommodation under ADA will not be in conflict with the fundamental nature of the academic programs of UMMS.

Appropriate Treatment of Students

In 2001, UMMS developed a policy and complaint procedure to help ensure the appropriate treatment of students (ATS) in the School of Medicine, Graduate School of Biomedical Sciences and Graduate School of Nursing. Students should expect to be treated with respect and to learn and work in a safe environment. All individuals who interact with students are expected to behave in accordance with the ATS policy, which applies to faculty, administrators, nurses, house staff, postdoctoral students, technicians, other learners, and other volunteer or paid staff. Inappropriate treatment occurs when behavior shows disrespect for the dignity of others and unreasonably interferes with the learning process. It can take the form of physical punishment or threat, sexual harassment, psychological cruelty, and discrimination based on race, color, national origin, religion, gender, sexual orientation, age, disability or veteran status. Please note that separate school-wide policies are in place covering sexual harassment, consensual amorous relationships, and discrimination based on protected-class status.

For more information, including definitions, policies and procedures for reporting suspected inappropriate treatment, students are encouraged to contact the Office of Undergraduate Medical Education or the DEOO.

The policy and procedure is also available in the Office of Student Affairs. The DEOO is responsible for coordination and monitoring of all ATS complaints and for training faculty members to serve as resource persons for students with ATS-related inquiries and concerns, and for ongoing oversight and periodic review of the training process.

Student Counseling Service

The Student Counseling Service (SCS) provides counseling, psychotherapy, assistance with stress management and educational programs on emotional well-being for students. Students may receive individual or couples' therapy. The SCS maintains strict standards of privacy and confidentiality. The service cost is covered by the prepaid Student Health Plan fee.

Student Health Service and Student Health Plan

The Student Health Service (SHS) seeks to preserve and enhance students' well-being at UMMS by providing programs that effectively respond to students' health care needs. Students are required to undergo a pre-matriculation health history and medical examination. The form to document this process is available through the SHS and must be completed by students' health care providers prior to registration, effectively putting the SHS on notice of students' pre-existing health conditions for which they may require ongoing medical care.

The Student Health Plan (SHP) is the administrative entity funded by the mandatory student health fee, providing routine primary health care coverage to students under the direction of physicians or nurse practitioners. With an additional fee, students may elect to have their

immediate family members (i.e., spouse, children) covered under the SHP. Students are covered by the SHP during their period of enrollment, from registration though August 31 of the following school year. A brochure describing the plan and its services is available through the Student Health Service.

The University requires all students to carry supplemental insurance to cover specialty consultations, diagnostic evaluations and inpatient services. Such a policy may be purchased either through the University or privately.

Food Services

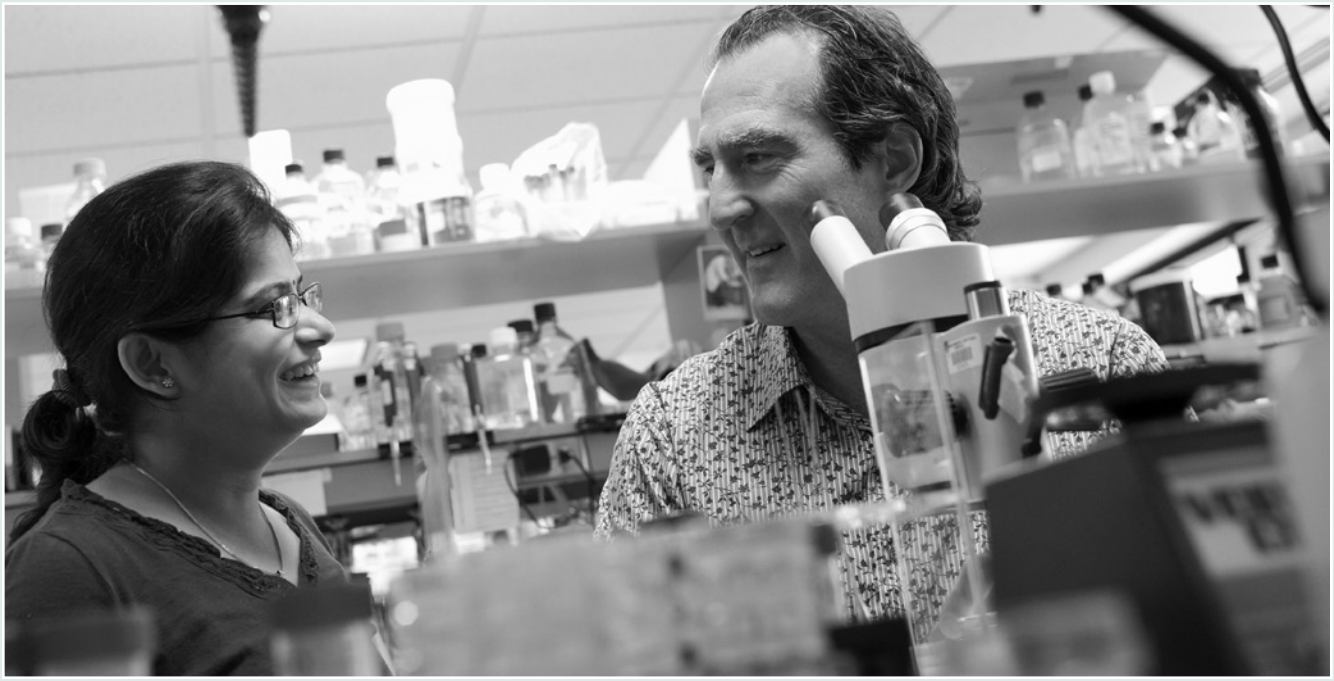
The cafeteria and dining room are located on the first floor of UMass Memorial Medical Center–University Campus, which is contiguous to UMMS. The menu features a variety of selections, including a large salad bar, deli bar, grill, soups, entrées, snacks, pastries and beverages. In addition, a cafeteria is located in the Aaron Lazare Medical Research Building.

Campus Bookstore

Located in the UMMS lobby, the campus bookstore is open Monday through Friday from 8:30 a.m. to 5 p.m. for students, faculty, staff and the general public. The bookstore offers all required text and reference books (at a 5 percent discount with no tax charged) for the School of Medicine, Graduate School of Biomedical Sciences and Graduate School of Nursing. Books not in stock may be ordered through the store or via the UMMS Web site. Trade books, school clothing, school insignia items, medical instruments, school supplies, magazines and a variety of snack foods are also available.

Housing and Transportation

Students reside in the local community or commute, as housing facilities are not available on campus. Bus transportation to the campus is available via several routes. Those who wish to park on campus are required to register with the Office of Public Safety and pay an annual parking fee.



Graduate School of Biomedical Sciences Divisional Organization

The Graduate School of Biomedical Sciences (GSBS) at the University of Massachusetts Medical School is a faculty-initiated and faculty-organized school with a mission to:

- engage in leading-edge research that advances our understanding of human biology in health and disease;
- translate discovery into treatments that transform the practice of medicine;
- determine the effectiveness and outcomes of primary, secondary and tertiary health interventions on patients and populations; and
- train the next generation of scientific leaders who will continue with this calling.

The research undertaken by our students and faculty varies widely, ranging from the study of single, isolated molecules to population genomics and health outcomes. As a result, GSBS faculty interests and student training modalities span the full spectrum of contemporary health sciences and, therefore, have been categorized within the GSBS as studies in Basic & Biomedical Sciences and studies in Clinical & Translational Sciences (see chart to the right).

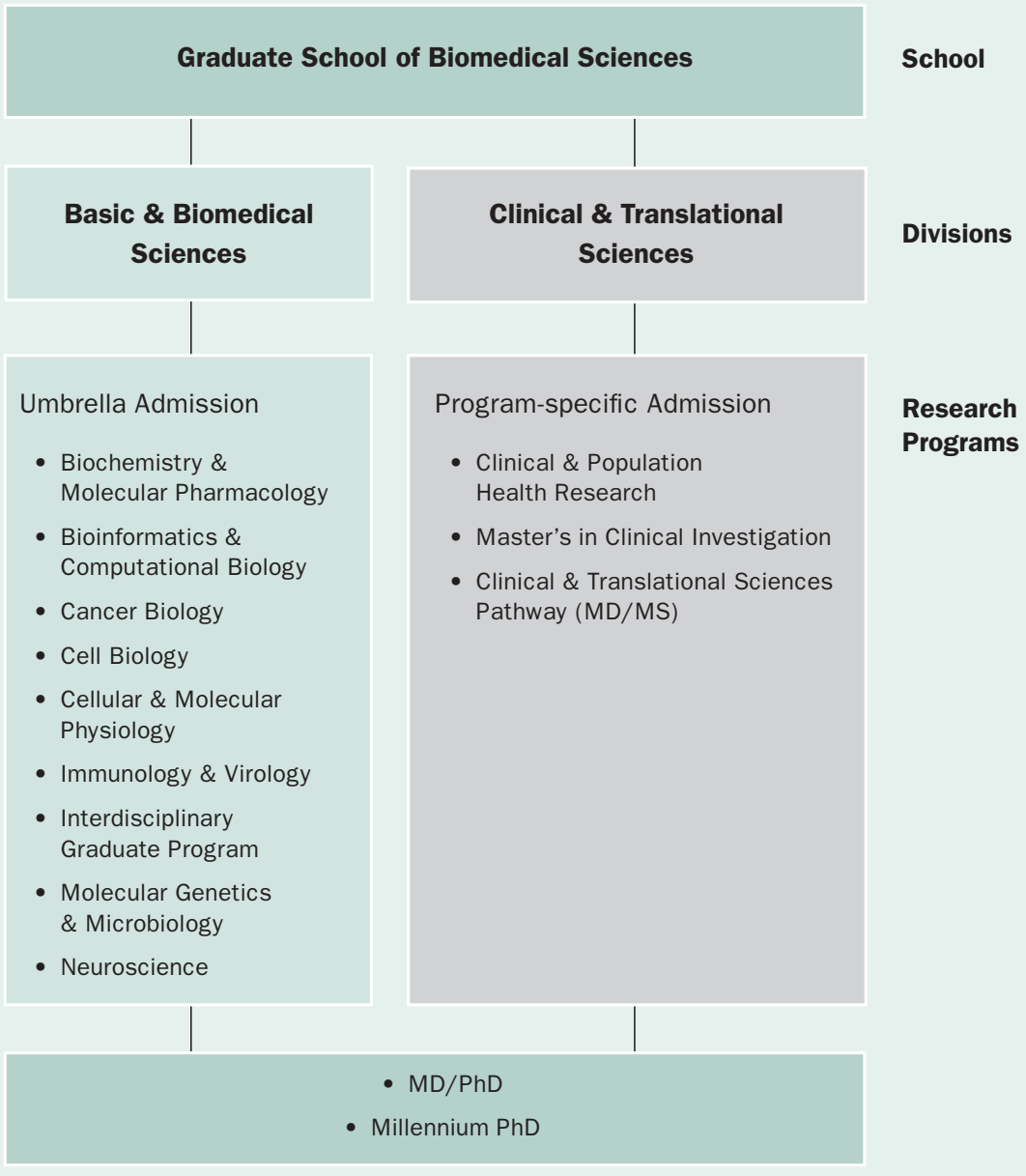
The Basic & Biomedical Sciences (BBS) Division consists of the six founding programs of the GSBS as well as new programs that reflect the rapidly changing nature of contemporary biomedical research. All BBS programs are highly interdisciplinary in their faculty membership and approach.

The Clinical & Translational Sciences (CTS) Division consists of the Clinical & Population Health Research program; the Master of Science in Clinical Investigation program for applicants with MD or PhD degrees; and the Clinical & Translational Sciences Pathway program for medical students seeking a master's degree in clinical and translational research.

BBS is an umbrella admissions program in which students select their program of specialization at the end of Year 1. CTS admits students directly into specific programs. Students enrolling in the MD/PhD or the Millennium PhD programs may select BBS or CTS program faculty for thesis research.

While this divisional structure defines the curricular and research distinctions between GSBS programs, a large number of our faculty engage in research that extends from the bench to the bedside to the community. This research progression—from molecule to cell to organ system to organism to population and clinical trial—is central to our training philosophy. GSBS students and faculty focus on the biology and/or pathology that define their central question and apply any and all approaches to resolve the problem. This results in a highly collaborative and interdisciplinary training environment that enriches all of our research programs.

Graduate School of Biomedical Sciences Academic Structure



Basic & Biomedical Sciences Division

Divisional Objectives and Curriculum

The objective of the Basic & Biomedical Sciences (BBS) Division is to educate students in the theory and practice of molecular, cellular and organismal biology, with the goal of enabling them to assume leadership roles in their chosen professions. BBS is based on the principle that graduates who choose careers in biomedical research and/or teaching are more successful when they obtain a solid foundation in the fundamentals of contemporary biomedical sciences. Here, knowledge and research are synonymous. Meaningful interpretation of experimental findings requires a deep appreciation of the existing body of biomedical knowledge and, often, that body of knowledge requires reinterpretation in light of new findings. In the arena of biomedical research, distinctions between "textbook" or "classroom" and research-based knowledge are an artificial and unproductive separation of what is, in practice, a scientific continuum.

The Basic & Biomedical Sciences Division seeks to:

- train biomedical scientists/educators with a broad background in the basic medical sciences and with an expertise in a specialty area;
- equip graduates to conduct research with direct relevance to human disease;
- prepare graduates to interact and collaborate with scientists and physicians involved in clinical investigations; and
- prepare graduates for careers as researchers and educators in the academic health sciences.

The Core Curriculum

The program of study leading to the Basic & Biomedical Sciences PhD degree consists of an interdisciplinary core curriculum taken by all students and a specialization and research phase selected by the individual student. The core curriculum provides all students with an integral foundation in the sciences basic to human biology and medicine, emphasizing contemporary topics in molecular biophysics/biochemistry, molecular genetics, and cellular architecture and regulation. Students are also required to take an ethics course on the responsible conduct of research and a scientific writing course that teaches students how to develop research proposals. Students should complete the core requirements in their first year, but no later than two years after admission.

Laboratory Rotations

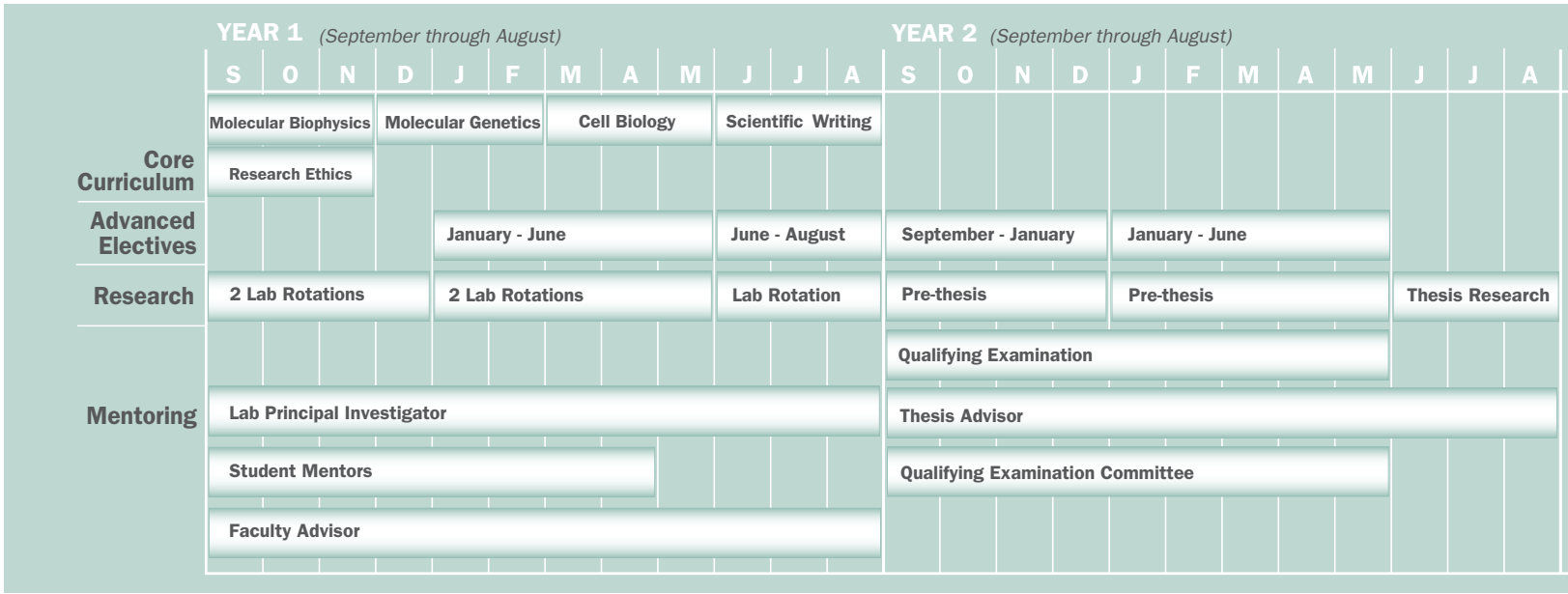
First-year students undertake laboratory research rotations during each semester. By year's end, students must have undertaken research in at least two different laboratories. Laboratory rotations are intended to familiarize students with the principles of scientific inquiry and the concepts and techniques of several scientific fields. They allow faculty members to observe and evaluate the research aptitudes of students and permit students to evaluate the types of projects that might be developed into dissertation projects. Upon completion of each rotation, students submit a written abstract or an oral presentation on the research accomplished. Each rotation lasts eight to nine weeks, allowing students to take two rotations in the fall, two in the spring and one in the summer.

Students experience faculty and student excellence firsthand, as they rub shoulders with:

- A Nobel Laureate who is the co-discoverer of RNA interference (RNAi), a favored method in labs throughout the world to interrupt the way genes direct the creation of proteins.
- Howard Hughes Medical Institute investigators whose research spans the regulation of gene expression through signal transduction mechanisms, neuron/glial cell interactions and microbial pathogenesis.
- National Academy members whose research focuses on RNAi, signal transduction and the regulation of gene expression.
- Investigators who study the development of diseases such as diabetes, cardiovascular disease, Lou Gehrig's disease, cancers, cystic fibrosis and HIV; their attendant molecular, genetic and physiological perturbations; and strategies to halt and even reverse disease progression.
- Students who have received the Harold M. Weintraub Graduate Student Award sponsored by the Basic Sciences Division of the Fred Hutchinson Cancer Research Center, which is often referred to by faculty as the Nobel Prize for graduate students.

Specialization

Upon completion of their first year of study, students request acceptance by a program to pursue advanced coursework and dissertation research. Students may enter the GSBS with an area of specialization in mind (biochemistry & molecular pharmacology, bioinformatics & computational biology, cancer biology, cell biology, cellular & molecular physiology, immunology & virology, interdisciplinary graduate program, molecular genetics & microbiology, neuroscience), or make that decision by or before completion of the core curriculum. Advanced courses offered by each program and laboratory may be applied to the requirements for specialization upon recommendation of the program director, the student's thesis advisor and/or Thesis Research Advisory Committee and with approval of the Dean.



Qualifying Examination

Prior to initiating formal research and no later than the summer semester of the second year, students are required to pass a qualifying examination. This examination is a training experience in which students must develop an original research proposal and defend it before a committee representative of the area of specialization. The examination is used to evaluate the ability of students to pose meaningful scientific questions, to propose experimental methods for answering those questions, and to interpret the validity and significance of probable outcomes of these experiments. Some programs may also require students to pass a comprehensive examination in their area of specialization before taking the qualifying examination.

Research and Thesis Advisors

Research toward the PhD dissertation may be done under the direction of a BBS faculty member actively engaged in research in a basic or clinical science department. Students select a thesis advisor and research problem prior to or at the time of completion of the core and specialization curriculum. The program director recommends and the Dean approves the appointment of the thesis advisor.

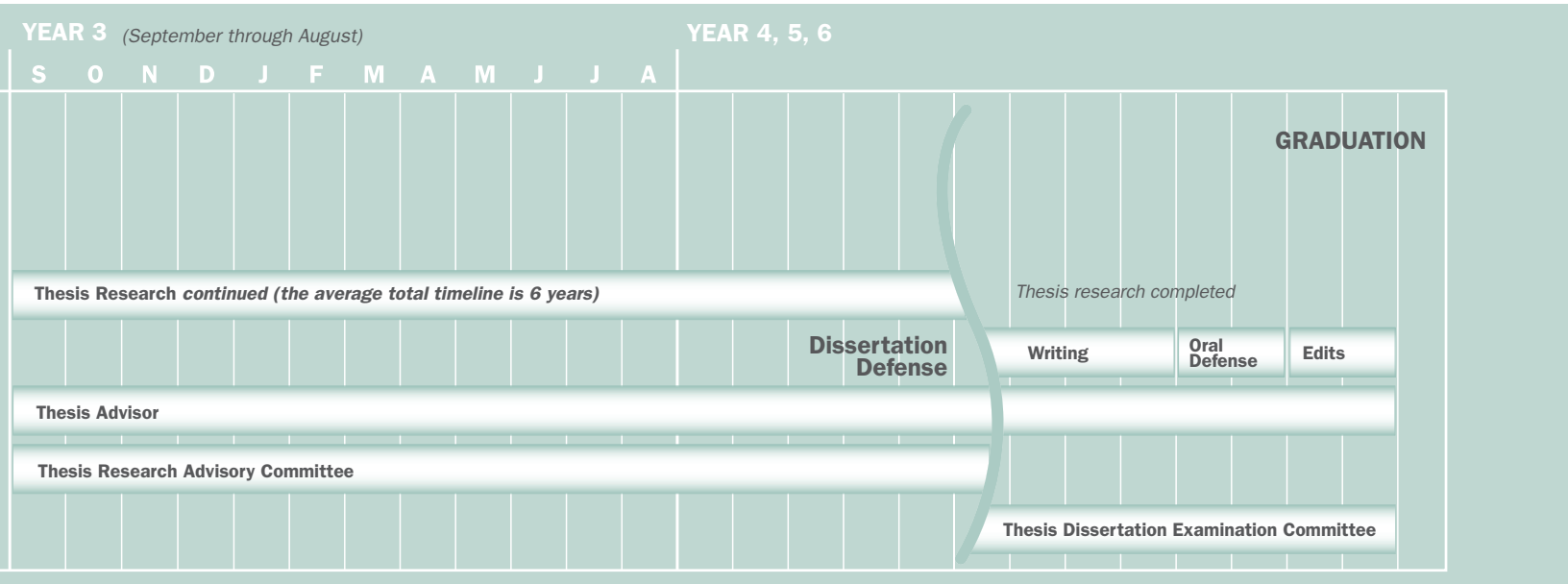
Each student must develop a detailed research proposal that must be approved by the student's Thesis Research Advisory Committee, which is appointed by the Dean, taking into account the recommendations of the thesis advisor and the program director. This committee consists of the advisor and at least two other faculty members and, if particularly knowledgeable in the research topic, an additional member who may be appointed from the Colleges of Worcester Consortium or the University of Massachusetts at Amherst, Boston, Dartmouth or Lowell.

The initial proposal may be the research proposal presented as the successful "Qualifying Examination" proposal. In this instance, the Qualifying Examination Committee may evolve into the student's Thesis Research Advisory Committee. The student presents annual progress reports and proposed follow-up research until the committee authorizes the writing of the dissertation. The Thesis Research Advisory Committee also provides continuing guidance to the student, reviewing, at least annually, the course of study being followed and the progress made toward meeting the various degree requirements.

Final Examination

The final examination in the program is a defense of the completed dissertation. Candidates for the PhD degree present a public seminar on the dissertation project and defend the dissertation before the thesis Dissertation Examination Committee, which consists of four GSBS faculty and one external member who is an expert in the field and, normally, a member of a PhD-conferring academic institution. This committee is recommended by the thesis advisor and the program director, and is approved by the Dean.

Passing of the final examination, satisfactory completion of all program and departmental requirements, and submission of the finished and ready-to-be-bound dissertation to the Dean result in the award of a PhD degree. Advanced courses and dissertation research are expected to occupy two to four years. Thus, on average, students should require six years to complete the program.



Summary of Basic & Biomedical Sciences Requirements

The following requirements, including the interdisciplinary courses described below, apply to all BBS students. Specific requirements for specialization are detailed in Graduate Programs, Courses and Faculty Research Interests, beginning on page 15. Graduate program directors are responsible for overseeing these aspects of their programs.

1. Core Curriculum

All first-year students must take:

- Biomedical Sciences Block I
- Biomedical Sciences Block II
- Biomedical Sciences Block III
- Responsible Conduct of Research
- Laboratory rotations (five or six rotations)
- Scientific Writing

2. Specialization

- Advanced and elective courses and rotations to be selected within guidelines set by the program of specialization. One, two- or three-credit advanced topics course must be taken in Year 1
- Prequalifying Research
- Thesis research

Total credits: 90

3. Qualifying Examination

- Presentation and defense of an original research proposal

4. Final Examination

- Presentation and defense of the research dissertation

5. Teaching Requirement

- Demonstration of teaching skills in a research seminar or course lecture format

Teaching Requirement

All candidates for the PhD degree must demonstrate teaching skills by preparing, presenting and being evaluated on a teaching exercise. This may involve a research seminar, lecture, demonstration or conference in the context of a medical school basic science course. The presentation and associated materials are critiqued and evaluated by faculty members, while the student's Thesis Research Advisory Committee evaluates the teaching exercise. Formal parts of the presentation may be videotaped as appropriate.

The teaching requirement can be fulfilled at any time during the program. This requirement does not limit the prerogative of academic departments and programs to set additional teaching requirements.

Courses

Biomedical Sciences I, II, III

A series of lectures and discussion sessions presenting the principles of the sciences basic to medicine, emphasizing contemporary topics in molecular biophysics/biochemistry, molecular genetics, and cellular architecture and regulation. Problem sets and article reviews develop the deductive reasoning methods for interpretation of experimental data.

Preparation for Qualifying Exam

Students are required to register for this course no later than the spring semester of the academic year in which they are to pass their Qualifying Examination. The course coordinator is the student's Graduate Program Director. Students register for the course in the spring semester even if they have already passed the exam in the prior semester. If the student successfully completes the exam by the end of the spring semester, the student will receive a grade of Pass. If the student has not yet successfully completed the exam by the end of the spring semester, the student will receive a grade of Incomplete, which will be changed to Pass once the exam is passed. This course must be passed before the beginning of the next academic year.

Responsible Conduct of Scientific Research

Required for all students, this blended course consists of classroom and online exercises that provide students the opportunity to explore some of the ethical, legal and social issues involved in the responsible conduct of scientific research in the 21st century. Classes include small group discussions of cases and/or exercises of institutional and national policies, and short presentations by faculty, administrators, postdoctoral fellows and students.

Scientific Writing

Required for all students, this course instructs students in the skills of developing scientific research proposals.

Laboratory Rotation

All programs offer laboratory rotations as individual courses within their programs. Laboratory rotations are defined periods of research experience under the direction of a faculty member. They are intended to familiarize the student with concepts and techniques in several areas of research and to assist the student in evaluating research laboratories and projects that might be developed into a dissertation project. The student will participate in an ongoing research project, gain familiarity with concepts underlying the research, acquire a working knowledge of techniques used in research, and write a report or present an oral summary of the results of the research.

Thesis Research Advisory Committee (TRAC) Meeting
All graduate students are required to have at least one TRAC meeting each academic year. After passing their Qualifying Examination and selection of their TRAC, students are required to register for this course each fall semester until their Dissertation Examination Committee is formed. The course coordinator is the student's Graduate Program Director. Students register for the course in the fall semester even if they have already had a TRAC meeting in the spring or summer semester of the previous academic year. If the student has a TRAC meeting by the end of the spring semester, the student will receive a grade of Pass. If the student has not yet had a TRAC meeting in the current academic year, the student will receive a grade of Incomplete, which will be changed to Pass once the meeting has been held. This course must be passed before the beginning of the next academic year.

Pre-qualifying Research
This course is for students who have selected a program and thesis advisor but who have not yet passed their Qualifying Examination.

Thesis Research
Students register for Thesis Research after passing a Qualifying Examination. They will take Thesis Research each semester until they have accumulated 90 credits.

Chosen from a field of more than 2,000 applicants at more than 200 institutions in the country, assistant professors Marc R. Freeman, PhD (right), and Christopher M. Sassetti, PhD, were two of only 50 young investigators to be name Early Career Scientists by the Howard Hughes Medical Institute (HHMI) in 2009.

Clinical & Translational Sciences Division

Divisional Objectives and Curriculum

The Clinical & Translational Science (CTS) Division of the GSBS is a rapidly evolving division that encompasses traditional and unique training pathways in clinical and translational research. The goal is to educate trainees through meaningful research projects in the various types of translational and clinical research, including all phases of clinical trials, epidemiological studies, guideline development, meta-analyses and practice-based research, as well as dissemination and implementation research.

Our guiding principle is to provide interdisciplinary training and research experience in clinical and translational research at all stages of career development both for physicians and scientists at the undergraduate, graduate and post-graduate levels. We provide flexibility in the training programs to support individual needs and career choices to train the next generation of leaders in clinical and translational research, including cutting-edge collaborations between clinical and basic science faculty in new areas of translational research.

CTS consists of five programs each with specific requirements for admission and programs of instruction. These programs are summarized below and are described in detail in Doctoral Programs, Courses and Faculty Research Interests, beginning on page 27.

MD/PhD Program

The MD/PhD program is an integrated program that provides research training for residents and non-residents of Massachusetts to become physician-scientists. The program combines the curriculums of the School of Medicine and the GSBS, plus the doctoral thesis research requirement of the GSBS to provide graduates with an exceptional opportunity to undertake physician-directed research.

Admitted students are free to undertake doctoral research with GSBS faculty in either the BBS or CTS programs. In both instances, students will undertake summer research rotations during Year 1 of Medical School and will enter the GSBS in prequalifying research in the summer of Year 2. As with all BBS and CTS students, MD/PhD students must select a thesis advisor, satisfy the curricular requirements of their mentor and program. CTS MD/PhD students complete a Qualifying Paper and Thesis Proposal before being admitted formally into doctoral thesis research. Following the doctoral thesis dissertation defense, students return to the School of Medicine for completion of their medical degree requirements before graduating with a dual medical and doctoral degree.

MD/PhD Timeline

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
School of Medicine		Graduate School of Biomedical Sciences (3-5 years to complete)					
School of Medicine Curriculum		Clinical Skills Tutorial					
Research Literature Tutorials		Prequalifying Research	Thesis Research		Dissertation		
Summer Lab Rotations		Responsible Conduct					
						School of Medicine (Final 2 yrs)	
Scientific Writing	Boards Step 1	Advanced Topics Courses or CPHR Curriculum				Clinical Rotations	
		Qualifying Exam					
School of Medicine							
School of Medicine Learning Communities							
MD/PhD Seminars (Held throughout all years of study)							

Millennium PhD Program

The Millennium PhD program is a pathway for training physician-scientists. Millennium PhD students hold a medical degree, are required to take appropriate ethics training and must take graduate courses that are deemed necessary by their Thesis Research Advisory Committee. Laboratory rotations are not required, since the program is intended for students affiliated with UMass Medical School (e.g., residents or fellows) who have already identified a mentor. Students are free to undertake doctoral research with GSBS faculty in either BBS or CTS programs. Students must complete their Qualifying Examination within six months of beginning their Millennium PhD studies, and then undertake thesis work with standards for ongoing evaluation and completion that are identical to those of PhD and MD/PhD students.

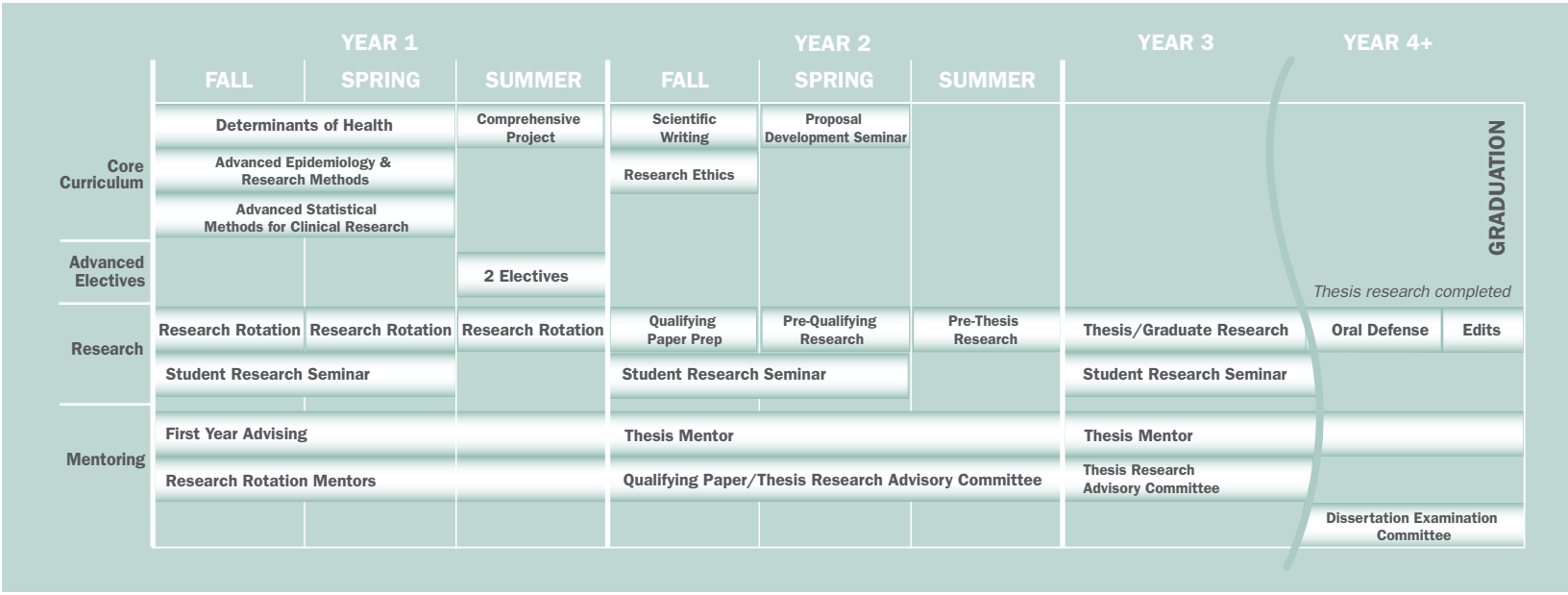
Clinical & Population Health Research

The Clinical & Population Health Research (CPHR) program addresses the national need to move health care research from laboratory to bedside and from individual patients and health care sites to systems of care. The program emphasizes clinical and health services research skills, and provides students the tools to conduct research on health care access, screening, treatment, quality and outcomes.

CPHR develops researchers with strong core competencies in statistics, epidemiology and research methodologies applicable to clinical trials and population health studies; public sector issues and vulnerable populations are emphasized. Students will be prepared to conduct investigator-initiated clinical and health services research, and applied research in clinical and public sector health services delivery systems.

The program has a core curriculum based on appropriate statistical, epidemiologic and research methods, as well as an understanding of the contextual issues of health and health care. Research ethics, scientific writing and a dissertation seminar are required courses. Two research rotations are required during the first year, culminating in selection of a research placement in the summer to initiate writing a qualifying paper and then a dissertation proposal. Dissertation research is completed with students' selected mentors. Two electives are required, chosen from an array of special topics, tutorials or with approval from the University of Massachusetts Master's in Public Health program or other Worcester-area colleges.

Applicants are expected to have received a master's degree in public health, clinical research or one of the social, psychological, physical or biological sciences, and to have completed adequate introductory coursework in biostatistics and epidemiology.



Master of Science in Clinical Investigation

This program is designed to equip graduates with the necessary skills to successfully design, conduct and analyze the results of translational research and clinical investigations at the individual and population-wide level. The program provides a flexible multidisciplinary focus that allows the curriculum to be tailored to the needs and interests of young researchers who aspire to become successful, independent clinical investigators.

The Master of Science in Clinical Investigation (MSCI) consists of one year of intensive coursework and a second year of electives and intensive research experience culminating in a publishable thesis. Students participate in a structured series of courses, seminars and workshops related to the successful design, conduct and analysis of clinical research. Students must satisfactorily complete a total of 44 credits in order to obtain the MSCI. Students complete the majority of their course work during their first academic year. Thesis completion requires that students design a research project, develop a formal research proposal, perform the described study and prepare a scholarly scientific paper on the principal study findings. The thesis will be relevant to the student's concentration track and will be written in the format of an article suitable for submission to a scientific journal.

Individuals accepted into the program represent a variety of backgrounds and disciplines with different levels of undergraduate and postgraduate training. All, however, demonstrate a high degree of motivation and commitment to a career in patient-oriented, clinical investigation. Applicants are U.S. citizens or permanent residents who have an MD, PhD, DNP, DON (Doctorate in Nursing), DVM, PharmD or DDS degree.

Clinical & Translational Research Pathway

The principal goal of the Clinical & Translational Research Pathway is to introduce methods and concepts in clinical and translational research (CTR) to medical students and to provide a training platform in the basics of CTR through a longitudinal, structured program throughout the four years of the Medical School curriculum. CTS provides the core academic and research components of the CTR Pathway. Participants may also apply to extend their School of Medicine studies to complete the MSCI.

MSCI Timeline

Fall I	Spring I	Summer I	Fall II	Spring II
Core Curriculum	Core Curriculum			
Introduction to Clinical Biostatistics	Intermediate Clinical Biostatistics			
Introduction to Clinical Epidemiology	Design of Observational Studies & Clinical Trials		2 Electives	1 Elective
Scientific Writing and Oral Presentation	Topics in Molecular Medicine			
Biomedical Informatics	Concepts in Team Science			
Ethical Aspects of Biomedical Research	Grant Writing	Pre-thesis Research	Thesis Research	
Journal Club (bi-weekly)				
Seminar in Clinical Investigation (monthly)				

Christine St. Pierre, PhD

2010 graduate who conducted research in the lab of Robert Finberg, MD, the Richard M. Haidack Professor of Medicine and chair and professor of medicine and professor of molecular genetics & microbiology

Christine was always certain she wanted to do her graduate work at UMass Medical School. While earning her degree in microbiology at UMass Amherst, she had heard good reports about the school and the GSBS from her advisors. “When I came here for my interview, I was impressed with both the quality of the research and the excitement shared by students and faculty. Everyone was more than willing to discuss their current projects as well as their future plans.”

Upon joining the GSBS in 2005, Christine found the environment to be collaborative and full of opportunity. “Everyone I interacted with was genuinely interested in helping you achieve your goals, whether they be optimizing an experiment or developing an entire project. There are also ample opportunities to develop your public speaking skills, such as the annual research retreat, departmental retreats and seminars, lab meetings, etc.”

Working in the lab of Dr. Finberg, Christine examined the immune response to titanium and synthetic microparticles and characterizing the differences between antibody-mediated and ligand-mediated internalization of membrane proteins. “I think it’s really important to understand how our cells respond to foreign materials and the pathways that are involved. My projects were aimed at characterizing these pathways in a way that can be useful for the development of future therapeutics.”

Doctoral Programs, Courses and Faculty Research Interests

The course descriptions listed on the following pages are provided as a guide to the types of courses offered over the last several years. An official listing of courses and descriptions are made available to students prior to registration. The following information is current as of July 2010.

Basic & Biomedical Sciences Division

- Biochemistry & Molecular Pharmacology
- Bioinformatics & Computational Biology
- Cancer Biology
- Cell Biology
- Cellular & Molecular Physiology
- Immunology & Virology
- Interdisciplinary Graduate Program
- MD/PhD
- Millennium PhD
- Molecular Genetics & Microbiology
- Neuroscience

Clinical & Translational Sciences Division

- Clinical & Population Health Research
- Master of Science in Clinical Investigation

Program in Biochemistry & Molecular Pharmacology

The Program in Biochemistry & Molecular Pharmacology offers graduate study and research focused in the areas of molecular, cellular and regulatory biochemistry; molecular biophysics; chemical biology; and structural biology. Students receive a rigorous foundation in modern biomedical science through an integrated program of laboratory research, advanced coursework, and attendance and participation in seminar programs. Students also organize and participate in a weekly informal seminar series in which they present recent research results.

Specific areas addressed within program laboratories include: protein folding and design; regulation of gene expression and epigenetics; RNA processing and trafficking; protein synthesis and transport; membrane transport and ion channel function; drug action at cellular membranes and signal transduction; structural basis of protein and enzyme function; computational investigation of protein dynamics; cell cycle control; DNA replication and repair; and neural development, differentiation and neurodegenerative disease.

Requirements for Specialization

Laboratory research is of central importance in the PhD program and starts with three semesters (one full year) of laboratory rotations. Typically, students contact the faculty member with whom they would like to work to discuss the availability and planning of a rotation project. Rotations consist of full- or half-semester projects, and students are encouraged to begin a rotation project during the summer prior to the start of their first academic year.

In addition to the required first-year Biomedical Sciences classes, students will take three Advanced Topics courses, one of which must be either Chemical Biology or Molecular Biophysics. Elective advanced courses can be chosen from among those offered by the program, or relevant courses offered by other GSBS programs. The plan of coursework is designed to be flexible in order to accommodate each student's needs and areas of interest.

Biochemistry & Molecular Pharmacology's notable achievements include:

- students awarded predoctoral training grants from the National Institutes of Health (NIH), the Department of Defense and the prestigious Harold Weintraub Graduate Student Award;
- NIH program project grant focused on HIV drug resistance and protease inhibitor design;
- faculty members named Howard Hughes Medical Institute Investigators, W. M. Keck Foundation Distinguished Young Scholars, Burroughs Wellcome Fellows, Worcester Foundation for Biomedical Research Scholars and a Pew Scholar; and
- a faculty member who patented discoveries in RNAi.

Qualifying Exam

Following completion of the Graduate Core Class, at least two semesters of laboratory rotations and two of the required Advanced Topics courses, students are eligible to take their qualifying exam. The exam consists of an oral presentation and defense of an original research proposal based on the student's own potential thesis work or any topic of the student's choosing. A student's plan for rotation projects, coursework and qualifying exam can be done in consultation with the graduate director.

Courses in Biochemistry & Molecular Pharmacology

Chemical Biology

This course focuses on the use of chemical approaches to answer fundamental questions in biology. Topics include post-translational modifications; chemical synthesis and modification of biopolymers; combinatorial chemistry; chemical genetics; rational drug design; ligand-receptor interactions; and the fundamentals of fluorescence.

Molecular Biophysics

The goal of this course is to give students a strong foundation in physical principles that underlie the thermodynamic and mechanistic properties of biological macromolecules and macromolecular complexes. In addition to providing theoretical background, lectures and discussion groups will focus on the application of physical chemical principles in contemporary biomedical research. Topics include spectroscopic and computational approaches to studying protein and nucleic acid structures; thermodynamics and kinetics of protein folding; the solution behavior of macromolecules; and principles that govern molecular recognition.

Structural Biology

The goal of this course is to provide students with a theoretical and practical understanding of techniques used to determine the three-dimensional structures of biological macromolecules. The primary methods explored will be X-ray crystallography and Nuclear Magnetic Resonance, but alternative approaches will also be discussed. Emphasis will be placed on both structural determination and analysis of dynamics, which can be crucial for macromolecular function.

RNA Biology

This Advanced Topics course covers current research in the general area of RNA biology. Topics envisioned may include RNA synthesis; modification and processing pathways; RNA structure; RNA transport and subcellular localization; translational regulation; RNAi and microRNAs; RNA decay; RNA aptamers; RNA catalysts; RNA and early evolution; and RNA as a drug and/or drug target. The format of this course will center on group discussion of papers from the primary literature.

Tutorial in Biochemistry & Molecular Pharmacology

Individual instruction on selected topics is arranged by student and instructor.

Seminar in Biochemistry

This course provides students with the opportunity to develop skills in public speaking necessary for scientific presentations. This experience will facilitate both formal and informal presentations of students' individual research.

Biochemistry & Molecular Pharmacology Graduate Program Faculty

Program Director

William R. Kobertz, PhD (Associate Professor, Biochemistry & Molecular Pharmacology) *– Structure, function and modulation of ion channels*

Professors

Alexei Bogdanov, Jr., PhD (Radiology and Cell Biology) *– Molecular imaging in cancer models and models of inflammatory vascular disease; development of imaging probes for detecting enzymatic activity in vivo*

Sumner H. Burstein, PhD (Biochemistry & Molecular Pharmacology) *– Regulation of anandamide biosynthesis; signal transduction events involved in cannabinoid-induced arachidonate release*

Anthony Carruthers, PhD (Dean, Graduate School of Biomedical Sciences; Biochemistry & Molecular Pharmacology) *– Mechanisms of glucose transport and glucose transport regulation*

Michael P. Czech, PhD (Chair, Molecular Medicine) *– Transmembrane signaling elicited by the insulin receptor tyrosine kinase and its dysfunction in obesity and type 2 diabetes*

Roger J. Davis, PhD (H. Arthur Smith Chair in Cancer Research; Howard Hughes Medical Institute Investigator; Molecular Medicine) *– Signal transduction by the epidermal growth factor receptor; mechanisms by which growth factors regulate cellular proliferation*

Stephen J. Doxsey, PhD (Molecular Medicine) *– Mitotic and meiotic spindle assembly with an emphasis on centrosome structure, functions and regulation*

Harvey M. Florman, PhD (Cell Biology) *– Cell and molecular biology of fertilization and of ion channel function*

Terence R. Flotte, MD (Dean, School of Medicine; Celia and Isaac Haidak Professor of Medicine; Pediatrics, Molecular Genetics & Microbiology) *– Gene therapy for cystic fibrosis, alpha-1 antitrypsine deficiency and other single gene defects*

Reid Gilmore, PhD (Vice Chair, Biochemistry & Molecular Pharmacology) *– Molecular mechanism of protein translocation across the endoplasmic reticulum; analysis of asparagine-linked glycosylation in the endoplasmic reticulum*

Michael R. Green, MD, PhD (Lambi and Sarah Adams Chair in Genetic Research, Howard Hughes Medical Institute Investigator; Director, Program in Gene Function & Expression; Molecular Medicine) *– Eukaryotic gene regulation and cancer molecular biology*

Mitsuo Ikebe, PhD (Physiology) *– Function and regulation of motor proteins in cellular processes*

Kendall L. Knight, PhD (Associate Dean, Graduate School of Biomedical Sciences; Biochemistry & Molecular Pharmacology) *– Homologous genetic recombination and DNA repair in prokaryotes and eukaryotes*

David G. Lambright, PhD (Molecular Medicine) *– Structural determination of key intermediates in cellular signaling and vesicle trafficking pathways*

José R. Lémos, PhD (Physiology) *– Molecular mechanisms of stimulus-secretion coupling in mammalian nerve terminals*

Shan Lu, PhD (Medicine) *– Immunogenicity of protein antigens*

Martin G. Marinus, PhD (Biochemistry & Molecular Pharmacology) *– Mechanism and specificity of DNA mismatch repair; drug resistance and DNA mismatch repair; function of methylated bases in nucleic acids*

C. Robert Matthews, PhD (Arthur F. and Helen P. Koskinas Professor of Biochemistry & Molecular Pharmacology; Chair, Biochemistry & Molecular Pharmacology) *– Investigation of structures and the dynamics of structural changes in biological molecules in solution, i.e., the mechanisms by which proteins fold to unique conformations; studies on the effects of single amino acid substitutions on the folding process; folding mechanisms of multi-subunit peptides and proteins; protein engineering*

Melissa J. Moore, PhD (Howard Hughes Medical Institute Investigator; Biochemistry & Molecular Pharmacology) *– Pre-mRNA splicing and its connections to intracellular mRNA localization, translation and degradation*

Thoru Pederson, PhD (Vitold Arnett Professor of Cell Biology; Biochemistry & Molecular Pharmacology) *– Eukaryotic gene expression at the level of RNA processing; RNA protein interactions and RNA traffic in the nucleus*

Craig L. Peterson, PhD (Vice Chair, Molecular Medicine) *– Roles of the SWI/SNF complex and chromatin in regulation of eukaryotic gene expression*

Alonzo H. Ross, PhD (Biochemistry & Molecular Pharmacology) *– PTEN phosphatase and tumor suppressor; CNS stem cells and neural tumors*

William E. Royer Jr., PhD (Biochemistry & Molecular Pharmacology) *– X-ray crystallographic imaging of macromolecular structures; structural basis for inter-subunit communication and macromolecular interactions*

Celia A. Schiffer, PhD (Biochemistry & Molecular Pharmacology) *– How conformational adaptability affects molecular recognition in drug resistant variants of HIV protease using phage display, X-ray crystallography and molecular dynamics calculations*

Lawrence J. Stern, PhD (Pathology) *– Molecular recognition in the immune system*

William E. Theurkauf, PhD (Molecular Medicine) *– Regulation of mitotic chromosome segregation*

M. David Ullman, PhD (Shriver Center) *– Glycoconjugates in neuropathology and neuroprotection*

Zhiping Weng, PhD (Director, Program in Bioinformatics & Integrative Biology) *– To explore and understand biological data through the application and development of computational tools*

Zuoshang Xu, MD, PhD (Biochemistry & Molecular Pharmacology) *– Structure, transport and function of neuronal cytoskeleton; neurodegenerative disease*

Phillip D. Zamore, PhD (Gretchen Stone Cook Chair in Biomedical Sciences; Howard Hughes Medical Institute Investigator) *– Control of mRNA stability and translation in development; molecular mechanisms of RNAi (post-transcriptional gene silencing)*

Associate Professors

Ingolf Bach, PhD (Molecular Medicine) *– Neuronal cell fate specification*

Job Dekker, PhD (Biochemistry & Molecular Pharmacology, Program in Gene Function) *– Spatial organization of genomes*

Lawrence J. Hayward, MD, PhD (Neurology) *– Mechanisms of motor neuron diseases and ion channel disorders using mouse and zebrafish models*

Haley E. Melikian, PhD (Psychiatry) *– Regulation and membrane trafficking of cocaine and antidepressant-sensitive monoamine transporters*

Mary Munson, PhD (Biochemistry & Molecular Pharmacology) *– Regulation of vesicle targeting and fusion*

Nick Rhind, PhD (Biochemistry & Molecular Pharmacology) *– DNA replication and replication checkpoints; cell size control; fission yeast comparative genomics*

Charles G. Sagerström, PhD (Biochemistry & Molecular Pharmacology) *– Transcriptional regulation in embryogenesis*

Scot A. Wolfe, PhD (Biochemistry & Molecular Pharmacology, Program in Gene Function) *– Protein-DNA recognition; targeted genome modification; transcriptional regulatory networks in metazoans*

Assistant Professors

Daniel Bolon, PhD (Biochemistry & Molecular Pharmacology) *– Role of molecular chaperones in biology and disease*

Hong-Sheng Li, PhD (Neurobiology) *– Neuronal regulation of membrane receptor signaling*

Francesca Massi, PhD (Biochemistry & Molecular Pharmacology) *– Protein dynamics, function and stability using NMR and computer simulation*

Zdenka Matijasevic, PhD (Cell Biology) *– Cellular responses to hypothermia*

Stephen C. Miller, PhD (Biochemistry & Molecular Pharmacology) *– Chemical approaches to study and control of cell biology*

Oliver Rando, MD, PhD (Biochemistry & Molecular Pharmacology) *– Role of chromatin structure in transcriptional control and mechanism of inheritance of chromatin states; role of epigenetically inherited information in evolution, development and disease*

Sean Ryder, PhD (Biochemistry & Molecular Pharmacology) *– RNA regulation in development and disease regulatory networks, mechanisms of specificity and ribonucleoprotein complex assembly*

Konstantin Zeldovich, PhD (Bioinformatics & Integrative Biology, Biochemistry & Molecular Pharmacology) *– Molecular evolution and protein folding using computer simulations and theory*

Research Assistant Professors

Osman Bilsel, PhD (Biochemistry & Molecular Pharmacology) *– Use of time-resolved fluorescence, excitation energy transfer and rapid mixing techniques to obtain structural information on protein folding intermediates in the microsecond-to-seconds time regime*

Jill A. Zitzewitz, PhD (Biochemistry & Molecular Pharmacology) *– Folding and assembly of multi-meric proteins and peptides using stopped-flow circular dichroism and fluorescence spectroscopies*

Katryn Harwood
sixth-year student
Conducting research in the lab of Stephen Miller, PhD, assistant professor of biochemistry & molecular pharmacology

Katryn feels that the GSBS, with its mix of established faculty and young investigators, is a growing and vibrant environment that fosters scientific discovery, excitement and creativity. “When I visited during a recruitment weekend, there seemed to be a great deal of collaboration and open scientific discussion. This seemed like a place where I could conduct and be exposed to fresh, innovative science in a supportive setting.”

In Dr. Miller’s lab, which focuses on applying chemistry to the study of biological questions, Katryn is working on using chemistry to control the activation states of proteins in a light-dependent fashion. “The proteins I work with are a family called the Rho GTPases. We chose this family because their activation at specific times and locations in the cell is essential for proper cellular function.”

During her time at GSBS, Katryn has found the faculty to be very accessible both in the classroom and the lab. “There is also a great deal of camaraderie among the students, both within each class and among different classes. When I first started at UMMS, it was nice to have the more senior students to go to for support. Now that I am a senior graduate student, I hope to be there for the graduate students just getting started.”

Program in Bioinformatics & Computational Biology

The Program in Bioinformatics & Computational Biology, new to the Graduate School of Biomedical Sciences, offers graduate study and research focused on the development and application of computational and mathematical models to biological problems, with an emphasis on the now-available, high-throughput genomic and proteomic data. Specific topics of research and study include systems biology; analysis of regulatory and metabolic networks; structure of the genome and comparative genomics; population genetics and molecular evolution; protein-protein and protein-DNA interactions; RNA; modeling of large-scale biological systems; structural biology; protein folding and modeling; and biological physics. Students receive a rigorous training in modern bioinformatics and computational biology through integration of guided research, coursework and participation in seminar programs. The program aims to bridge the gap between wet-lab biologists and computational scientists to their mutual benefit, and prepares students for careers in cutting-edge, highly quantitative biomedical research.

Requirements for Specialization

Laboratory research is of primary importance in the PhD program, and starts with three semesters of laboratory rotations in the program's or the affiliated faculty's laboratories. Students directly contact the faculty member in whose laboratory they would like to work to discuss their rotation project. Rotations can be of full- or half-semester projects, and students are highly encouraged to start a rotation project during the summer prior to the start of their first academic year.

In addition to the mandatory, first-year Basic Biomedical Sciences core classes, students will take three Advanced Topics courses, two of which must be in Bioinformatics. Elective advanced courses can be chosen from those offered by the program or other GSBS programs as appropriate, such as Molecular Biophysics. The plan of the coursework is flexible in order to accommodate each student's needs and interests.

Notable achievements of the Program in Bioinformatics & Computational Biology include:

- a faculty member developing an algorithm to predict protein-protein interactions, consistently scoring among the best in the CAPRI competition;
- faculty members awarded NIH grants; and
- a faculty member developing a method to find the signatures of natural selection in the genomic data.

Qualifying Exam

Students are eligible to take their qualifying exam upon completion of the Graduate Core Classes, at least two semesters of laboratory rotations and two of the required Advanced Topics courses. The exam includes an oral presentation and defense of an original research proposal based on the student's potential thesis work or any relevant topic of the student's choosing. A student's plan for rotation projects, coursework and qualifying exam can be prepared in consultation with the graduate director.

Courses in Bioinformatics & Computational Biology

Courses in this new program will be added as the program develops. Current offerings include:

Advanced Topics in Bioinformatics

The course covers several important areas of modern bioinformatics and computational biology. The course is aimed not only at students specializing in bioinformatics, but also general biology students who would like to utilize bioinformatics tools in their daily research. The course will begin with an overview of modern sources of bioinformatics data, including high-throughput sequencing and microarrays, followed by a thorough presentation of sequence search and alignment algorithms, and the structure of the eukaryotic genome. Population genetics will be introduced, covering areas from molecular phylogenetics to natural selection, with an emphasis on analyzing genomic datasets. The biophysical section of the course will include discussions of protein structure and folding, as well as the physical architecture of the genome in vivo and the relations between sequences and structures for proteins and DNA. Some experience with computers, programming and statistics is desirable, but the necessary tools will be introduced and explained as needed.

Molecular Evolution

This course will set the mathematical foundations of molecular evolution, explaining how the genetic variability emerges and eventually spreads across populations via the mutation, recombination and selection processes. Both phenomenological-statistical and first-principle biophysical approaches to selection will be considered. The course will introduce modern computational tools to detect and quantify signatures of natural selection in high-throughput genomic and structural data, and discuss specific applications of these tools to dissect evolutionary histories of several species. Patterns of genome duplications and copy number variations will be discussed, as well as their importance for disease resistance.

Bioinformatics & Computational Biology Faculty

Program Director

Konstantin Zeldovich, PhD (Assistant Professor, Bioinformatics & Integrative Biology)
– Biophysical aspects of molecular evolution and protein folding using computer simulations and theory

Professors

Schahram Akbarian, MD, PhD (Director, Brudnick Neuropsychiatric Research Institute; Psychiatry) *– The prefrontal cortex and schizophrenia; dopaminergic signaling and chromatin remodeling in neurons; genetic models for Rett disorder*

Victor Ambros, PhD (Silverman Chair in Natural Sciences; Molecular Medicine) *– Gene regulatory mechanisms controlling the timing of animal development using the C. elegans model system, including microRNAs that control stage-specific expression of key transcription factors; molecular mechanisms of post-transcriptional gene regulation by microRNAs; how microRNAs function in regulatory networks affecting development and disease*

Robert H. Brown, MD, PhD (Chair, Neurology) *– Identification of gene defects that elucidate the molecular pathogenesis of selected neuromuscular diseases, including amyotrophic lateral sclerosis (ALS, also known as Lou Gehrig's disease), muscular dystrophy, adrenoleukodystrophy, hereditary neuropathy and hyperkalemic periodic paralysis; creation of mouse and cell-based models of these disorders to study of therapeutic strategies using conventional small molecule approaches and new modalities such as inhibitory RNAi*

Michael Czech, PhD (Chair, Molecular Medicine) *– Discovery of molecular mechanisms whereby insulin signaling regulates energy homeostasis, including RNAi screens, digital imaging and TIRF microscopy, phenotyping mice with gene knockouts and analysis of human adipose tissues*

Michael Green, MD, PhD (Howard Hughes Medical Institute Investigator; Lambi and Sarah Adams Chair in Genetic Research; Director, Gene Function & Expression; Molecular Medicine) *– Mechanisms that regulate gene expression in eukaryotes and the role of gene expression in various human disease states; major emphasis on the use of transcription-based approaches and functional screens to identify new genes and regulatory pathways involved in cancer*

Jane Lian, PhD (Cell Biology) *– Molecular mechanisms regulating skeletal development and metastasis of cancer cells to bone*

C. Robert Matthews, PhD (Arthur F. and Helen P. Koskinas Professor of Biochemistry & Molecular Pharmacology; Chair, Biochemistry & Molecular Pharmacology) *– Investigation of structures and the dynamics of structural changes in biological molecules in solution, i.e., the mechanisms by which proteins fold to unique conformations; studies on the effects of single amino acid substitutions on the folding process; folding mechanisms of multi-subunit peptides and proteins; protein engineering*

Craig Mello, PhD (Howard Hughes Medical Institute Investigator; Blais University Chair in Molecular Medicine; Molecular Medicine) *– Using the nematode worm C. elegans as a model organism to investigate how embryonic cells differentiate and communicate during development; investigating the mechanism of RNA interference, a form of sequence-specific gene silencing triggered by double-stranded RNA*

Melissa Moore, PhD (Howard Hughes Medical Institute Investigator; Biochemistry & Molecular Pharmacology) *– Pre-mRNA splicing and its connections to intracellular mRNA localization, translation, and degradation*

Celia Schiffer, PhD (Biochemistry & Molecular Pharmacology) *– How conformational adaptability affects molecular recognition in drug-resistant variants of HIV protease; tools are phage display, X-ray crystallography and molecular dynamics calculations*

William Theurkauf, PhD (Molecular Medicine) *– Addressing RNA localization and embryonic patterning, the response of mitotic cells to DNA damage and small RNA function in germline development, using high-resolution imaging, genetic and molecular approaches in Drosophila and mammalian cultured cell systems*

Zhiping Weng, PhD (Director, Bioinformatics & Integrative Biology) *– To explore and understand biological data through the application and development of computational tools*

Phillip D. Zamore, PhD (Howard Hughes Medical Institute Investigator; Gretchen Stone Cook Chair of Biomedical Sciences; Biochemistry & Molecular Pharmacology) *– Control of mRNA stability and translation in development; molecular mechanisms of RNAi (post-transcriptional gene silencing)*

Associate Professors

Job Dekker, PhD (Program in Gene Function & Expression; Biochemistry & Molecular Pharmacology) *– Spatial organization of genomes*

Nick Rhind, PhD (Biochemistry & Molecular Pharmacology) *– Checkpoint regulation in the fission yeast cell cycle*

Marian Walhout, PhD (Molecular Medicine) *– Regulatory networks control of animal development, function and homeostasis, and how dysfunctional networks affect or cause diseases like diabetes, obesity and cancer; a combination of experimental and computational systems biology methods are used to map, characterize and manipulate regulatory networks, most notably in the nematode C. elegans*

Scot Wolfe, PhD (Gene Function & Expression; Biochemistry & Molecular Pharmacology) *– Targeted gene regulation using novel, designed transcription factors*

Assistant Professors

Jeffrey Bailey, MD, PhD (Bioinformatics & Integrative Biology) *– Genetic variation in infectious disease susceptibility and pathogenesis, concentrating on the role of segmental duplication and copy number variation*

Dan Bolon, PhD (Biochemistry & Molecular Pharmacology) *– The role of molecular chaperones in biology and disease*

Jeffrey Jensen, PhD (Bioinformatics & Integrative Biology) *– Theory of adaptive evolution and employing this theory to computationally analyze empirical data to quantify evolutionary forces shaping genomic variation in nature*

Francesca Massi, PhD (Biochemistry & Molecular Pharmacology) *– Protein dynamics, function and stability using NMR and computer simulation*

Oliver Rando, MD, PhD (Biochemistry & Molecular Pharmacology) *– Role of chromatin structure in transcriptional control and mechanism of inheritance of chromatin states; role of epigenetically inherited information in evolution, development and disease*

Sean Ryder, PhD (Biochemistry & Molecular Pharmacology) *– RNA regulation in development and disease; regulatory networks, mechanism of specificity and ribonucleoprotein complex assembly*

Thom Vreven, PhD (Bioinformatics & Integrative Biology) *– Computational analysis and determination of protein-protein interactions*

Troy Whitfield, PhD (Bioinformatics & Integrative Biology) *– Regulatory genomics through the computational identification of transcription factor binding sites; molecular models of protein-DNA binding*

Program in Cancer Biology

The Program in Cancer Biology provides:

- a strong emphasis on cancer cell biology and cancer genetics;
- a combination of rigorous basic science with exposure to clinical cancer medicine; and
- faculty who are basic scientists and clinician scientists drawn from ten Medical School departments.

Cancer biology is an academic discipline with a tangible end point: improving the prevention, diagnosis and treatment of human cancers. The Program in Cancer Biology provides students interested in pursuing a career in cancer biology with rigorous training in biochemistry, genetics, molecular and cell biology, as well as an understanding of the clinical aspects of cancer. The program is based in the Department of Cancer Biology, but it also includes faculty from most basic science departments and several clinical departments. The strength and diversity of the faculty enable students to explore different approaches to the study of cancer in their laboratory rotations and to develop interdepartmental and interdisciplinary collaborations during their thesis research. This program is also an integral component of the Cancer Center of Excellence and it affords students the opportunity to participate in disease-based programs of the Cancer Center that are designed to translate achievements from the basic sciences to the clinical management of human cancers.

Requirements for Specialization

In addition to Biomedical Sciences I, II and III, students will take three specific courses: Histology and Tumor Pathology, Cancer Medicine and Therapeutics, and Cancer Biology.

Courses in Cancer Biology

Cancer Biology

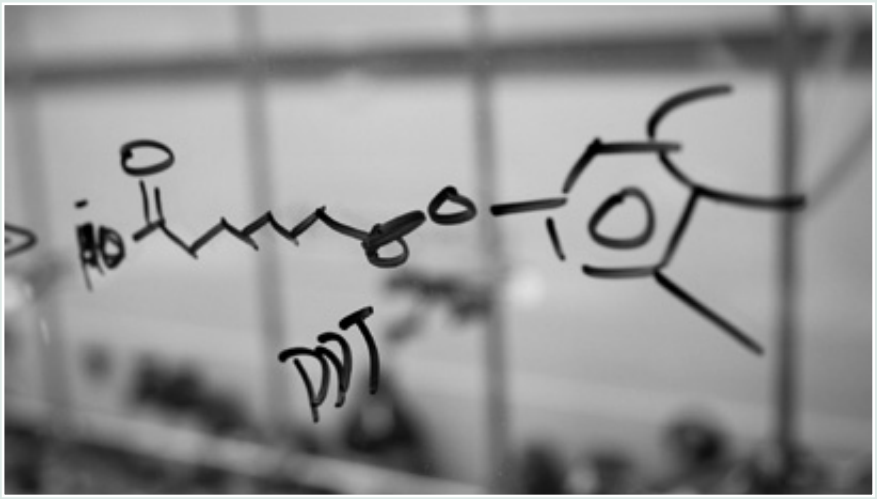
This course provides students with a rigorous and comprehensive understanding of the mechanisms that underlie the genesis and progression of human cancers. It builds on the basic science knowledge acquired in the core curriculum and the appreciation of cancer as a disease obtained from the Pathology and Cancer Medicine courses. The salient topics covered include stem cells, oncogenes and tumor suppressor genes, tumor-host interactions, invasion, metastasis and angiogenesis. A major theme of the course is to integrate the biology of cancer with the clinical behavior of tumors. Faculty from the Department of Cancer Biology and other basic science departments participate in the teaching of this course.

Histology and Tumor Pathology

The overall goal of the course is to expose students to the pathology of different types of cancers that occur in humans and the methods used for diagnosis, including histology, cytology, immunohistochemistry, flow cytometry and molecular diagnostics. Faculty from the Departments of Pathology and Cancer Biology teach this course. The course starts with a review of normal tissue histology of all the major organ systems and an overview of diagnostic techniques. The remainder of the course consists of organ-based lectures in tumor pathology along with a hands-on microscopic review of pathologic tumor samples. The general format of the six-week course consists of a one-hour lecture followed by a one-hour laboratory session, given three days per week.

Cancer Medicine and Therapeutics

This course is designed to familiarize students with clinical aspects of cancer etiology, diagnosis, treatment and survival. The level of instruction is geared such that clinical background knowledge is not required, but provided where absolutely needed. Where possible, tie-ins with basic science and molecular mechanisms are included. Faculty are based out of the Hematology and Medical Oncology Divisions of the Department of Medicine, and include guest lecturers from nearby institutions where specific expertise is required or desirable. Curriculum includes the following topics: Cancer as a Human Disease (definitions, statistics and epidemiology; psychosocial impact); Concepts of Cancer Medicine (diagnosis, staging, therapeutics and chemoprevention); and Introduction to Medical Oncology (disease-specific epidemiology, diagnosis and treatment).



Cancer Biology Faculty

Program Director

Arthur M. Mercurio, PhD (Professor and Interim Chair, Cancer Biology) *– Mechanisms that underlie the genesis of invasive carcinoma and the progression to metastatic disease*

Professors

Eric H. Baehrecke, PhD (Cancer Biology) *– Cell survival, death and autophagy*

Roger J. Davis, PhD (H. Arthur Smith Chair in Cancer Research; Howard Hughes Medical Institute Investigator; Molecular Medicine) *– Mechanisms by which growth factors regulate cellular proliferation*

Stephen J. Doxsey, PhD (Molecular Medicine) *– The role of the centrosome in microtubule nucleation, spindle assembly and cancer*

Michael R. Green, MD, PhD (Lambi and Sarah Adams Chair in Genetic Research; Howard Hughes Medical Institute Investigator; Director, Program in Gene Function & Expression; Molecular Medicine) *– Eukaryotic gene function and expression*

Chung-Cheng Hsieh, ScD (Cancer Biology) *– Cancer epidemiology and biostatistics; in utero exposure and subsequent risk of breast cancer; stem cells and perinatal factors for breast cancer risk*

Ashraf Khan, MD (Pathology) *– Identification of molecular markers for the diagnosis, prognosis and therapy of breast and thyroid cancers*

Richard P. Moser, MD (Neurosurgery) *– Isolation and characterization of stem cell populations in primary glial and meningeal derived brain tumors to identify and manipulate germane signaling pathways for the design and implementation of preventative and therapeutic clinical interventions*

Peter E. Newburger, MD (Ali and John Pierce Chair in Pediatric Hematology/Oncology; Pediatrics, Molecular Genetics & Microbiology) *– Global analysis and regulation of phagocyte gene expression; mechanisms of translation of selenium-containing proteins such as glutathione peroxidase*

Alan G. Rosmarin, MD (Medicine) *– Regulation of gene transcription in myeloid cell development and hematopoiesis, and cell cycle control*

Alonzo H. Ross, PhD (Biochemistry & Molecular Pharmacology) *– Neurotrophin receptors and signal transduction; central nervous system stem cells; tumor suppressor phosphatases; oncogenes and brain tumors*

Giles Whalen, MD (Surgery) *– Translational strategies for the management of regional metastatic disease (lymph node metastases, liver metastases from GI cancers, peritoneal carcinomatosis)*

Associate Professors

Sharon B. Cantor, PhD (Cancer Biology) *– Hereditary breast cancer*

Lucio H. Castilla, PhD (Molecular Medicine) *– Genetics of leukemia in mouse models*

Steven R. Grossman, MD, PhD (Cancer Biology) *– The ubiquitin/proteasome system and cancer*

JeanMarie Houghton, MD, PhD (Medicine) *– Host immune response to Helicobacter pylori infection, immune modulation of gastric cell signaling and growth regulation in response to Helicobacter infection*

Stephen N. Jones, PhD (Cell Biology) *– Analysis of signal transduction and cancer using genetically modified mice*

Michelle A. Kelliher, PhD (Cancer Biology) *– Mechanism of tal-1-induced leukemogenesis; death receptor signaling in apoptosis*

Timothy F. Kowalik, PhD (Molecular Genetics & Microbiology) *– Cell proliferation and DNA viruses; relationship between proliferation and cell death; targeting of Rb family members by cytomegalovirus; E2F1 transcription factor as a link between proliferation and p53-dependent apoptosis; RNAi and animal viruses*

Brian Lewis, PhD (Molecular Medicine) *– Molecular genetics of pancreatic and liver cancers*

Shaoguang Li, MD, PhD, (Medicine) *– Understanding the biology of leukemia stem cells and identifying target genes for eradicating these stem cells*

Stephen Lyle, MD, PhD (Cancer Biology) *– Molecular and cellular characterization of adult epithelial stem cells and alterations in stem cells that lead to tumor formation*

Leslie M. Shaw, PhD (Cancer Biology) *– Mechanisms of breast cancer metastasis*

Lan Xu, PhD (Molecular Medicine) *– TGF-beta signal transduction and its regulation of cell proliferation and differentiation*

Assistant Professors

Craig C. Creol, PhD (Molecular Medicine) *– Tumor initiation and maintenance, using zebrafish models and human tissue culture to focus on melanoma and other solid cancers*

David A. Guertin, PhD (Molecular Medicine) *– Nutrient and growth factor sensing pathways in cancer and development*

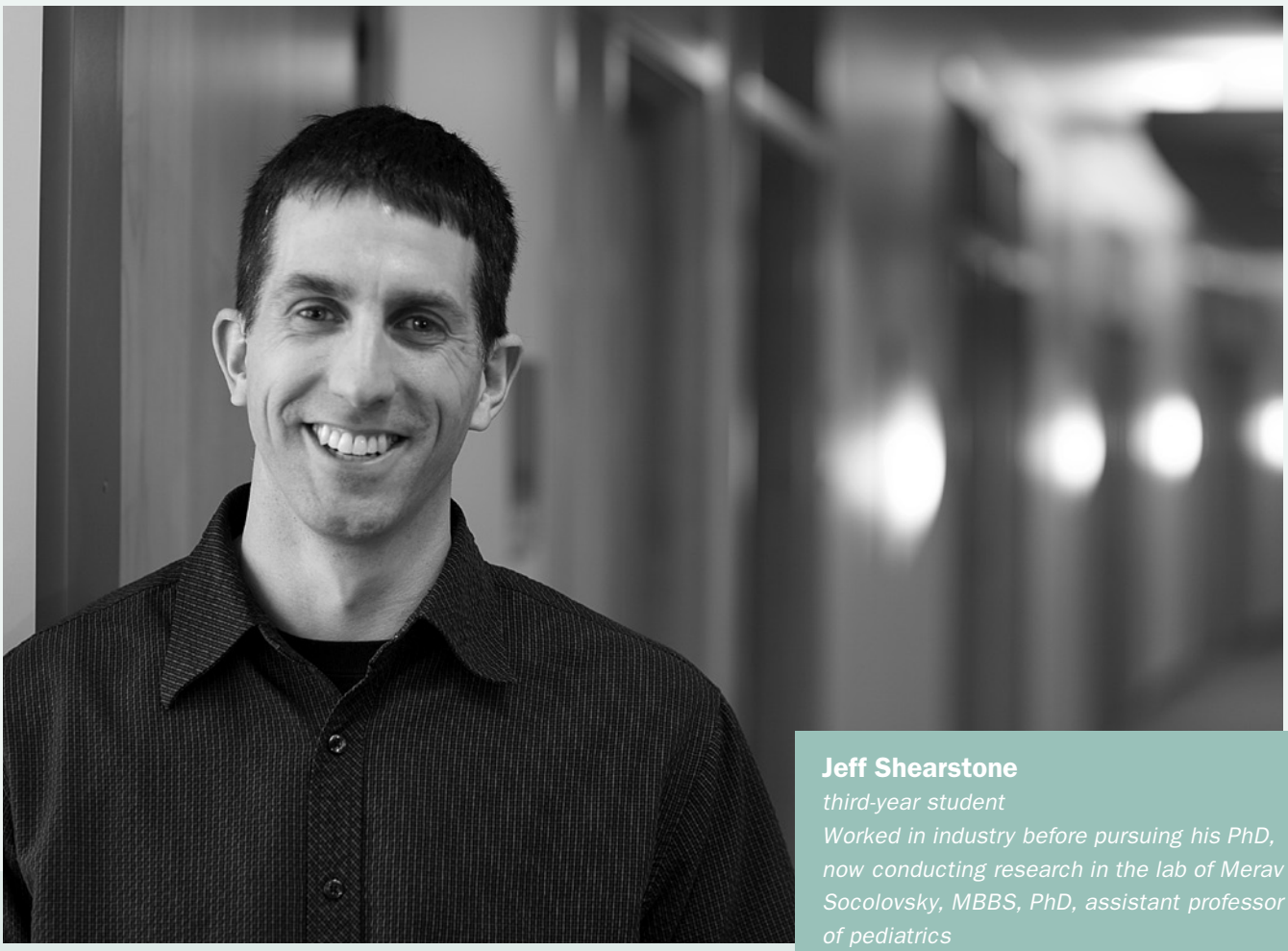
Junhao Mao, PhD (Cancer Biology) *– Hedgehog signaling and cancer*

Glen Raffel, MD, PhD (Medicine) *– Regulation of hematopoiesis by the Ott1(Rbm15) gene and its involvement in leukemogenesis*

Karl Simin, PhD (Cancer Biology) *– Role of tight junction complexes and their regulatory pathways in malignant progression*

Merav Socolovsky, PhD, MBBS (Pediatrics) *– Molecular mechanisms regulating the homeostasis of hematopoietic progenitors*

Jennifer F. Tseng, MD, MPH (Surgery) *– Pancreatic cancer epidemiology, prediction modeling and decision analysis and development of prospective tissue-linked databases to study survival and quality of life in gastrointestinal cancer patients*



Jeff Shearstone
third-year student
Worked in industry before pursuing his PhD, now conducting research in the lab of Merav Socolovsky, MBBS, PhD, assistant professor of pediatrics

Jeff studied chemical engineering at UMass Amherst and while pursuing his master's degree in the subject at the University of Washington, he was introduced to biochemistry research and enjoyed it. Before entering the GSBS, he worked at Amgen and Biogen Idec for a combined seven years, but discovered he would have more professional opportunities if he obtained a PhD. He found the GSBS "without question, head and shoulders above" the other graduate schools he visited on his path to a doctoral degree program. "The way the campus is set up, with the modern facilities, faculty and a hospital all in one location appealed to me. The core technologies are outstanding, particularly the flow cytometry facility. Researchers here have great support systems."

Jeff, who researches the maturation process of red blood cells and the connection to cancer progression, likes the balance of established faculty with the continual infusion of young investigators with fresh ideas. "There are many opportunities to collaborate. The curriculum fosters direct interactions with a variety of professors and students." Jeff also appreciates the competitive stipend and health care benefits the GSBS provides.

Program in Cell Biology

Cell Biology is noteworthy for:

- a rank of 10th nationwide for research among medical school cell biology departments;
- faculty consistently recognized for excellence in medical education; and
- its position as the lead department for interdepartmental research program grants investigating nuclear structure and cancer, and cell structure and musculoskeletal disease.

The Program in Cell Biology offers graduate study and research in molecular cell biology, leading to a PhD degree. Research interests of the graduate faculty and affiliates are focused on the use of cellular, genetic and molecular approaches to address structure-function relationships associated with cell growth and differentiation; development; stem cell biology; cell signaling; chromatin structure; transcriptional control of gene expression; DNA replication and repair; and cell motility. The Cell Biology faculty have expertise in many molecular and cellular techniques, including: 3-D image analysis; bioinformatics; immunofluorescense and confocal microscopy; electron microscopy; protein chemistry; recombinant DNA; tissue engineering; stem cell research; transgenic animal models; in situ hybridization; microarrays; gene mapping; and magnetic resonance imaging.

The department offers graduate courses in advanced cell biology topics, development, tumor biology, and tissue and organ structure; maintains an active basic research program; and strongly supports graduate student participation in this research. Cellular, molecular and developmental biologists from the Medical School, UMass Memorial Health Care and the UMass Memorial Cancer Center participate in the graduate program, adding a further dimension to the expertise available.

Requirements for Specialization
Specific course requirements for specialization in Cell Biology include two advanced courses, at least one of which is Advanced Topics in Cell Biology, as well as two semesters of Seminar in Cell Biology.

Advanced Topics Courses in Cell Biology
These courses represent current areas of focus and special emphasis in the Program in Cell Biology. New topics are added as student and faculty interests dictate.

Image Works: Principles of Light and Electron Microscopy

This course covers principles and applications of microscopy in biomedical research for graduate students at all levels. Demonstrations and laboratory exercises will be incorporated into some blocks of instruction. This course is designed to teach the biologist how microscopes work and how to optimize image quality.

Cytoskeleton and Disease

This course focuses on functions of actin- and microtubule-based cytoskeleton systems in the context of human disease, organized as a series of seminars with presentations by students and faculty. Discussions will include how molecular information contributes to diagnosis and treatment of disease and how clinical phenotypes elucidate protein functioning in whole organisms.

Nuclear Structure and Function in Disease

This course encompasses the relationship of nuclear and chromatin structure to gene function and regulation. Topics will be chosen from the recent research literature to illustrate molecular and cellular aspects of nuclear organization and regulation and how defects contribute to human disease. The format includes student presentations and faculty-student discussions of selected research papers.

Mammalian Development and Stem Cells

The potential of stem cells in therapeutic applications has ignited a fiercely competitive field of research aimed at the isolation, maintenance and differentiation of stem cells into specific pathways of differentiation. The use of stem cells in clinical application, however, requires an understanding of the molecular and cellular and epigenetic events that transform pluripotent cells into differentiated ones. Mammalian embryogenesis can be conceived as a sequence of developmental decisions that result in progressive restriction in cell potency. In this course the cellular and molecular mechanisms of mammalian development will be used as a framework for understanding the origin and differentiation of multiple pluripotent cells and their role in stem cell research and human disease.

Cell Signal Transduction

Proper intracellular signaling is critical to cell growth and differentiation, and dysregulation of signal transduction underlies a wide variety of human disorders. This course will examine various signal transduction pathways utilized by eukaryotes. A different pathway will be discussed each week, with special emphasis on the biological role(s) of the pathway in cell growth and function. Research papers highlighting one or more aspects of the signal pathway will be assigned for student presentation.

Cancer Biology

This course will encompass focal topics in cancer and tumorigenesis, using experiments and salient papers published in scientific literature to highlight key concepts and further questions that remain to be addressed. Although some attention will be given to cell cycling defects and their links to cancer, the majority of the subjects

covered will involve a broader look at tumor biology including metastasis, angiogenesis, chromosomal abnormalities, DNA repair defects, telomeres and senescence and the response of the host to the disease state.

Human Genetics

This course focuses strictly on human and clinically relevant genetics with emphasis on the basic underlying scientific mechanisms and concepts. Chromosomal, single gene, multifactorial and non-mendelian inheritance, as well as cancer genetics and human genomics will be covered. Problem solving will involve clinical, molecular and statistical data. A framework for understanding a fast-growing and highly technical field, and an appreciation of how current research impacts diagnostic, prenatal and pre-symptomatic testing, genetic screening and therapy, will be provided. This is a Medical School course. Approval of instructor required for registration.

Eukaryotic Gene Regulation

This course encompasses current research in important areas of eukaryotic gene regulation. The goals are two-fold: to improve skills in reading, presenting, discussing and critically analyzing research articles, and to obtain an up-to-date understanding of some key topics in eukaryotic gene regulation. Format involves student presentations and faculty-student discussions.

Developmental Biology

This course concentrates on salient papers in areas of developmental biology that are presently under intensive investigation. Probable topics to be covered include maternal inheritance, establishment of the body plan, cell-cell signaling, neurogenesis, limb development and left-right asymmetries. The organisms that are used most extensively for these investigations, including *Drosophila*, zebrafish, *Xenopus*, *C. elegans* and the mouse, will be emphasized.

Tutorial in Cell Biology

Tutorial arranged with individual faculty.

Seminar in Cell Biology

Topics to be announced.

Program in Cell Biology Faculty

Program Director

Anthony N. Imbalzano, PhD (Vice Chair, Research; Cell Biology) *– Effects of chromatin structure on the regulation of gene expression and the control of cell growth and differentiation*

Professors

Neil Aronin, MD (Medicine, Physiology)
– Molecular mechanisms in the pathogenesis of neurodegenerative diseases, particularly Huntington's disease and Parkinson's disease

Alexei Bogdanov, PhD (Radiology)
– High resolution imaging in biological models

Roger W. Craig, PhD (Cell Biology)
– Molecular mechanism of contraction in muscle

Stephen J. Doxsey, PhD (Molecular Medicine)
– The role of the centrosome in microtubule nucleation, spindle assembly and cancer

Andrew H. Fischer, MD (Pathology)
– Structural basis of nuclear envelope abnormalities in cancer cells

Harvey M. Florman, PhD (Cell Biology)
– Cell and molecular biology of fertilization, secretory mechanisms, ion channel structure and function

Mark I. Furman, MD (Medicine) *– Thrombin receptor activation of platelets in atherosclerosis*

Susan B. Gagliardi, PhD (Vice Chair, Medical Education) *– Development, genetics and experimental study of myelin; cytological and ultra-structural methods*

Ellen Gravallese, MD (Medicine)
– Rheumatoid arthritis and osteoporosis

Shalesh Kaushal, MD, PhD (Opthalmology)
– Vitreoretinal disorders

Lucia Languino, PhD (Cancer Biology)
– Signaling mechanisms activated by integrins that control cell migration and cell proliferation

Jeanne B. Lawrence, PhD (Cell Biology)
– Developmental genetics including chromosome mapping and the functional organization of DNA and RNA within the interphase nucleus

Mary M. Lee, MD (Cell Biology)
– Role of Mullerian inhibiting substance in testicular development; Paracrine and endocrine regulation of leydig cell differentiation; effects of environmental toxins on male reproductive development

Jane B. Lian, PhD (Cell Biology) *– Transcriptional control of bone tissue-specific genes regulating osteogenesis and gene therapy approaches for skeletal disorders*

Elizabeth J. Luna, PhD (Cell Biology) *– Biochemistry and control of actin assembly at the plasma membrane during motile processes*

Craig C. Mello, PhD (Howard Hughes Medical Institute Investigator; Blais University Chair in Molecular Medicine; Molecular Medicine) *– Analysis of fate specification in C. elegans embryonic development; analysis of RNAi in C. elegans*

Gerald A. Schwarting, PhD (Cell Biology) *– Axon guidance and cell migration mechanisms during olfactory development*

Greenfield Sluder, PhD (Cell Biology) *– Checkpoint controls for entry into and exit from mitosis; spindle organization; centrosome formation, function and reproduction*

Gary S. Stein, PhD (Gerald L. Haidak, MD, and Zelda S. Haidak Professor of Cell Biology; Chair, Cell Biology) *– Molecular mechanisms involved in the relationship of proliferation and differentiation; organization and regulation of expression of cell growth and tissue-specific genes*

Janet L. Stein, PhD (Cell Biology) *– Molecular mechanisms regulating expression of histone genes and other cell growth-related genes, especially at the transcriptional level*

Andre J. van Wijnen, PhD (Cell Biology) *– Cell cycle control of gene expression; homeo domain transcription factors*

George B. Witman III, PhD (George F. Booth Chair in the Basic Sciences) *– Molecular and cell biology of cilia and flagella; cilia and disease; microtubule motors*

Zuoshang Xu, MD, PhD (Biochemistry & Molecular Pharmacology) *– Mechanism and therapy of neurodegenerative diseases*

Robert B. Zurier, MD (Medicine) *– Mechanisms of action of fatty acids and cannabinoid acids in inflammation, immune responses and rheumatoid arthritis*

Associate Professors

Athena Andreadis, PhD (Cell Biology) *– Complex regulation of tau and the role of mis-splicing in frontal temporal dementia*

Zheng-Zheng Bao, PhD (Medicine) *– Regulation of vertebrate development*

Y. Tony Ip, PhD (Molecular Medicine) *– Gene regulatory molecules in Drosophila embryonic development and immune response*

Stephen N. Jones, PhD (Cell Biology) *– Analysis of signal transduction and cancer using genetically modified mice*

Daniel L. Kilpatrick, PhD (Physiology) *– Transcriptional control of neurogenesis*

Joan B. Mannick, MD (Medicine) *– Regulation of cell signaling by protein nitrosylation*

Mary Munson, PhD (Biochemistry & Molecular Pharmacology) *– Regulation of vesicle targeting and fusion*

Jeffrey A. Nickerson, PhD (Cell Biology) *– Structure of the nucleus; architectural organization of RNA metabolism*

Paul R. Odgren, PhD (Cell Biology) *– TRANCE regulation of chondrocyte maturation*

Nicholas R. Rhind, PhD (Biochemistry & Molecular Pharmacology) *– Checkpoint regulation in the fission yeast cell cycle*

Assistant Professors

Paul J. Fanning, PhD (Surgery) *– Mechanisms of mechanotransduction and their relation to health and disease states*

David LaPointe, PhD (Cell Biology) *– Bioinformatics and computational biology, specifically gene expression and pathway analysis*

Maria Morabito, PhD (Cell Biology) *– Regulation of excitatory synapses in development and disease*

Jaime Rivera, PhD *– Morphogenetic and molecular mechanisms in early mammalian development*

Jie Song, PhD (Orthopedics & Physical Rehabilitation) *– Musculoskeletal tissue engineering; use of synthetic extracellular matrices and stem cells to guide musculoskeletal tissue regeneration*

Hong Zhang, PhD *– Molecular mechanisms of cell senescence and relationships to cancer and aging*

Linzy Hendrickson
fourth-year student
Conducting research in the lab of Andrew Tapper, PhD, assistant professor of psychiatry and Paul Gardner, PhD, associate professor of psychiatry in the Brudnick Neuropsychiatric Research Institute

Linzy is conducting research to understand the molecular mechanisms that contribute to the use and co-abuse of nicotine and alcohol, the two most commonly abused drugs in the world. "Specifically, I'm focusing on the role of neuronal nicotinic acetylcholine receptors within the reward circuitry of the brain. I use a combination of pharmacology, electrophysiology, behavioral assays and genetic mouse models to address this question."

While at the University of Arizona in Tucson, where she earned degrees in psychology as well as molecular and cellular biology, Linzy was set to pursue her medical degree. However, in her junior year she entered a research program where she conducted learning and memory experiments in a neuroscience lab—and loved it.

When exploring graduate school options, the GSBS stood out. "Before I interviewed, I was already impressed with the research on campus. Once I spoke with the faculty and spent some time with students, it felt like a great scientific community."

Linzy also liked the structure of the first year, particularly the option of exploring labs from every discipline before making a selection. "The structure of the program builds a sense of community with fellow students, instructors and senior students, which compels you to become the best scientist you can be. UMass Medical School's GSBS is a program designed to challenge and foster your scientific mind."

Program in Cellular & Molecular Physiology

The Program in Cellular & Molecular Physiology boasts a world-class faculty and an NIH ranking among the top 15 percent of physiology departments nationwide for the past decade.

The Department of Physiology offers the Cellular & Molecular Physiology training program, which prepares students to answer fundamental questions in contemporary biology with a focus on integration of complex molecular and cellular events that are responsible for cell and organ function. Faculty members have expertise in both contemporary (molecular, biochemical and biophysical aspects of cell and tissue function) and classical (organ system function) areas of the physiological sciences. Graduate students benefit from this broadly based program in its novel and innovative approaches, as well as its overall quality in the physiological sciences. Upon graduation, students will have mastered the skills highly sought by the pharmaceutical and biotechnology industries and by academic institutions. Students will become proficient in the use of molecular techniques such as cloning, RT-PCR, mutagenesis and microarray analysis, and their use in solving problems in integrative biology, modern 3-DI imaging techniques, and single channel and whole cell patch clamp techniques.

Requirements for Specialization

The Cellular & Molecular Physiology program offers a multidisciplinary approach to provide the basic academic foundation for general, as well as specialized research projects, and includes formal coursework and tutorials on specific research topics and/or techniques. Graduate students in the Program in Cellular & Molecular Physiology are required to complete two core courses, The Cell Works: Principles of Cell Physiology, and The Body Works: Cellular and Organ Physiology. One additional elective is chosen from courses offered by Cellular & Molecular Physiology or the other graduate programs. Required annual enrollment in the Seminar in Physiology helps students develop presentation skills by requiring annual talks on their dissertation research. Physical chemistry is strongly recommended for specialization in physiology. Students are also encouraged to gain competence in exposition, statistics and computer programming since these skills are used extensively by biomedical scientists, irrespective of subdiscipline.

Courses in Cellular & Molecular Physiology

Human Physiology

Required for all first-year medical students, this course is also offered to graduate students who can elect to take the entire course or any of the four modules that correspond to their research interests. Modules include principles of cell physiology; gastrointestinal and endocrine physiology; cardiovascular and pulmonary physiology; and renal and reproductive physiology. Prerequisite: Biochemistry

The Cell Works: Principles of Cell Physiology

The objectives of this course are to provide a fundamental understanding of the basic biophysical principles of cell physiology; the ability to relate cellular function to whole organ physiology; and the cellular mechanisms underlying disease. By emphasizing the principles of cell physiology, the course will identify important physiological paradigms and the modern research methods used to resolve outstanding questions concerning cell function. Prerequisites: Biochemistry and Molecular Biology; minimum enrollment and consent of course coordinator

Molecular Mechanisms of Hormone Action

This course provides the student with an understanding of the basic molecular machinery and signaling cascades responsible for hormone action at the cellular and multicellular level. Prerequisites: Biochemistry, Principles of Cell Physiology and consent of course coordinator

The Image Works: Optical Methods in Physiology

This course studies basic optical techniques and their application to physiological problems, with special emphasis on digital image processing. Prerequisite: Calculus is required for all first-year medical students. This course is also offered to graduate students who can elect to take the entire course or any of the four modules that correspond to their research interests. Modules include principles of cell physiology; gastrointestinal and endocrine physiology; cardiovascular and pulmonary physiology; and renal and reproductive physiology. Prerequisite: Biochemistry

The Body Works: Cellular and Organ Physiology

The objectives of this course are to provide a fundamental understanding of the basic biophysical principles of physiology; the relationship between cellular function and whole organ physiology; the integration and regulation of the major organ systems of the human body; and the mechanism of pathogenesis and disease. By correlating cellular processes with organ function, this course will identify important physiological paradigms and the modern research methods used to resolve outstanding questions. Prerequisites: Biochemistry, Molecular Biology and Principles of Cell Physiology, minimum enrollment and consent of course coordinator

Seminar in Physiology

Students present seminars on topics in contemporary physiology or their research projects.

Cellular & Molecular Physiology Faculty

Program Director

Jack L. Leonard, PhD (Physiology) *– Hormonal control of brain development; the molecular events that mediate hormonal control of gene expression in the brain, with an emphasis on the molecular events that mediate vesicle trafficking in the nerve terminal*

Professors

Neil Aronin, MD (Medicine, Cell Biology)
– Pathogenesis of neurodegenerative diseases, especially Parkinson's disease and Huntington's disease

Robert E. Carraway, PhD (Physiology) *– Chemical and biological character of neurotensin-related peptides and their receptors*

Anthony Carruthers, PhD (Dean, GSBS; Biochemistry & Molecular Pharmacology)
– Molecular mechanisms of glucose transport and glucose transport regulation

Harvey M. Florman, PhD (Cell Biology)
– Cell and molecular biology of fertilization, secretory mechanisms, ion channel structure and function

Mitsuo Ikebe, PhD (Physiology) *– Regulation of smoothmuscle/nonmusclecontractilemachinery; function of protein kinases/phosphatases on cell contractility; functional expression of unconventional myosin motors and their role in cell motility*

José R. Lémos, PhD (Physiology) *– Molecular mechanism underlying stimulus secretion coupling; effects of drugs of abuse on synaptic transmission and regulation of hypothalamic neurohypophysial system*

J. Mark Madison, MD (Medicine) *– Airway smooth muscle; cytokine regulation of calcium*

David Paydarfar, MD (Neurology)
– Respiratory and autonomic neurophysiology

Daniel A. Pollen, MD (Neurology)
– Pattern recognition in the visual cortices of the primate; detailed analyses of the receptive field properties of neurons at successively higher levels of the visual system

Michael J. Sanderson, PhD (Physiology)
– Mechanisms of intercellular communication and calcium signaling in excitable and non-excitable cells

Jeffrey S. Stoff, MD (Medicine) *– Translation of immunobiologic principles into clinical strategies for organ transplantation; patient-tailored immunosuppression and new approaches to achieving immunologic tolerance*

John V. Walsh, MD (Physiology)
– Molecular biology and physiology of ion channels; the NMDA receptor-channel; ATP as a neurotransmitter in neurons and smooth muscle cells, and the molecular biology of the ATP receptor-channel complex; molecular basis of signaling that coordinates long-term processing in the nervous system

Associate Professors

Richard A. Fenton, PhD (Physiology) *– Role of adenosine in the regulation of cardiac function and neurotransmitter responsiveness in the ischemic, aging and alcoholic mammalian heart*

Lawrence J. Hayward, MD, PhD (Neurology)
– Ion channelopathies; motor neuron disease

Julie A. Jonassen, PhD (Physiology)
– Regulation of gene expression, signal transduction and cell growth/death by hormones, growth factors and free radicals

Daniel L. Kilpatrick, PhD (Physiology)
– Transcriptional control of terminal differentiation of neurons and spermatogenic cells; transcriptional dysfunction in growth arrest/ differentiation in nervous system neoplasias

Ann R. Rittenhouse, PhD (Physiology)
– Characterization of the role of calcium channels and their modulators in nerve cell plasticity using molecular, biochemical and patch-clamp techniques

Research Assistant Professors

Karen Beningo, PhD (Physiology) *– Role of the cytoskeleton and molecular motors in transport, motility and phagocytosis in mammalian and yeast systems*

Liwang Liu, MD (Physiology) *– Modulation of calcium channels in neurons*

Madelyn Schmidt, PhD (Physiology)
– Gene therapy approaches to treat genetic immunodeficiencies

Ronghua ZhuGe, PhD (Physiology)
– Local calcium signaling and ion channel function in smooth muscle and neurons

Jennifer Griffin
sixth-year student
Conducting research in the lab of Christopher Sassetti, PhD, assistant professor of molecular genetics & microbiology

Having spent two successful undergraduate summers at UMMS—one as a National Institutes of Health summer undergraduate research fellow and another as a summer research assistant—Jennifer decided that GSBS was where she wanted to be. "I knew that this was a completely collaborative environment and the type of scientific community that fosters problem solving and focusing on the important questions. I also knew that UMass Medical School had the tools and resources I would need for a productive and meaningful graduate experience."

A *magna cum laude* graduate of UMass Amherst, Jennifer is working in Dr. Sassetti's lab, which focuses on using genetics to understand the biology of tuberculosis (TB) infection. Specifically, her thesis research is aimed at understanding how and why *Mycobacterium tuberculosis*, the etiologic agent of TB, is able to survive on host cholesterol during infection. "I utilized large scale genetic approaches to identify the entire gene set required for this unique carbon metabolism of *Mycobacterium tuberculosis*. By understanding the biology of *Mycobacterium tuberculosis*, we can better identify drug targets to be used for the development of more effective antibiotics and treatments."

Throughout her GSBS experience, Jennifer has encountered nothing but support and guidance from the entire faculty. "It's important to consider not just the research an institution is conducting, but who is actually conducting it. It is the people that set UMass Medical School apart. The collaborative environment that exists here allows graduate students to flourish."

Program in Clinical & Population Health Research

The Program in Clinical & Population Health Research builds upon the existing array of centers, clinical departments and divisions addressing a range of health care needs, including:

- Commonwealth Medicine and its affiliated centers, the Center for Health Policy and Research and Shriver Center/Center for Developmental Disability Evaluation and Research;
- the Departments of Family Medicine & Community Health; Medicine, including the Division of Cardiovascular Medicine and Division of Preventive and Behavioral Medicine; Orthopedics & Physical Rehabilitation; Pediatrics; Psychiatry, including the Center for Mental Health Services Research; Quantitative Health Sciences; and Surgery, including the Center for Outcomes Research; and
- the Meyers Primary Care Institute and the Myelodysplastic Syndromes (MDS) Center at UMass Memorial Health Care.

The Program in Clinical & Population Health Research (CPHR) addresses the national need to move health care research from laboratory to bedside and from individual patients and health care sites to systems of care. The program emphasizes clinical and health services research skills, and provides students the tools to conduct research on health care access, screening, treatment, quality and outcomes.

CPHR develops researchers with strong core competencies in statistics, epidemiology and research methodologies applicable to clinical trials and population health studies. Improving clinical care and health care systems, particularly for vulnerable populations, is emphasized. Students will be prepared to conduct investigator-initiated clinical and health services research, and applied research in clinical and public sector health services delivery systems.

The program has a coherent core curriculum based on appropriate statistical, epidemiologic and research methods, as well as an understanding of the contextual issues of health and health care. Research ethics, scientific writing and a dissertation seminar are required courses. A series of three research rotations are required during the first year and the summer between the first and second year, culminating in selection of a research placement for writing a qualifying paper and then a dissertation proposal. Dissertation research is completed with students' selected mentors. Two electives are required, chosen from an array of special topics, tutorials or with approval from the University of Massachusetts Master's in Public Health program or other Worcester-area colleges.

Applicants are expected to have received a master's degree in public health, clinical research or in one of the social, psychological, physical or biological sciences, and to have completed adequate introductory coursework in biostatistics and epidemiology. Strong applicants may be admitted conditionally and required to complete such coursework prior to matriculation.

Courses in Clinical & Population Health Research

Determinants of Population Health

This two-semester, first-year course provides an introduction to the multiple determinants of health, including biology, genetics, structure and financing of health care, socioeconomic status, the physical environment, individual behavior and the interaction of these factors. Students are expected to demonstrate basic knowledge and skills in course topics through exams and papers. The course has a faculty leader and is team taught by various program faculty.

Advanced and Selected Topics in Epidemiology and Research Methods in Clinical and Health Services Research

Building on basic skills in epidemiology and scientific research methods, this two-semester course covers research design, sampling, hypothesis development and testing. Students develop skills in use of clinical and epidemiological databases and national health surveys. In addition, methodological strengths of various quantitative and qualitative techniques and designs will be explored. Students complete problem sets, in addition to assignments to develop original research approaches to specific scientific and clinical questions. The course has a faculty leader, with guest lectures from various program faculty.

Intermediate and Advanced Statistical Methods for Clinical and Health Services Research

The third, full-year core course provides an overview of multivariate analysis and advanced analytical strategies for clinical and population health research. It assumes competency in basic statistical techniques. Emphasis is on developing an understanding of multivariable modeling in the context of linear, logistic and Poisson regression; ANOVA factorial designs; survival analysis; and repeated measures and longitudinal methods, such as random effects models, GEE models and Hierarchical Linear Modeling. Computational lab assignments and a final project will be completed. The course is taught by the program biostatistician, with guest lectures by various program faculty.

Comprehensive Project

This course will provide structure and support for students to complete an independent research project using a secondary data set provided by the instructors. Students will develop, write and present their research study, including

sections on background, study hypotheses, study methods, results, conclusions, study limitations and recommended further research. Students will conduct their own data analysis and will be evaluated on summative competencies expected to be achieved by the end of their first year of CPHR core coursework and research rotations.

Scientific Writing for Clinical & Population Health Research

This course prepares students to complete their qualifying paper. Individual writing assignments will address different aspects of scientific writing. Students learn how to organize and deliver research papers and the various rules and conventions of manuscript production.

Research Ethics for Clinical & Population Health Research

This course covers basic human subject research issues, including NIH guidelines, required certification and Institutional Review Board processes and procedures. Topics include general research and data ethics. Students complete papers on specific ethical dilemmas and a final project relevant to their area of dissertation research.

Electives in Clinical & Population Health Research

Elective courses include both methods and population-specific courses and are scheduled based on student needs and interests. Courses include: Advanced Topics in Determinants of Health; Advanced Topics in Epidemiology; Advanced Topics in Biostatistics; Advanced Topics in Pediatric Research; Biostatistical Applications Using SAS®; Principles and Practice of Clinical Research; and Advanced Analytical Methods for Health Outcomes Studies. Additional electives will be developed and offered each year.

Proposal Development Seminar

The purpose of this course is to allow students to develop their dissertation proposals in a systematic fashion under faculty guidance. The dissertation proposal will be in the format of a National Institutes of Health (NIH) R03 grant proposal and, at the end of the semester, the students are expected to have completed the dissertation proposal. As such, the course is designed to walk the student through each of the NIH grant proposal requirements and expectations. The course will include detailed reviews of the grant process, participation in a mock proposal review session and the completion of each of the written grant components. It is expected that students will involve their mentor and three-member Thesis Research Advisory Committee (TRAC) in making decisions regarding their proposals and receive their input throughout the semester, so that the students will be prepared to defend their proposals soon after the semester is completed. The course will also be useful as an introduction to NIH proposal writing for students outside of the CPHR program.

Pre-Thesis Research

Upon completion and defense of their Qualifying Paper, students are expected to complete a thesis proposal. The preparation work and writing of this proposal typically takes place in the spring or summer of the second year. Students are expected to defend their thesis proposal by the end of the summer of their second year and to initiate their research by the fall of their third year. Students work under the guidance of their mentor and in their chosen labs or project sites to complete the proposal.

Clinical & Population Health Research Faculty

Program Director

Carole C. Upshur, EdD (Family Medicine & Community Health) *– Mental health integration in primary care; chronic pain; delivery of care to disadvantaged populations*

Professors

Jeroan Allison, MD, MPH (Quantitative Health Sciences) *– Clinical epidemiology; quality measurement and outcomes research; health services delivery to medically indigent populations*

Frederick A. Anderson, PhD (Surgery, Center for Outcomes Research) *– Cardiovascular epidemiology; evidence-based medicine; health outcomes; quality of care*

David Ayers, MD (Orthopedics & Physical Rehabilitation) *– Arthroscopy; total knee replacement; total hip replacement; revision hip replacement; revision knee replacement; arthritis surgery*

Marjorie A. Clay, PhD (Medicine, Family Medicine & Community Health) *– Ethics*

Patrick J. Connolly, MD (Orthopedics) *– Adult spinal deformity; cervical myelopathy; cervical spine disk; herniation; lumbar spinal stenosis; spinal fractures*

Mary E. Costanza, MD (Professor Emeritus; Medicine) *– Breast cancer and cancer prevention*

Joseph DiFranza, MD (Family Medicine & Community Health) *– Onset of nicotine dependence; effects of tobacco advertising; tobacco industry public relations programs; tobacco-related complications of pregnancy; school smoking cessation programs; effects of environmental tobacco smoke*

Francis A. Ennis, MD (Medicine, Molecular Genetics & Microbiology) *– Immunology; virology; clinical research*

Walter Ettinger, MD, MBA (Medicine, Division of Geriatrics) *– Geriatrics and aging*

Andrew H. Fischer, MD (Pathology, Cell Biology) *– Oncogenes/tumor suppressors; cell dynamics; cancer biology; nuclear architecture; histopathology*

William H. Fisher, PhD (Psychiatry) *– Mental health policy and services research; epidemiology of psychiatric disorders; sociology of mental health*

Terence R. Flotte, MD (Dean, School of Medicine; Celia and Isaac Haidak Professor of Medicine; Pediatrics, Molecular Genetics & Microbiology) *– Gene therapy for cystic fibrosis, alpha-1 antitrypsine deficiency and other single gene defects*

Robert J. Goldberg, PhD (Medicine) *– Cardiovascular epidemiology; preventive cardiology; epidemiologic methods*

Joel M. Gore, MD (Edward Budnitz, MD, Professor of Cardiovascular Medicine; Medicine) *– Critical Care/CCU; clinical trials; cardiovascular epidemiology; coronary artery disease*

Jerry H. Gurwitz, MD (Dr. John Meyers Professor of Primary Care Medicine; Medicine, Family Medicine & Community Health) *– Geriatric medicine; the safe use of medications in elderly patients; pharmacoepidemiology*

Stephen O. Heard, MD (Anesthesiology, Surgery) *– Catheter-related blood stream infections, sepsis and ARDS*

Jay S. Himmelstein, MD, MPH (Family Medicine & Community Health) *– Health services research focusing on Medicaid and disabled populations; work and health policy; worker's compensation medical care*

Catarina Kiefe, MD, PhD (Quantitative Health Sciences) *– Health care quality measurement and outcomes research*

Charles W. Lidz, PhD (Psychiatry) *– Ethical issues in medicine; coercion in mental health care; violence involving people with mental illness*

Shan Lu, MD, PhD (Medicine) *– Immunogenicity of protein antigens*

Lawrence Madoff, MD (Medicine) *– Infectious disease; immunology*

William J. McIlvane, PhD (Director, Shriver Center; Psychiatry) *– Symbolic potential in pre-symbolic populations; behavioral studies of mental retardation and depression; process analysis in behavioral allocation and persistence in severe mental retardation; typical and atypical brain development: A SEPA Project for Grades 3-6*

Thomas McLaughlin, ScD (Pediatrics) *– Mental health services research; longitudinal data analysis; policy evaluation; quality measurement*

Joanne Nicholson, PhD (Psychiatry, Family Medicine & Community Health) *– Mental illness; mental health policy; parental mental illness; mental health services; systems change*

Ira S. Ockene, MD (David J. and Barbara D. Milliken Professor of Preventive Cardiology; Medicine) *– Risk factor modification using behavioral and nutritional interventions; systems-based interventions for risk factor control and for improvement of adherence to medications; intervention for the prevention of diabetes; seasonal/cultural patterns of lipids and of the underlying factors; studies of foods with lipid-altering pharmacologic effects*

Judith K. Ockene, PhD, MEd, MA (Barbara Helen Smith Chair in Preventive and Behavioral Medicine; Medicine) *– Women's health; obesity; multiple risk behaviors; quality of life; population health; tobacco/alcohol use; relationship of lifestyle behaviors to disease; community-based interventions for lifestyle behaviors*

Brian O'Sullivan, MD (Pediatrics) *– Cystic fibrosis and platelet function; Cystic fibrosis and fatty acid metabolism; Cystic fibrosis and newborn screening*

Robert A. Phillips, MD, PhD (Medicine) *– Hypertensive heart and renal disease*

Alan Rothman, MD (Medicine) *– Dengue/ dengue hemorrhagic fever and other acute viral illnesses of the developing world; physiology and immunology of acute infection; diagnostic and prognostic models; epidemiology of viral transmission and disease*

Anthony J. Rothschild, MD (Irving S. and Betty Brudnick Chair in Psychiatry; Psychiatry) *– Pharmacoepidemiology; clinical research; clinical trials; mental illness*

Katherine F. Ruiz de Luzuriaga, MD (Pediatrics, Medicine) *– Viral and immunopathogenesis of persistent viral infections (EBV, CMV, HIV); characterization of antiviral CD4+ and CD8+ T cell responses from acute through chronic infection; ontogeny of cell-mediated immune responses to viral infections in infants and children; development of prophylactic and therapeutic vaccine strategies for HIV*

John L. Sullivan, MD (Pediatrics) *– Immunology; viral infections and immunity; clinical research; infectious disease; HIV/AIDS; Epstein-Barr virus*

Gyongyi, Szabo, MD, PhD (Gastroenterology, Medicine) *– Immune alterations induced by acute alcohol consumption; intracellular signaling pathways in leukocytes mediating altered cytokine production after alcohol use; immune mechanisms leading to increased liver injury in HCV plus alcohol; immunopathogenesis of liver injury in obese mice; immune mechanisms of increased liver injury in HCV plus alcohol; therapeutic studies in chronic hepatitis C; therapeutic approaches in non-alcoholic fatty liver disease (NAFLD) and non-alcoholic steatohepatitis (NASH)*

Linda F. Weinreb, MD (Family Medicine & Community Health) *– Health and support needs of homeless and low-income families; depression in primary care*

Robert Zurier, MD (Medicine, Rheumatology) *– Autoimmunity; clinical research; animal models of disease; gene expression; inflammation/ inflammatory diseases*

Associate Professors

Robin E. Clark, PhD (Family Medicine & Community Health) *– Economic evaluation; mental health and substance abuse policy; health care financing*

Sybil L. Crawford, PhD (Medicine) *– Women's health, particularly menopause; ethnic differences in health and health care utilization; applied statistical techniques, including missing-data methods and longitudinal modeling*

Terry S. Field, DSc (Medicine) *– Health disparities; cancer; patient safety; health services research; long-term care*

Patricia Franklin, MD, MBA, MPH (Joy McCann Professorship for Women in Medicine; Family Medicine & Community Health) *– Patient reported health outcomes; measuring cost and quality of care; total joint replacement outcomes; e-Health interventions; worksite prevention*

Sharone Green, PhD (Medicine) *– Immunopathogenesis of viral infections; human T cell responses to flavivirus infections, including dengue and West Nile virus; human immune responses to novel viral vaccines*

J. Lee Hargraves, PhD (Family Medicine & Community Health) *– Patient and consumer assessments of health care and quality of medical care; survey methods to assess health care quality from patients' perspectives; racial and ethnic disparities in health care; treatment of disparities in health care as an opportunity for improving health care quality*

Roger Luckmann, MD, MPH (Family Medicine & Community Health) *– Health services research, cancer and prevention*

Yunsheng Ma, MD, PhD, MPH (Medicine) *– Effect of diet and other lifestyle factors on obesity, diabetes and heart disease; cardiovascular disease epidemiology; improving methods of dietary assessment in epidemiological studies; applied statistical methods in clinical research*

Darlene M. O'Connor, PhD (Family Medicine & Community Health) *– Long-term care policy issues; aging; disability; stakeholder involvement in public policy; integrating Medicare and Medicaid*

Lori Pbert, PhD (Medicine) *– Evaluation of clinic-based interventions for health promotion and disease prevention; tobacco treatment in adolescents and adults; training and certification programs for Tobacco Treatment Specialists; obesity prevention and treatment; asthma management*

Milagros Rosal, PhD (Medicine) *– Treatment adherence; health behavior change (smoking, diet, physical activity); stress; women's health; minority health; adjustment to chronic illness, diabetes and cardiovascular disease prevention; diabetes self-management; mood and anxiety disorders*

Lawrence Rosenthal, MD, PhD, FACC (Medicine, Cardiovascular Medicine) *– Electrophysiology; treatment of cardiac arrhythmias in humans*

George W. Reed, PhD (Medicine) *– Biostatistics; obesity research; metabolism; physical activity; applied statistical methods and modeling*

Barry Saver, MD, MPH (Family Medicine & Community Health) *– Traditional health services research on issues of access, cost and quality for disadvantaged populations; cost-effective interventions for improving care for common conditions encountered in primary care*

Clinical Associate Professor

Robert A. Klugman, MD (Medicine)

Assistant Professors

Becky A. Briesacher, PhD (Medicine) *– Access to prescription drugs; geriatrics; Medicare; drug policy; long-term care*

Elizabeth Dugan, PhD (Medicine) *– Clinical trials; patient trust; aging; geriatrics; women's health*

Gordon FitzGerald, PhD (Surgery) *– Coronary syndromes; venous thromboembolism; survival analysis*

Carl Fulwiler, MD, PhD (Center for Mental Health Services Research) *– Forensic populations and co-occurring mental health and addictions*

Nancy R. LaPelle, PhD (Medicine) *– Tobacco treatment; cancer screening/ prevention; child health*

Stephenie C. Lemon, PhD (Medicine) *– Primary health care delivery; cancer detection and control; chronic disease management and treatment adherence; patient/clinician communication; clinical decision making*

Wenjun Li, PhD (Medicine) *– Biostatistics; sample survey; GIS; neighborhood environment; obesity; falls; physical activity; musculoskeletal diseases; randomized clinical trials*

Craig M. Lilly, MD (Medicine) *– Pulmonary, allergy and critical care medicine*

Wen-Chieh Lin, PhD (Family Medicine & Community Health) *– Medicaid*

Qin Liu, PhD (Preventive & Behavioral Medicine) *– Statistical design and analysis of clinical trials, population-based and basic science studies; applied biostatistical methods; survival analysis; logistic regression models; simulations; power and sample size estimation; hierarchical regression model for meta-analysis; mixed-effects models; longitudinal data analysis*

Tiffany Moore Simas, MD (Obstetrics & Gynecology) *– Pregnancy risks and complications*

Sheila B. Noone, PhD (Obstetrics & Gynecology) *– Human subjects protection; capacity-building for clinical research; applied research ethics; research compliance*

Sherry Pagoto, PhD (Preventive & Behavioral Medicine) *– Emotional eating and obesity; psychiatric comorbidities of obesity, including depression; clinical weight loss treatment; evidence-based research and practice; cancer prevention*

Julie Pilitsis, MD, PhD (Surgery) *– Deep brain stimulation; Parkinson's disease; cognition in neurodegenerative disorders; utilization in health care*

Shimul A. Shah, MD (Surgery) *– Hepatocellular carcinoma and liver tumors*

Jennifer Tjia, MD, MSCE (Geriatrics, Medicine) *– Effect of state and federal prescription drug policies on elder health outcomes and health service utilization; understanding the predictors of medication uptake and adherence among older adults*

Jennifer F. Tseng, MD, MPH (Surgery) *– Pancreatic cancer epidemiology; prediction modeling, decision analysis and development of prospective tissue-linked databases to study survival and quality of life in gastrointestinal cancer patients*

Molly Waring, PhD (Quantitative Health Sciences)

Sharada Weir, DPhil (Family Medicine & Community Health) *– Costs of trauma care; economics of occupational injury; health risk predictive modeling/risk-adjustment*

Special Appointments

Bruce Cohen, PhD *– Director of Research and Epidemiology, Bureau of Health Statistics, Research, and Evaluation, Massachusetts Department of Public Health, Boston*

Helen Hackman, MD *– Massachusetts Department of Public Health, Boston*

Instructor

Marzena Galdzicka, PhD (Psychiatry) *– RNA splicing; genomics; gene expression; medical genetics; genetics*

Jeff Bailey, MD, PhD
assistant professor of bioinformatics & computational biology

Shortly after joining UMass Medical School in 2009, Dr. Bailey received a Massachusetts Life Sciences Center New Investigator Award, which is designed to encourage innovative, cutting-edge research and advance the careers of new Massachusetts investigators. The award funds his research on dissecting the role of human copy number variation, characterized by gains and losses of small segments of the genome that are putatively associated with human malaria.

In general, the Bailey lab focuses on understanding the role of segmental duplication and copy number variation in human disease susceptibility and pathogenesis. "We are optimizing both experimental and computational approaches for the assessment of copy number variation using techniques such as array comparative genomic hybridization and massively parallel next generation sequencing within the context of several specific diseases." For example, Bailey's lab is working with Robert Brown, DPhil, MD, chair and professor of neurology, to identify copy number variants affecting risk for amyotrophic lateral sclerosis (ALS), or Lou Gehrig's disease.

After completing his bachelor's degree in biology from Saint Olaf College, Bailey worked as a science and math teacher in Liberia and Botswana as a member of the Peace Corps before going on to earn his PhD in genetics in 2002 and his MD in 2005 at Case Western Reserve University. He is also board certified in clinical pathology and practices transfusion medicine at UMass Memorial Health Care.

Program in Immunology & Virology

Supported by NIH training grants, the Immunology & Virology Program features cutting-edge research in:

- viral immunology, pathogenesis and vaccine development;
- molecular virology;
- diabetes and transplantation immunology;
- molecular and cellular immunology;
- mechanisms of bacterial pathogenesis; and
- mechanisms of resistance to bacterial pathogens.

Immunology, virology and bacterial pathogenesis are active interdisciplinary biomedical fields with studies ranging from molecular mechanisms to clinical trials. The Immunology & Virology Program (IVP) is administered by the Immunology and Virology Committee, an interdepartmental group that includes faculty with diverse research interests, including the molecular and cellular basis of immune responsiveness; molecular mechanisms of viral replication; host-pathogen interactions; and the control of viral, bacterial and parasitic infections. The program has National Institutes of Health (NIH) training grant support for both graduate students and postdoctoral fellows.

Graduate students in IVP acquire a broad base of knowledge in biochemistry, genetics, and cellular and molecular biology through the core curriculum. Specialized training in immunology, virology and bacteriology is initiated in a first-year course, which introduces students to the immune system, basic principles of bacteriology and virology, and the interaction of bacteria and viruses with the host. Emphasis is placed on experimental systems and analysis of primary research papers. Further training continues in the fall of the second year with three courses: Advanced Virology, Advanced Cell and Molecular Immunology, and Advanced Bacterial Pathogenesis. Also offered is an advanced course in flow and image cytometry. Advanced courses emphasize reading and critical analysis of recent research papers. Additional training in the second year includes seminars, journal clubs and tutorials that explore the most active areas of current research. Laboratory rotations help familiarize students with current research methods, and facilitate the selection of an area of interest and a laboratory in which students can pursue their dissertation research.

Requirements for Specialization

In addition to the core courses and laboratory rotations, IVP students should take Infection and Immune Response in the first year and, in the second year, two advanced-level courses offered by the Immunology & Virology Program. Equivalent advanced topics courses can be substituted with permission. All students, except for those in the final stages of their dissertation research, are required to take the Graduate Student Seminar each fall semester, and students are required to take Immunobiology and Virology Seminar and Discussion, a guest scientist seminar program, twice.

Courses offered by the IVP Program

Infection and Immune Response

This course has three sections. The first section provides a comprehensive introduction to the concepts and principles of immunology and the molecular and cellular events that underlie immune system function. Topics covered include the structure, function and genetics of immunoglobulins, T cell receptors and MHC proteins; the development and differentiation of lymphocytes; cell-cell interactions in the immune system; and the initiation and regulation of immune responses. A textbook is used to illustrate experimental approaches to current and classic immunological questions.

The bacteriology section of the course emphasizes the basic properties of microbes and the mammalian host defenses that have evolved to respond to them; the interplay, in both the dynamic and the evolutionary sense, between host defenses and microbial virulence; and the mechanisms of pathogenesis during infection. Comparative clinical and epidemiological pictures of selected diseases are presented and serve as a framework for development of key molecular, cellular and physiological concepts.

The virology section of the course focuses on general principles of virus replication cycles, mechanisms of cell transformation by viruses and host-virus interactions. Topics include general principles of virus structure; mechanisms of virus entry, replication and assembly; virus oncogenes; immune evasion mechanisms; and virus pathogenesis. Discussion sections expand on and provide context for the lecture materials.

Introduction to Immunology

Designed for medical students, this intensive five-week survey provides an introduction to basic concepts in immunology and immunopathology. It is recommended primarily for students transferring into the Immunology & Virology Program at the beginning of their second year.

Immunology/Virology Summer Tutorial

Students in the class will read one primary and one review paper the week before each class. The topic, paper and review will be chosen by two student mentors. In a brief presentation, the mentors will describe the current state of the field and summarize the review. The class will be split into two groups, pro and con, that will each present arguments for their opinion. The purpose is to have more discussion on the positives and negatives of technique, systems and conclusions. Prerequisites: Biomedical Sciences I, II and III

Advanced Molecular and Cellular Immunology

The most active areas of current immunology are investigated through the reading and discussion of research papers. Students further develop the ability to pose questions and design experiments to answer them through writing a research proposal. Topics covered include regulation of lineage specification/commitment and antigen receptor gene recombination; mechanisms of immunological tolerance and lymphocyte activation; cellular transactions and their consequences (e.g., APC:T cell); and immune responses in infectious diseases. Prerequisites: Biomedical Sciences I, II and III and Infection and Immune Response, or its equivalent

Advanced Animal Virology

This course offers a detailed consideration of cutting-edge research in virology with specific emphasis on molecular mechanisms of virus infection and virus-cell interactions. Classes include lectures, but emphasize reading and discussion of primary papers. Topics vary from year to year, but may include virus structure; virus entry; viral DNA or RNA replication; transcription; translation; virus assembly and release; persistence; latency; effects on host macromolecular metabolism; cell lysis; and interference and viral immunology. The emphasis is on basic principles as well as experimental design. Students further develop the ability to formulate and address hypotheses by writing a research proposal. Prerequisite: Biomedical Sciences III and Infection and Immune Response or its equivalent

Advanced Bacterial Pathogenesis

Spanning the eukaryotic and prokaryotic worlds and involving an array of disciplines—from genetics, cell biology and immunology through epidemiology and evolutionary biology—bacterial pathogenesis is a fascinating and dynamic area of study. In particular, exploring the intricate mechanisms that pathogenic bacteria have evolved for manipulating mammalian systems at the cellular and molecular levels is significantly contributing to our knowledge of cell biology and immune system function. Advances in microbial genomics and genomic level genetic approaches, coupled with excellent small animal infection models and sophisticated mouse genetics, hold the promise of continued rapid progress. This course, grounded in current literature, will introduce students to selected topics at the forefront of research in bacterial pathogenesis. Specific topics investigated are based on the interests of the class. Students present reviews of selected research articles and develop and present brief research proposals addressing issues related to the articles under review. In addition to introducing the modern literature and experimental approaches of bacterial pathogenesis research, the format of this course is intended to assist students with preparation for qualifying examinations.

The participating faculty introduce topics, provide background information and meet individually with students to provide constructive criticism of in-class presentations. The majority of class time is devoted to open discussion. Prerequisites: Biomedical Sciences I, II and III and Infection and Immune Response, or its equivalent, or by special permission from the instructors

Introduction to Flow and Image Cytometry, Part I

The emphasis of the course will be an introduction to the practical aspects of flow and image cytometry. As the majority of students will either rely on or be exposed to data generated from flow and image cytometry, the course will enhance their understanding of the technology, instrumentation skills, applications and interpretation of data. This course will be a hands-on, lab-based program emphasizing flow and image cytometry instrumentation, components, cell sample staining procedures for immunophenotyping, DNA analysis and image analysis. Students will participate in polychromatic flow and image cytometry experiments and will progress from flow cytometry analysis to cell sorting. Prerequisites: General knowledge of Cell Biology and Immunology

Introduction to Flow and Image Cytometry, Part II

Part II will progress to cell sorting, complementary technology, such as confocal microscopy, and advanced applications that rely on these novel technologies. The course will also incorporate guest lectures from leaders in the field. Prerequisite: General knowledge of Cell Biology and Immunology

Graduate Student Seminar in Immunology & Virology

This course is designed to provide both practice and guidance in delivering formal research seminars. Advanced graduate students present seminars on their thesis research with feedback provided by faculty and peers. Prerequisites: Biomedical Sciences I, II and III and Infection and Immune Response or its equivalent

Immunobiology and Virology Seminar and Discussion

Leading researchers present a weekly seminar on basic or clinical immunology or virology topics. Prior to the seminar, students read papers suggested by the seminar speaker and discuss the papers in class. Following the seminar, students meet with the speaker for a discussion of the formal seminar. This course surveys the most important areas of basic and clinical immunology and virology including, but not limited to, mechanisms of viral infectivity and replication; viral persistence and latency; antigen presentation; antigen receptor gene rearrangements; immune tolerance; cytokines; immune cell development; immunodeficiency diseases; autoimmune diseases; human immune system malignancies; and immune response to infectious agents such as viruses, parasites and bacteria. Prerequisite: Infection and Immune Response taken previously or concurrently

Immunology & Virology Faculty

Chair

Timothy Kowalik, PhD (Molecular Genetics & Microbiology) *– Activation of DNA damage responses by virus infection and their role in replication; relationships among DNA damage signaling, cell cycle and cancer; relationship between virus infection and RNAi including the contribution of host and virus-encoded miRNAs to virus replication and disease*

Vice Chair

Lawrence Stern, PhD (Pathology, Biochemistry & Molecular Pharmacology) *– Molecular mechanisms that underlie recognition and response in the immune system; structural, biochemical and cellular studies of MHC proteins, T cell receptors and antigen processing pathways*

Program Director, Immunology

Leslie J. Berg, PhD (Pathology)
– Signal transduction proteins involved in T cell development and activation, with a focus on T cell antigen receptor and cytokine receptor signaling; animal models of immunodeficiencies using transgenic and knockout mice

Program Director, Virology

Trudy G. Morrison, PhD (Molecular Genetics & Microbiology) *– Mechanisms of enveloped virus entry and virus assembly; structure, function and intracellular processing of viral glycoproteins; vaccine development*

Professors

Ronald C. Desrosiers, PhD (Molecular Genetics & Microbiology) *– Herpes viruses and retroviruses; use of the simian immunodeficiency virus to better understand the contribution of individual viral genes to the development of AIDS; understanding and overcoming viral resistance to antibody-mediated neutralization; novel strategies for vaccination and prevention*

Francis A. Ennis, MD (Medicine, Molecular Genetics & Microbiology) *– Human cross-reactive T cell responses to virus infected cells; identifying structure of epitopes recognized by human CD4+ and CD8+ CTL and function of these CTL in clearance of infected cells, immunopathology and for vaccine development*

Robert W. Finberg, MD (Richard M. Haidack Professor of Medicine; Chair, Medicine; Molecular Genetics & Microbiology)
– Relationships between host cell surface proteins and infectious agents; basis of cellular activation mediated by cell surface protein

Terence R. Flotte, MD (Dean, School of Medicine; Celia and Isaac Haidak Professor of Medicine; Pediatrics, Molecular Genetics & Microbiology) *– Immune pathogenesis of cystic fibrosis; gene therapy for single gene disorders: cystic fibroses, alpha-1 antitrypsin deficiency and disorders of fatty acid oxidation*

Uri Galili, MD (Medicine) *– Intratumoral injection of a-gal glycolipids for in vivo conversion of solid tumors into anti-tumor vaccines (includes clinical trials); targeting microbial vaccines to antigen presenting cells by formation of immune complexes with the anti-Gal antibody; accelerating healing of injuries by alpha-gal liposomes (liposomes expressing a-gal epitopes) in order to recruit and activate macrophages within injuries*

Guangping Gao, PhD (Molecular Genetics & Microbiology) *– Discovery, development and use of adeno-associated virus vectors for gene therapy of genetic diseases and the study of miRNA functions in mammals; isolation, characterization and vectorology of novel AAV vectors from primate tissues; molecular mechanisms of AAV evolution and diversity; and molecular interactions between endogenous AAV, AAV vector, host genomes and innate RNAi defense pathways*

Ricardo Gazzinelli, DSc, DVM (Medicine, Infectious Diseases) *– Cognate innate immune receptors and development of vaccines for protozoan parasites*

Douglas Golenbock, MD (Medicine, Molecular Genetics & Microbiology) *– Mammalian receptor systems for microbial products including bacterial lipopolysaccharide; toll-like receptors*

Heinrich Gottlinger, PhD, MD (Molecular Medicine) *– Study of HIV-1 molecular biology, with emphasis on cellular factors required for virus release and for the function of HIV-1 accessory proteins*

Dale L. Greiner, PhD (Medicine) *– Study of normal and abnormal T cell development in animal models of autoimmunity; pathogenesis of autoimmune diabetes in BB rats and NOD mice; mechanisms of transplantation tolerance by co-stimulation blockade*

Hardy Kornfeld, MD (Medicine) *– Study of host defense against respiratory infections, with an emphasis on tuberculosis; topics include apoptosis of macrophages infected with Mycobacterium tuberculosis, the impact of diabetes and hyperlipidemia on TB defense, novel approaches for TB vaccines and immunoadjuvant therapy, and heterologous immunity between mycobacteria and viruses*

Evelyn A. Kurt-Jones, PhD (Medicine) *– Innate immunity and inflammation in infection and cancer; cellular and molecular basis of innate immunity; role of pattern recognition receptors, including Toll-like receptors, in triggering the synthesis and release of inflammatory cytokines in response to infection or injury; role of inflammation in the development of cancer*

John M. Leong, MD, PhD (Molecular Genetics & Microbiology) *– Investigation of the Lyme disease spirochete, Borrelia burgdorferi, to recognize multiple elements of the extracellular matrix, a property that contributes to the chronic and multisystemic nature of Lyme disease and which may also trigger a novel form of T cell-independent immunologic memory; investigation of enterohemorrhagic Escherichia coli O157:H7, which manipulates host cell actin assembly in ways that promote colonization and disease, and provides an avenue to investigate fundamental mechanisms of actin assembly in mammalian cells*

Stuart Levitz, MD (Medicine) *– Study of host defenses against opportunistic fungal infections with the long term goal of developing novel vaccines and immunotherapies*

Shan Lu, MD, PhD (Medicine) *– Immunogenicity of protein and peptide antigens; novel vaccine development against infectious diseases including HIV-1, emerging and re-emerging infectious diseases*

Elizabeth J. Luna, PhD (Cell Biology) *– Phagocyte membrane skeletons; molecular mechanisms associated with chemotaxis, cell motility and cell-substrate interactions*

Ann Marshak-Rothstein, PhD (Medicine) *– Innate immune triggers of autoantibody production in the context systemic autoimmune diseases; inflammatory and apoptotic functions of molecular variants of Fas ligand*

Peter E. Newburger, MD (Ali and John Pierce Chair in Pediatric Hematology/Oncology; Pediatrics, Cancer Biology) *– Global analysis and regulation of phagocyte gene expression; pattern recognition receptor expression and function in neutrophils*

Peter A. Rice, MD (Medicine) *– Interaction of human compliment with bacteria, Neisseria in particular; gonococcal vaccine discovery and development*

Kenneth L. Rock, MD (Chair, Pathology) *– Antigen presentation on MHC Class I and Class II molecules; immune surveillance of viral infections and tumors; dendritic cells and antigen presenting cells; Immunological Danger; acute inflammation to sterile cell death*

Alan L. Rothman, MD (Medicine) *– Immunity and pathogenesis of flavivirus infections; T-lymphocyte responses to dengue and hepatitis C*

Katherine F. Ruiz de Luzuriaga, MD (Pediatrics, Medicine) *– Viral and immunopathogenesis of persistent viral infections (EBV, CMV, HIV); characterization of antiviral CD4+ and CD8+ T cell responses from acute through chronic infection; ontogeny of cell-mediated immune responses to viral infections in infants and children; development of prophylactic and therapeutic vaccine strategies for HIV*

Liisa K. Selin, MD, PhD (Pathology) *– Viral immunity and immunopathogenesis; cytotoxic T cell and gamma-delta T cell responses during acute viral infection and in the memory state; heterologous immunity and cross-reactive T cell responses in both murine and human viral infection*

Janet M. Stavnezer, PhD (Molecular Genetics & Microbiology) *– Molecular mechanism and regulation of antibody class switch recombination; the role of DNA repair genes in class switching using animal models*

Lawrence Stern, PhD (Pathology, Biochemistry & Molecular Pharmacology) *– Molecular mechanisms that underlie recognition and response in the immune system; structural, biochemical, and cellular studies of MHC proteins, T cell receptors and antigen processing pathways*

Mario Stevenson, PhD (David J. Freelander Professor of AIDS Research, Molecular Medicine, Molecular Genetics & Microbiology) *– Mechanisms of HIV and SIV pathogenesis; functions of HIV gene products examined at the biochemical, genetic and cellular levels*

John L. Sullivan, MD (Pediatrics, Molecular Genetics & Microbiology, Molecular Medicine, Pathology) *– Pathogenesis of chronic infection with Epstein-Barr virus and HIV*

Gyongyi Szabo, MD, PhD (Medicine) *– Molecular and cellular basis for regulation of innate immunity by alcohol and its role in hepatitis C virus infection; mechanisms of increased liver injury in animal models of fatty liver.*

Raymond M. Welsh, PhD (Pathology, Molecular Genetics & Microbiology) *– Viral immunology and pathogenesis; natural killer and cytotoxic T cells in murine model systems; T cell apoptosis and memory*

Bruce Woda, MD (Pathology) *– Hematopathology*

Associate Professors

Rita Bortell, PhD (Medicine) *– Role of gut immunity in the pathogenesis of autoimmune diabetes in BB rats; ADP-ribosyltransferase activity in T cell immunoregulation*

Jason Chen, PhD (Medicine) *– Regulation of cell cycle and genomic instability by the papillomavirus oncogenes; antiviral and anticancer research*

Paul R. Clapham, PhD (Molecular Medicine, Molecular Genetics & Microbiology) *– HIV receptors and tropism; the study of how variation in receptor-use affects the types of cells infected and whether this impacts on HIV transmission and pathogenesis*

Katherine Fitzgerald, PhD (Medicine, Infectious Diseases) *– Innate immunity to viruses*

Rachel M. Gerstein, PhD (Molecular Genetics & Microbiology) *– Developmental regulation of lymphocyte development, including lineage commitment, V(D)J recombination and cytokine receptor signaling; defective B-cell development in aging*

Jon D. Goguen, PhD (Molecular Genetics & Microbiology) *– Role of innate immunity in controlling bacterial infections and mechanisms used by pathogens to evade this control, with special emphasis on Yersinia pestis, the causative agent of plague; the role of fibrin (ogen) and fibrin-neutrophil interactions in innate immunity; the role of plasminogen activators in enhancing bacterial virulence; the role of secreted bacterial proteases in pathogenesis*

Sharone Green, MD (Medicine) *– Pathogenesis of heterologous flavivirus infections in human and murine model systems; T cell responses to novel virus vaccines*

Ronald M. Iorio, PhD (Molecular Genetics & Microbiology) *– Viral pathogenesis; virus-receptor interactions; mechanisms of virus-induced membrane fusion; viral glycoprotein structure and function*

Joonsoo Kang, PhD (Pathology) *– Molecular and cellular basis of T cell lineage commitment processes; morphogen WNT and TGFb signaling in immune cell subset generation; regulation of T cell antigen receptor gene rearrangement and expression by cytokines and lineage determining factors; generation of animal model systems to study aberrant development of T subsets and T cell tumors*

Michelle A. Kelliher, PhD (Cancer Biology, Molecular Genetics & Microbiology) *– Mechanism of tal-1-induced leukemogenesis; death receptor signaling in apoptosis*

Daniel Libraty, MD (Medicine) *– Human immunity to dengue viruses and other flaviviruses; modulation of anti-viral T cell immunity by innate signaling mechanisms*

Egil Lien, PhD (Medicine) *– Mechanisms for activation and evasion of host innate immunity by pathogens, with emphasis on Toll-like receptors; strategies utilized by Yersinia pestis, a Gram-negative bacteria and the causative agent of plague, to evade innate immunity by altering its lipopolysaccharide/lipid A*

Pranoti Mandrekar, PhD (Medicine)
– Signaling mechanisms involved in the pathogenesis of alcohol-induced liver disease; Interactions of oxidative stress, molecular chaperones and innate immune signaling pathways during liver injury, chemokines and fatty liver, cytokine- and chemokine-directed migration of innate and adaptive immune cells to the liver

William L. Marshall, MD (Medicine)
– Impact of viral bcl-2s on innate and adaptive immune responses; poxviral inhibitors on innate immune signaling; viral perturbation of signaling by TNF family members

Ann Moormann, PhD, MPH (Pediatrics - Immunology/ID/Rheumatology)
– Viral immunology and epidemiology

Neal Silverman, PhD (Medicine)
– Innate immune signaling pathways in Drosophila; genetic, molecular and biochemical analysis of Drosophila NF-kB transcription factor activation; pathogen-encoded inhibitors of innate immune responses

Eva Szomolanyi-Tsuda, MD (Pathology)
– Immune responses to virus infection and to virus-induced tumors; murine model of viral pathogenesis with the small DNA tumor virus polyoma; B cell responses to virus infection

Robert T. Woodland, PhD (Molecular Genetics & Microbiology) *– Signaling mechanisms maintaining B lymphocyte growth, survival and immune responsiveness; HIV vaccine development using humanized chimeric mice*

Assistant Professors

Jeff Bailey, MD, PhD (Medicine, Bioinformatics & Integrative Biology) *– Infectious disease genetics and genomics; global studies of copy number variation (gains and losses of segments of genomic DNA) using high-throughput array comparative genomic hybridization and next generation sequencing; current studies are concentrated on understanding the role of copy number variation in malaria for both the human host and the pathogen*

Victor Boyartchuk, PhD (Molecular Genetics & Microbiology) *– Identification of genetic factors controlling differential susceptibility to infectious diseases using animal model systems*

Michael A. Brehm, PhD (Medicine) *– Generation of antiviral T cell responses; mechanisms of transplantation tolerance; development of humanized mouse models for the study of infectious disease and diabetes*

Francis K. Chan, PhD (Pathology) *– Signaling of Tumor Necrosis Factor (TNF) receptors in autoimmunity, cancers and viral infections*

Steven Grossman, MD, PhD (Cancer Biology, Medicine) *– Role of the ubiquitin/proteasome system in tumor progression, with focus on regulation of p53 tumor suppressor protein stability by p19ARF, MDM2 and p300 proteins; identification of p14/p19ARF interacting proteins; role of proteasome adaptor (Rad23) proteins in regulation of the p53 pathway; characterization of a ubiquitin ligase activity of the p300 HAT/coactivator and its regulation by the adenovirus E1A oncoprotein*

Eric Huseby, PhD (Pathology) *– Studies to define the molecular and cellular interactions of T cells with MHC during development, peripheral activation and autoimmune responses*

Richard F. Konz Jr. (Director, Flow Cytometry Core Facility; Medicine) *– supervise Core and staff; assist investigators in designing experiments, data analysis and interpretation; design and implement training programs for graduate students, post-doctoral fellows, technical staff and senior investigators in DNA cell cycle analysis, multicolor data acquisition and analytical techniques and instrument specific training, as well as a formal Flow and Image course*

Eicke Latz, PhD, MD (Medicine, Infectious Diseases) *– Study of mechanisms of Toll-like receptor and inflammasome activation and their role for sterile inflammatory diseases*

Craig Lilly, MD (Medicine, Pulmonary, Allergy & Critical Care Medicine) *– Mechanisms of airway inflammation, biomarkers of disease and critical care outcomes*

Sanjay Ram, MD (Medicine) *– Complement evasion strategies of microbes, with an emphasis on Neisseria meningitides and N. gonorrhoeae*

Madelyn R. Schmidt, PhD (Molecular Genetics & Microbiology) *– Gene therapy approaches for treatment of immune deficiency disease and cancer; mechanisms regulating B lymphocyte homeostasis; mechanisms of RNA virus persistence in B lymphocytes*

Carol E. Schrader, PhD (Molecular Genetics & Microbiology) *– The role of base-excision repair and DNA mismatch repair proteins in DNA breaks formed during immunoglobulin class switch recombination*

Merav Socolovsky, PhD, MBBS (Pediatrics, Cancer Biology) *– The link between the cell cycle and key chromatin events during red cell differentiation; the signaling mechanisms responsible for stress erythropoiesis*

Masanori Terajima, MD, PhD (Medicine) *– T cell immune responses against viruses and vaccines (vaccinia virus, influenza virus); virus-host interaction (vaccinia virus); immunopathology of virus infection (hantavirus pulmonary syndrome)*

Jennifer Wang, MD (Medicine, Infectious Diseases) *– Viral immunology*

Maria L. Zapp, PhD (Molecular Medicine, Molecular Genetics & Microbiology)
– Regulation of eukaryotic gene expression at the level of nucleocytoplasmic transport; HIV-1 Rev-dependent RNA export; cellular factors mediating mRNA and viral RNA intracellular trafficking; molecular mechanisms of genomic HCV RNA replication and packaging

Shenghua Zhou, PhD, MD (Medicine, Infectious Diseases) *– Interactions between virus-host innate immune signaling molecules and how these interactions impact both the development of the adaptive immune response and pathogenesis; development of small molecules that might interfere with viral protein-host protein interactions and prevent the virus-induced inflammation or immunosuppression*

Patricia D. Franklin, MD, MBA, MPH
the Joy McCann Professorship for Women in Medicine, professor of orthopedics & physical rehabilitation, family medicine & community health and clinical and population health research

An academic physician for more than 25 years, Dr. Franklin has focused her research on biopsychosocial predictors of functional outcome, cost and utilization in chronic musculoskeletal conditions; the role of physical activity and self-care in functional outcome; and eHealth interventions to support self-care and tertiary prevention in aging, chronic disease populations. While at UMMS, she has developed and directed a clinical and outcomes research program for the Department of Orthopedics & Physical Rehabilitation with clinical partner UMass Memorial Medical Center; Franklin has also secured a $1.7 million National Institutes of Health grant to evaluate strategies to improve patient function after orthopedic surgery and two Robert Wood Johnson Foundation eHealth grants to test electronic decision support tools for adults with advanced osteoarthritis.

"UMass Medical School's broad faculty expertise, combined with its emphasis on collaboration, supports successful clinical and outcomes research. The addition of the faculty for the Department of Quantitative Health Sciences has accelerated our ability to be a national leader."

Franklin joined UMMS in 2004 from SUNY Upstate Medical University, where she was associate professor of medicine and served as director and health services researcher for its Center for Outcomes Research and Evaluation. In 2008, she was the recipient of The Knee Society's 2008 Chitranjan Ranawat Award, with colleagues David C. Ayers, MD, and Wenjun Li, PhD, for their research on total knee replacement.

The Interdisciplinary Graduate Program

The Interdisciplinary Graduate Program is characterized by:

- a streamlined and flexible graduate curriculum tailored to the specific needs of individual students;
- participation from more than 130 UMMS labs; and
- encouragement of students' rapid initiation into full-time thesis research.

The Interdisciplinary Graduate Program (IGP) was established to support interdisciplinary approaches to graduate training in biomedical research. The more than 130 laboratories that participate in the program are directed by a distinguished group of faculty affiliated with 13 basic science and clinical departments at the Medical School. Program investigators employ a wide range of instrumentation and experimental approaches to their research including: classical and molecular genetics; proteomics and genomics; X-ray crystallography and nuclear magnetic resonance; and digital imaging and laser confocal microscopy of single cells and tissues. Specialized core facilities in gene chip analysis, mass spectroscopy, transgenics, DNA sequencing, analytical ultracentrifugation and biomedical imaging enhance the research capabilities of individual labs.

Characterized by a streamlined and flexible graduate curriculum that is tailored to the specific needs of individual students, the IGP encourages rapid initiation of full-time thesis research. A weekly seminar series, sponsored by the Program in Molecular Medicine, features distinguished lecturers from around the world. IGP students also host one or two of these seminars each semester, and faculty, students and postdoctoral fellows participate in weekly journal clubs and research forums.

Program Requirements

The IGP curriculum allows students the opportunity to become fully engaged in thesis research as early as the end of their first year. Students are encouraged to perform two laboratory rotations per semester in order to ensure that they are exposed to a variety of experimental approaches and laboratory environments. Optimally, rotations will be completed and a thesis laboratory selected by the summer of a student's first year. Advanced coursework, journal clubs and other enrichment activities beyond the graduate core course are tailored to the requirements of each student and are determined after discussion between the faculty advisor and student. In general, a minimum of two Advanced Topics courses are required.

Courses in the Interdisciplinary Graduate Program

Introduction to Neuroscience

This course gives an overview of the fundamental principles of molecular, cellular, developmental and integrated neuroscience, including state-of-the-art experimental approaches. Required for all students in the Neuroscience Program. Prerequisites: Completion of Biomedical Sciences I and II or permission from instructors

DNA Repair and Genome Stability

DNA repair is vitally important to protect the genome from endogenous and exogenous DNA damage. This course explores the various mechanisms cells employ to protect their DNA using examples from the molecular to the cellular and from bacteria to humans.

Image Works: Principles of Light and Electron Microscopy

This course is designed to teach the biologist how microscopes work and how to optimize image quality; principles and applications of microscopy in biomedical research will apply for graduate students at all levels. Demonstrations and laboratory exercises will be incorporated into blocks of instruction.

Cytoskeleton and Disease

This course studies the functions of actin- and microtubule-based cytoskeleton systems in the context of human disease and will be organized as a series of seminars with presentations by students and faculty. Discussions will include how molecular information contributes to diagnosis and treatment of disease and how clinical phenotypes elucidate protein functioning in whole organisms.

Current Topics in Aging

This is a journal club offered every two weeks to discuss papers on aging and genomic stability. The topics will be mechanisms of aging with a focus on genetics. The objective is to cover a large number of papers that identify genes that act to promote or limit life span and theories of aging.

Eukaryotic Gene Expression

This course encompasses current topics in eukaryotic gene regulation including the study and discussion of current research articles. Course goals are to improve skills in reading, presenting, discussing and critically analyzing research articles and to obtain an up-to-date understanding of some key topics in eukaryotic gene regulation.

Development Biology

This course will provide basic instruction in contemporary developmental biology with an emphasis on animal development. The course will familiarize students with development in each of the major model systems (worms, flies, frogs, fish and mice) and expose them to commonly used techniques (genetics, molecular biology, cell biology, biochemistry) in the context of animal development. The class will meet twice per week and each week will cover a different topic. Each topic will be introduced by a lecture and subsequently explored in depth by discussion of relevant articles from the literature. Each student will be expected to lead at least one group discussion.

Molecular Biology of the Cell Cycle

This course covers genetic, biochemical and cellular mechanisms of cell cycle control. Topics include genetic screens for cell cycle regulators, cell cycle checkpoints, cell cycle regulation of DNA replication and chromosome structure, and the cell cycle in development and cancer.

Educational Outreach to High Schools and Middle Schools

Middle and high school educational outreach is coordinated through the IGP, Worcester Pipeline Collaborative and Regional Science Resource Center. IGP-coordinated activities include development of in-class presentations and experiments in collaboration with high school teachers, and one-on-one and small group mentoring of high school science students. The Worcester Pipeline Collaborative coordinates a range of programs with the Worcester Public Schools dedicated to educating and challenging minority and/or economically disadvantaged students for success in the health care and science professions. The Regional Science Resource Center at the Shrewsbury Campus provides lab space, technical support and materials for area teachers interested in implementing more inquiry-based, student-centered science in the classroom.

Genome Biology Journal Club

Papers published in high-profile journals relating to systems biology, genomics, chromosome structure and gene expression are discussed. Each participant is required to present one paper and to participate in other paper discussions.

Tutorial in the Interdisciplinary Graduate Program

Individual instruction on selected topics is arranged by student and instructor.

Seminar Series in the Interdisciplinary Graduate Program

This course offers students an opportunity to learn scientific information and presentation skills. Students are required to attend the weekly IGP seminar series and to write a short critique about each seminar. The goal is for students to understand the important elements of a successful presentation, including style, interaction and organization.

Cell Dynamics Journal Club

The Cell Dynamics Journal Club covers molecular mechanisms underlying the movements of cells and organelles; morphology, proteomics and mutagenesis of functional cytoskeletal structures; and the dynamics of actin-, microtubule-, and intermediate filament-associated proteins. Related signaling mechanisms and disease processes—including those associated with muscular dystrophies, developmental abnormalities, and the formation and spread of tumors—also are appropriate.

To obtain course credit, students read and help discuss the papers covered during the semester and present a paper of their choice. Grades are based on participation and the presentation. The course coordinator and other faculty members in the Cell Dynamics Group guide students through the process, as needed, and provide scientific feedback. The Journal Club meets throughout the academic year. Auditors are welcome.

Genetic Systems

This course introduces students to genetic techniques used in yeast, flies, worms and mice. Forward and reverse genetic approaches and genetic screen design are illustrated through an analysis of journal examples, and the advantages and limitations of each system are discussed. The course combines faculty lectures and student presentations.

RNA Biology Journal Club

The RNA Biology Journal Club discusses recent and classical papers covering various topics in RNA biology. Students will choose from a list of papers provided by course coordinators or from recent literature with approval from coordinators.

Interdisciplinary Graduate Program Faculty

Graduate Directors

Craig L. Peterson, PhD (Molecular Medicine, Biochemistry & Molecular Pharmacology)
– Roles of the SWI/SNF complex and chromatin in regulation of eukaryotic gene expression

William E. Theurkauf, PhD (Molecular Medicine)
– Control of chromosome segregation in early development

Professors

Victor R. Ambros, PhD (Silverman Chair in Natural Sciences; Molecular Medicine)
– Molecular and genetic control of animal development; microRNA regulatory mechanisms

Eric Baehrecke, PhD (Cancer Biology)
– Cell death and autophagy

Leslie J. Berg, PhD (Pathology)
– Signal transduction pathways in T cell development and activation

Vivian Budnik, PhD (Neurobiology) *– Molecular mechanisms of synapse assembly and plasticity*

Anthony Carruthers, PhD (Dean, Graduate School of Biomedical Sciences; Biochemistry & Molecular Pharmacology) *– Mechanisms of glucose transport and glucose transport regulation*

Silvia Corvera, MD (Molecular Medicine, Cell Biology) *– Molecular mechanisms involved in the regulation of endocytosis and exocytosis by growth factors*

Michael P. Czech, PhD (Chair, Molecular Medicine) *– Transmembrane signaling mechanisms elicited by the insulin receptor tyrosine kinase related to membrane trafficking of glucose transporters*

Roger J. Davis, PhD (H. Arthur Smith Chair in Cancer Research; Howard Hughes Medical Institute Investigator; Molecular Medicine, Biochemistry & Molecular Pharmacology) *– Signal transduction by the epidermal growth factor receptor; mechanisms by which growth factors regulate cellular proliferation*

Stephen J. Doxsey, PhD (Molecular Medicine, Biochemistry & Molecular Pharmacology, Cell Biology) *– The role of the centrosome in microtubule nucleation, spindle assembly and cancer*

Robert W. Finberg, MD (Richard M. Haidack Professor of Medicine; Chair, Medicine; Molecular Genetics & Microbiology) *– Relationships between host cell surface proteins and infectious agents; basis of cellular activation mediated by cell surface protein*

Harvey M. Florman, PhD (Cell Biology, Physiology) *– Cell and molecular biology of fertilization; secretory mechanisms, ion channel structure and function*

Terence R. Flotte, MD (Dean, School of Medicine; Celia and Isaac Haidak Professor of Medicine; Pediatrics, Molecular Genetics & Microbiology) *– Gene therapy for cystic fibrosis, alpha-1 antitrypsine deficiency and other single gene defects*

Ricardo Gazzinelli, DSc, DVM (Medicine)

Reid J. Gilmore, PhD (Biochemistry & Molecular Pharmacology) *– Molecular mechanism of protein translocation across the endoplasmic reticulum; analysis of asparagine-linked glycosylation in the endoplasmic reticulum*

Edward I. Ginns, MD, PhD (Pediatrics, Neurology, Pathology, Psychiatry) *– Molecular basis of psychiatric and neurologic disorders*

Douglas Golenbock, MD (Medicine, Molecular Genetics & Microbiology) *– Toll receptors; pathophysiology of sepsis and pelvic inflammatory disease*

Heinrich Göttlinger, MD, PhD (Molecular Medicine) *– Molecular biology of HIV-1*

Michael R. Green, MD, PhD (Lambi and Sarah Adams Chair in Genetic Research; Howard Hughes Medical Institute Investigator; Molecular Medicine, Biochemistry & Molecular Pharmacology, Surgery) *– Eukaryotic gene function and expression*

Dale L. Greiner, PhD (Medicine) *– Transplantation tolerance and autoimmune diabetes*

Mitsuo Ikebe, PhD (Physiology) *– Regulation of smooth muscle/non-muscle contractile machinery; function of protein kinases/phosphatases on cell contractility; functional expression of unconventional myosin motors and their role in cell motility*

Allan Jacobson, PhD (Chair, Molecular Genetics & Microbiology) *– Post-transcriptional regulation of gene expression in yeast*

John Keaney, MD (Medicine) *– Cardiovascular Medicine*

Jason Kim, PhD (Molecular Medicine) *– Role of inflammation in obesity, diabetes and cardiovascular complications*

Hardy Kornfeld, MD (Medicine) *– Bacterial and viral respiratory pathogens relating to tuberculosis*

Kendall L. Knight, PhD (Biochemistry & Molecular Pharmacology) *– Homologous genetic recombination and DNA repair in prokaryotes and eukaryotes*

David G. Lambright, PhD (Molecular Medicine, Biochemistry & Molecular Pharmacology) *– Structural determination of key intermediates in cellular signaling and vesicle trafficking pathways*

Jeanne Lawrence, PhD (Cell Biology) *– Genome organization and the functional relationship of DNA/RNA with nuclear structure*

Andrew B. Leiter, MD, PhD (Medicine) *– GI endocrine cells in health and disease*

John M. Leong, MD, PhD (Molecular Genetics & Microbiology) *– Interaction of Lyme disease spirochetea Borrelia burgdorferi with mammalian cells*

Stuart M. Levitz, MD (Medicine, Molecular Genetics & Microbiology) *– Interplay between host immune system and opportunistic fungal pathogens*

Elizabeth J. Luna, PhD (Cell Biology) *– Biochemistry and control of actin assembly at the plasma membrane during motile processes*

Martin G. Marinus, PhD (Biochemistry & Molecular Pharmacology) *– DNA mismatch and double-strand break repair of drug-induced lesions*

Craig C. Mello, PhD (Blais University Chair in Molecular Medicine; Howard Hughes Medical Institute Investigator; Molecular Medicine, Cell Biology) *– Analysis of fate specification in C. elegans embryonic development; analysis of RNA interference in C. elegans*

Arthur M. Mercurio, PhD (Cancer Biology) *– Mechanisms that underlie the genesis of invasive carcinoma and the progression to metastatic disease*

John P. Mordes, MD (Medicine) *– Pathogenesis of virus-induced diabetes in the rat and the development of lenti-viral transgenic and knockdown animals for use in studying this process*

Peter Newburger, MD (Ali and John Pierce Chair in Pediatric Hematology/Oncology; Hematology/Oncology, Cancer Biology, Pediatrics) *– Molecular basis of phagocyte function and selenoprotein biosynthesis*

Thoru Pederson, PhD (Vitold Arnett Professor of Cell Biology; Biochemistry & Molecular Pharmacology) *– Eukaryotic gene expression at the level of RNA processing; RNA-protein interactions and RNA traffic*

Steven M. Reppert, PhD (Higgins Family Professor of Neuroscience; Neurobiology) *– Circadian clockwork of animals*

Peter Rice, MD (Infectious Diseases and Immunology, Medicine) *– Host interactions with Neisseria gonorrhea*

Joel D. Richter, PhD (Molecular Medicine) *– Regulation of maternal mRNA expression in early development*

Alonzo H. Ross, PhD (Biochemistry & Molecular Pharmacology) *– Neurotrophin receptors and signal transduction; central nervous system stem cells; tumor suppressor phosphatase; oncogenes and brain tumors*

Katherine F. Ruiz de Luzuriaga, MD (Pediatrics, Medicine) *– Viral and host factors in the pathogenesis of vertical HIV-1 infection; HIV-1 specific cytotoxic T lymphocytes in naturally infected or immunized infants; development of therapeutic agents/strategies for HIV-1 infection*

Celia A. Schiffer, PhD (Biochemistry & Molecular Pharmacology) *– How conformational adaptability affects molecular recognition in drug-resistant variants of HIV protease using phage display, X-ray crystallography and molecular dynamics calculations*

Greenfield Sluder, PhD (Cell Biology) *– Checkpoint controls for entry into and exit from mitosis; spindle organization; centrosome formation, function and reproduction*

Janet M. Stavnezer, PhD (Molecular Genetics & Microbiology, Pathology) *– Molecular mechanism and regulation of antibody class switch recombination*

Lawrence Stern, PhD (Pathology, Biochemistry & Molecular Pharmacology) *– Molecular recognition in the immune system*

John L. Sullivan, MD (Pediatrics, Molecular Medicine, Molecular Genetics & Microbiology, Pathology) *– Virological and immunological studies of HIV-1 pathogenesis; development of a vaccine and therapeutic agents for HIV-1 infection; early HIV-1 envelope-specific cytotoxic T lymphocyte responses in vertically infected infants*

Heidi A. Tissenbaum, PhD (Molecular Medicine) *– Molecular mechanisms of aging in C. elegans*

David Weaver, PhD (Neurobiology) *– Molecular physiology of circadian rhythms*

Zhiping Weng, PhD (Biochemistry & Molecular Pharmacology, Bioinformatics & Integrative Biology) *– Bioinformatics and computational genomics*

George B. Witman III, PhD (George F. Booth Chair in the Basic Sciences; Cell Biology) *– Molecular and cell biology of cilia and flagella; cilia and disease; microtubule motors*

Zuoshang Xu, MD, PhD (Biochemistry & Molecular Pharmacology) *– Structure, transport and function of neuronal cytoskeleton; neurodegenerative diseases*

Phillip D. Zamore, PhD (Gretchen Stone Cook Chair in Biomedical Sciences; Howard Hughes Medical Institute Investigator; Biochemistry & Molecular Pharmacology) *– Control of mRNA stability and translation in development; molecular mechanisms of RNAi (post-transcriptional gene silencing)*

Associate Professors

Schahram Akbarian, MD (Psychiatry) *– Noradrenergic neuron function in neurotrophin mutant mice*

Ingolf Bach, PhD (Molecular Medicine) *– Neuronal cell fate specification*

Zheng-Zheng Bao, PhD (Medicine, Cell Biology) *– Molecular mechanisms in vertebrate development*

Rita Bortell, PhD (Medicine) *– Pathogenesis of autoimmune diabetes*

Lucio H. Castilla, PhD (Biochemistry & Molecular Pharmacology, Molecular Medicine) *– Genetics of leukemia in mouse models*

Jason J. Chen, PhD (Medicine) *– Proliferation and apoptosis of cells expressing papillomavirus oncogenes*

Paul R. Clapham, PhD (Molecular Genetics & Microbiology, Molecular Medicine) *– HIV receptors and cellular tropisms*

Job Dekker, PhD (Biochemistry & Molecular Pharmacology) *– Spatial organization of genomes*

Patrick Emery, PhD (Neurobiology) *– Circadian rhythms and their synchronization in Drosophila*

Katherine Fitzgerald, PhD (Medicine) *– Innate immune signaling*

Paul D. Gardner, PhD (Psychiatry) *– Molecular studies of neurotransmitter receptor gene expression*

Rachel M. Gerstein, PhD (Molecular Genetics & Microbiology) *– Developmental regulation of V(D)J recombination and B cell development; defective B cell development and function in Btk-deficient mice; the extent to which homology can constrain coding exon diversity in V(D)J recombination*

Steven R. Grossman, MD, PhD (Cancer Biology, Medicine) *– The ubiquitin/proteasome system and cancer*

Lawrence J. Hayward, MD, PhD (Neurology, Physiology) *– Hyperkalemic periodic paralysis, motor neuron degeneration in ALS*

Anthony N. Imbalzano, PhD (Cell Biology) *– Effects of chromatin structure on the regulation of gene expression and the control of cell growth and differentiation*

Tony Ip, PhD (Molecular Medicine, Biochemistry & Molecular Pharmacology, Cell Biology) *– Regulatory mechanisms in Drosophila innate immunity*

Stephen N. Jones, PhD (Cell Biology, Cancer Biology) *– Analysis of signal transduction and cancer using genetically modified mice*

Paul Kaufman, PhD (Molecular Medicine) *– Assembly and function of eukaryotic chromosomes*

Michelle A. Kelliher, PhD (Cancer Biology) *– Genetic analysis of programmed cell death in the mouse*

William R. Kobertz, PhD (Biochemistry & Molecular Pharmacology) *– Structure, function and modulation of ion channels*

Timothy F. Kowalik, PhD (Molecular Genetics & Microbiology) *– Regulation of cellular proliferation control during viral infection*

John Landers, PhD (Neurology) *– Genetics of familial and sporadic ALS*

Nathan Lawson, PhD (Molecular Medicine) *– Determining the signals responsible for blood vessel development using zebrafish*

Tzumin Lee, MD, PhD (Neurobiology) *– Neural circuitry formation and plasticity in Drosophila brain*

Brian Lewis, PhD (Molecular Medicine) *– Molecular genetics of pancreatic and liver cancers*

Shaoguang Li, MD, PhD (Medicine) *– Molecular basis of human Philadelphia chromosome-positive leukemias*

Egil Lien, PhD (Medicine, Molecular Genetics & Microbiology) *– Mechanisms for microbial activation and evasion of innate immune responses via Toll-like receptors*

Stephen Lyle, MD, PhD (Cancer Biology) *– Molecular and cellular characterization of adult epithelial stem cells and alterations in the stem cells that lead to tumor formation*

Dannel McCollum, PhD (Molecular Genetics & Microbiology) *– Molecular mechanisms that regulate cytokinesis in the yeast Schizosaccharomyces pombe*

Haley E. Melikian, PhD (Psychiatry, Biochemistry & Molecular Pharmacology) *– Cocaine and antidepressant-sensitive monoamine transporters*

Gregory J. Pazour, PhD (Molecular Medicine) *– The role of the intraflageller transport (IFT) proteins in eukaryotic ciliary assembly*

Peter M. Pryciak, PhD (Molecular Genetics & Microbiology) *– Function of yeast heterotrimeric G proteins in signal transduction and cell polarity*

Nicholas Rhind, PhD (Biochemistry & Molecular Pharmacology, Cell Biology) *– Checkpoint regulation of the fission yeast cell cycle*

Ann R. Rittenhouse, PhD (Physiology) *– Characterization of the role of calcium channels and their modulators in nerve cell plasticity using molecular, biochemical and patch-clamp techniques*

Charles G. Sagerström, PhD (Biochemistry & Molecular Pharmacology) *– Developmental neurobiology of zebrafish*

Leslie Shaw, PhD (Cancer Biology) *– Mechanisms involved in the progression of breast cancer*

Neal Silverman, PhD (Medicine) *– Signal transduction during the insect immune response*

YanPing Sun, PhD (Radiology)

Fumihiko Urano, MD, PhD (Molecular Medicine) *– Molecular pathogenesis of protein conformational diseases*

Scott Waddell, PhD (Neurobiology) *– Drosophila learning and memory*

Marian Walhout, PhD (Molecular Medicine) *– Mapping transcription regulatory circuits in the nematode C. elegans*

Scot A. Wolfe, PhD (Biochemistry & Molecular Pharmacology) *– Creating novel transcription factors for targeted gene regulation*

Lan Xu, PhD (Molecular Medicine) *– TGFb signal transduction*

Assistant Professors

Usha Acharya, PhD (Molecular Medicine) *– Molecular genetics of lipid metabolism and signaling*

Jeffrey Bailey, MD, PhD (Transfusion Medicine) *– Infectious disease susceptibility and pathogenesis*

Jennifer Benanti, PhD (Molecular Medicine) *– Regulation of cell growth and division*

Claire Bénard, PhD (Neurobiology) *– Maintenance of nervous system architecture: making it is not good enough*

Daniel Bolon, PhD (Biochemistry & Molecular Pharmacology) *– Computational design and experimental dissection of macromolecular systems*

Daryl Bosco, PhD (Neurology) *– Elucidating the factors involved in sporadic ALS*

Victor Boyartchuk, PhD (Molecular Genetics & Microbiology) *– Studies of the genetic factors controlling susceptibility to infectious diseases using animal model systems*

Michael H. Brodsky, PhD (Molecular Medicine) *– Drosophila p53 and DNA damage-induced apoptosis*

Robert Brown, DPhil, MD (Chair, Neurology) *– Amyotrophic lateral sclerosis*

Sharon Cantor, PhD (Cancer Biology) *– Hereditary breast cancer*

Craig Ceol, PhD (Molecular Medicine) *– Genetic regulators of melanoma formation using the zebrafish*

Francis K. Chan, PhD (Pathology) *– Analysis of TNF receptor signaling in healthy and diseased immune systems*

Miguel Esteves, PhD (Neurology) *– Treatment of neurodegenerative lysosomal storage diseases*

Thomas Fazzio, PhD (Molecular Medicine) *– Chromatin regulation in stem cells*

David Guertin, PhD (Molecular Medicine) *– Signal transduction in development and cancer*

Kirsten A. Hagstrom, PhD (Molecular Medicine) *– Chromosome structure and segregation during cell division*

Eric S. Huseby, PhD (Pathology) *– Development of T cell tolerance of self and the autoimmune consequence of when it fails*

Eicke Latz, MD, PhD (Medicine) *– Molecular mechanisms of Toll-like receptor activation; molecular imaging (FRET and FLIM) of protein/protein interactions*

Hong-Sheng Li, PhD (Neurobiology) *– Neuronal signal transduction and degeneration in the fly eye*

Madelena Martin, MD (Pediatrics)

Stephen Miller, PhD (Biochemistry & Molecular Pharmacology) *– Chemical dissection of cellular GTPase function*

Mary Munson, PhD (Biochemistry & Molecular Pharmacology, Cell Biology) *– Regulation of vesicle targeting and fusion*

Oliver J. Rando, MD, PhD (Biochemistry & Molecular Pharmacology) *– Genomic approaches to chromatin structure and function, and to epigenetic inheritance*

Sean Ryder, PhD (Biochemistry & Molecular Pharmacology) *– RNA-protein interactions and post-transcriptional regulation in development and complex disease*

Hayla Sluss, PhD (Cancer Biology) *– Tumor suppressors and metabolic control*

Merav Socolovsky, MBBS, PhD (Pediatrics) *– Molecular mechanisms regulating the homeostasis of hematopoietic progenitors*

Jie Song, PhD (Orthopedics & Physical Rehabilitation, Cell Biology) *– Musculoskeletal tissue engineering: A biomimetic synthesis approach*

Andrew R. Tapper, PhD (Psychiatry) *– Neuronal nicotinic acetylcholine receptors in addiction and neurological disease*

Bert van den Berg, PhD (Molecular Medicine) *– Structure and function of membrane transport proteins*

Yong-Xu Wang, PhD (Molecular Medicine) *– Transcriptional control of energy metabolism and metabolic diseases by the nuclear receptor PPAR subfamily*

Maria L. Zapp, PhD (Molecular Medicine, Molecular Genetics & Microbiology) *– Regulation of nuclear transport of viral and cellular mRNAs by cellular factors*

Hong Zhang, PhD (Cell Biology) *– Molecular mechanisms of senescence and its roles in cancer and aging*

Jianhua Zhou, PhD (Medicine) *– Molecular pathogenesis of neurodegenerative diseases*

Michael Horwich, MD, PhD
2010 graduate who conducted research in the lab of Phillip D. Zamore, PhD, Howard Hughes Medical Institute Investigator, the Gretchen Stone Cook Chair of Biomedical Sciences and professor of biochemistry & molecular pharmacology

When Michael joined the MD/PhD program at the University of Chicago in 2002, he quickly became fascinated with a new phenomenon called RNA interference (RNAi). Unfortunately, none of the labs there were working in that area. Luckily, Michael and his wife relocated in 2004 to Massachusetts where UMass Medical School—home to RNA pioneers Philip Zamore, PhD, and Craig Mello, PhD—had just begun accepting out-of-state MD/PhD candidates. "I was unbelievably lucky to be able to transfer into the MD/PhD program here as I thought UMass Medical School would be an excellent environment for my PhD."

In the Zamore lab, Michael used biochemistry and genetics to understand how small RNAs are made and how they function. "I was excited about the prospect of RNAi-based therapeutics. But I was just as interested in the biology underlying small RNA silencing, which ultimately has strong implications for therapeutics, both in their design and potential side effects. In fact, therapeutics that block or mimic endogenous small RNAs, involved in diseases such as cancer and hepatitis C, are already well on their way to the clinic."

After four years in the lab and two years in a clinic, Michael is still passionate about science. "UMMS has assembled an outstanding group of scientists and I feel I received superb training in the Zamore lab. There is so much great science being done here, you really can't go wrong."

MD/PhD Program

The MD/PhD Program is an integrated pathway that:

- provides training for both residents and non-residents of Massachusetts to become physician-scientists;
- offers the choice of vigorous research training in either biomedical or clinical and population health sciences;
- is flexible and diverse, drawing upon the innovative curricula of the School of Medicine and the Graduate School of Biomedical Sciences; and
- offers thesis research with leading scientists and clinical rotations and electives that are individually tailored to match students' academic career goals.

For students planning a career in biomedical research, the MD/PhD Program represents an integrated pathway for training as a physician-scientist. The program combines the curricula of the School of Medicine and the GSBS to provide a structured foundation of diverse topics, with the flexibility necessary to meet the needs of the individual student.

Curriculum

In the typical MD/PhD curriculum, the PhD degree is completed between the second and third years of medical school. There is flexibility in this structure and changes are at the discretion of the program director. During the first two years, students take the standard pre-clinical courses offered to first- and second-year students in the School of Medicine. In addition, MD/PhD students enroll in a research tutorial with selected GSBS faculty each semester during the pre-clinical years. This one-hour-per-week course facilitates integration between the medical and graduate school curricula and the selection of a thesis lab.

During the summer between the first and second year, students select a laboratory rotation and participate in an intensive research literature course taken from the GSBS curriculum. Students may elect to perform a laboratory research rotation in the summer before medical school begins, and additional rotations may be performed in the summer following the second year. After the second year of medical school, students select a research lab for their thesis project and enroll in relevant advanced-level graduate courses.

During graduate school, MD/PhD students participate in a clinical skills tutorial taken each semester during the PhD years. This course stresses the importance of maintaining clinical skills throughout the graduate years and requires a minimum of 10 hours per semester with clinical faculty of any discipline in a variety of activities, including ward rounds, outpatient clinic or supervised free-standing clinics in the local area.

Upon successful completion of all requirements for the PhD degree and defense of the PhD thesis, students join the third- and fourth-year medical program for clinical training. Clinical rotations and electives are tailored to match students' academic needs and career goals and to fulfill the requirements for the MD degree. Students typically complete the entire MD/PhD Program in seven to eight years.

Additional highlights include:

- yearly MD/PhD retreats;
- opportunities to submit individual fellowship applications;
- MD/PhD-specific mentoring program; and
- participation at national professional meetings and career conferences.

Eligibility

Residents and non-residents of Massachusetts are eligible for admission to the joint MD/PhD Program through the Graduate School of Biomedical Sciences and the School of Medicine. Students must complete both the MD and PhD degree at the University of Massachusetts Medical School to be eligible for the benefits (tuition and fee waiver, stipend) of the program.

Financial Support, Tuition and Fees

Tuition is waived and fees are set forth in the general schedule (page 76). MD/PhD students are eligible for graduate student stipends ($29,000 for 2010/2011) and health insurance throughout the program. Out-of-state MD/PhD students are subject to the GSBS non-resident annual Special Program Fee of $36,465 for each year of medical school completed prior to the completion of their PhD. Massachusetts residents are subject to an annual Special Program Fee of $21,465. The Special Program Fees are deferred and forgiven in full with the successful completion of the MD and PhD degrees.

Application Procedures

Candidates for the MD/PhD Program begin the application process by submitting an application to the School of Medicine through the American Medical College Application Service (AMCAS). After receipt of the AMCAS application, candidates will be sent a supplementary MD/PhD application. Only the MCAT is required for application. Additional information is available by contacting phdmd@umassmed.edu.

James Potts, PhD
2010 graduate who conducted research in the lab of Alan L. Rothman, MD, professor of medicine

James's CV grew exponentially during his time with the GSBS

Clinical Population Health Research (CPHR) program. "It's all due to the faculty, the structure of the program and the patience of my mentor, Dr. Alan Rothman. At the GSBS, I had the opportunity to be on many publications, I wrote my own grant and received funding, and I earned a couple of awards along the way."

With a master of public health degree in biostatistics from the University of Oklahoma Health Sciences Center, James had taken courses in clinical trials and the FDA drug-approval process. He also worked for the Oklahoma State Department of Health Communicable Disease Division as a student epidemiologist, assisting in disease surveillance and outbreak investigations. "I knew I wanted to pursue something in that realm that would also harness my biology/infectious disease and biostatistics background."

In the UMMS Center for Infectious Disease and Vaccine Research, James's research focused on the application of clinical laboratory tools for the classification and prediction of dengue illnesses. "I applied various analytical techniques to data collected from a pediatric prospective cohort study conducted in Thailand, which had not been analyzed before."

Upon completion of the program, James accepted a senior statistician position.

The Millennium PhD Program

In its commitment to training physician-scientists, the School of Medicine and the Graduate School of Biomedical Sciences created a unique PhD-granting program, the Millennium PhD Program (MPP). This track is designed for residents, residency graduates and fellows who seek more rigorous biomedical education, including formal coursework and preparation of a thesis.

MPP participants choose their thesis mentors from among a selected pool of top-flight scientists and educators in the GSBS. The mentor, along with the candidate's advisory committee and the Dean of the GSBS, select graduate courses tailored to the candidate's needs.

As in conventional graduate programs, trainees are awarded their degree pending successful performance of a Qualifying Exam and successful defense of their thesis. It is anticipated that completion of the MPP will require three to four years, concurrent with the research period outlined in the Research Pathways options.

MPP students who are in clinical training must dedicate 80 percent of their time to MPP training. Graduates of this program are awarded a PhD in Biomedical Sciences and will be well positioned to compete for independent research funding. Application to the MPP can be submitted before or during the residency program, or in a fellowship program.

Complete information on the program can be found at www.umassmed.edu/gsbs/futurestudents/MPP.aspx

Program in Molecular Genetics & Microbiology

Molecular Genetics & Microbiology boasts:

- research focused on the pathogenesis of infectious disease, host defense mechanisms and fundamental cellular controls;
- nationally and internationally known investigators who exploit classic, molecular and genomic approaches in a variety of model systems; and
- the interdisciplinary Bacterial Genetics and Pathogenesis Group, interested in basic biological processes in bacteria and the molecular basis of microbial pathogenesis.

The Program in Molecular Genetics & Microbiology (MGM) offers research training in fundamental cellular and molecular biology with an emphasis on the pathogenesis of infectious diseases. Students entering the program are introduced to microbial pathogenesis in the program's core course, Infection and Immune Response, which focuses on the mammalian immune system, and the bacterial and viral pathogens that have shaped it. Students then specialize in one or more of the following subject areas: bacterial or viral pathogenesis; immunology; or basic cell/molecular biology. Each of these tracks of study is supported by highly interactive Advanced Topics classes and is represented by a core group of the research faculty. Students are kept up to date with current scientific advances through journal clubs and a weekly seminar series, which attracts distinguished speakers from around the world. The student's ability to evaluate and present their own work is fostered in a weekly intradepartmental seminar series. Together, these activities are designed to prepare the student to conduct an independent research program and to teach cellular and molecular biology at the highest level.

Program Requirements

All MGM students are required to take the program's introductory Advanced Topics course, Infection and Immune Response, and a second GSBS advanced topics course. Students will select the second course according to their needs and background, in consultation with the graduate advisor and/or research advisor. Students in their second year are required to participate in a journal club or regular lab meeting at which they give an oral presentation, while students in the third year and beyond must give a yearly research presentation in the internal seminar program. For the qualifying examination, normally taken during the spring semester of the second year, students write and orally defend a research proposal on a topic related to their thesis research or other topic of interest.

Courses in Molecular Genetics & Microbiology

Infection and Immune Response

This course presents a modern view of the fundamental biology of bacterial and viral disease in the context of molecular mechanisms of host defense. A detailed knowledge of cellular and molecular components of the immune system will be integrated with current understanding of microbial virulence strategies to provide a working understanding of biological mechanisms important in health and disease. The course is organized as three integrated sections focusing on the fields of immunology, bacterial pathogenesis and virology. Students will obtain a background for advanced course work in each of these disciplines. The focus will be on three themes: basic properties of microbes and the innate and adaptive immune defenses that have evolved to respond to them; the interplay—in both a dynamic

and an evolutionary sense—between host defenses and microbial virulence; and the mechanisms of pathogenesis during infection. Comparative clinical and epidemiological pictures of selected diseases will be presented and will serve as a framework for the development of key molecular, cellular and physiological concepts. Students taking this course will be eligible to continue advanced studies in either the Program in Immunology & Virology or the Program in Molecular Genetics & Microbiology. Prerequisites: GSBS Core Course Blocks I and II

Advanced Bacterial Pathogenesis
This course introduces students to cutting-edge topics in bacterial pathogenesis in a class format designed to encourage both critical analysis and concentration on experimental design. By doing so, it will aid students in preparation for qualifying exams. On a rotating basis, groups of two or three students will lead discussions of selected topics. Presenting students are required to prepare written reviews to focus the discussion. The bulk of class time is devoted to open discussion and critical analysis of the literature under consideration, and constructive criticism of student reviews and research plans. Presenting students meet with faculty following class sessions for evaluation and constructive criticism, including specific recommendations for improvement. Grading is based on written reviews and research outlines, quality of presentations, performance as discussion leaders and class participation. Prerequisites: Infection and Immune Response

Advanced Animal Virology
This course is a comprehensive presentation of all the families of animal viruses with specific emphasis on the molecular mechanisms of virus infection and virus-cell interactions. Classes include lectures as well as reading and discussion of primary papers. The course covers topics such as virus entry, viral DNA or RNA replication; transcription; translation; virus assembly and release; persistence; latency; effects on host macromolecular metabolism; cell lysis; interference; and viral immunology for each family of viruses. The emphasis is on basic principles as well as experimental design. Prerequisites: GSBS Core Course Blocks I, II and III

DNA Repair and Genome Stability
This lecture/paper discussion course focuses on mechanisms by which cells protect their genomes from endogenous and exogenous DNA damage using examples from the molecular to the cellular and from bacteria to humans. Lectures on a specific topic are followed by a discussion of recent papers from the literature. Lecturers are drawn from several departments to ensure a multidisciplinary approach. Prerequisites: GSBS Core Course Blocks I, II and III

Advanced Topics in Molecular Biology
This paper discussion course is intended to help students refine their reading, debating and problem-solving skills. Readings consist of recent and classic research papers relating to a central problem in eukaryotic molecular genetics. Individual class sessions consist of detailed discussion of one or two papers accompanied by a student oral presentation of relevant background material. During the semester, each student will develop and orally defend a limited research proposal based on one of the discussed papers. Prerequisites: GSBS Core Course Blocks I, II and II

Molecular Genetics of Bacteria
The goal of this course is to provide students with the background needed for participation in research involving bacteria. A tutorial format is used with sessions alternating between textbook-based problem solving and the presentation/discussion of papers from the current literature. The paper presentation/discussion portion of the course may be taken separately. Topics to be covered include: chromosome structure, replication and segregation; mutations and genetic analysis; plasmids; conjugation; transformation; lytic bacteriophages; lysogenic bacteriophages; transposition and site-specific recombination; homologous recombination; DNA repair and mutagenesis; global mechanisms regulating gene expression; and strategies for molecular genetic analysis. Prerequisites: GSBS Core Course Blocks I and II

Current Topics in Prokaryotic Genetics
A weekly journal club that discusses current research articles concerning prokaryotic genetics.

Current Topics in Molecular Genetics
A weekly journal club that discusses current research articles of general interest.

Molecular Genetics & Microbiology Program Faculty

Program Director

Richard E. Baker, PhD (Associate Professor, Molecular Genetics & Microbiology) *– Mechanisms of eukaryotic chromosome segregation; functional analysis of centromere H3-like proteins*

Professor Emeritus

Donald J. Tipper, PhD (Molecular Genetics & Microbiology) *– Transmembrane insertion of mammalian proteins in yeast and bacterial pathogenicity factors in host cells*

Professors

Ronald C. Desrosiers, PhD (Molecular Genetics & Microbiology) *– Pathogenesis of primate immunodeficiency viruses; AIDS vaccines*

Robert W. Finberg, MD (Richard M. Haidack Professor of Medicine; Chair, Medicine; Molecular Genetics & Microbiology) *– Relationships between host cell surface proteins and infectious agents; basis of cellular activation mediated by cell surface protein*

Terence R. Flotte, MD (Dean, School of Medicine; Celia and Isaac Haidak Professor of Medicine; Pediatrics, Molecular Genetics & Microbiology) *– Gene therapy for cystic fibrosis, alpha-1 antitrypsine deficiency and other single gene defects*

Guangping Gao, PhD (Director, Gene Therapy Center & Vector Core, Molecular Genetics & Microbiology) *– Adeno-associated virus vector mediated gene transfer for gene therapy; gene therapy of inherited neurodegenerative Canavan disease*

Douglas T. Golenbock, MD (Medicine) *– Immune signaling in gram-negative sepsis*

Allan Jacobson, PhD (Chair, Molecular Genetics & Microbiology) *– Post-transcriptional regulation of gene expression*

John M. Leong, MD, PhD (Molecular Genetics & Microbiology) *– Interaction of bacterial pathogens with mammalian cells*

Stuart M. Levitz, MD (Medicine) *– Interplay between a host immune system and opportunistic fungal pathogen*

Dannel McCollum, PhD (Molecular Genetics & Microbiology) *– Understanding the molecular mechanisms that regulate cytokinesis*

Beth McCormick, PhD (Molecular Genetics & Microbiology) *– Molecular and cellular mechanisms by which bacterial pathogens induce mucosal inflammation*

Trudy G. Morrison, PhD (Molecular Genetics & Microbiology) *– Structure and intracellular processing of viral glycoproteins*

Peter E. Newburger, MD (Ali and John Pierce Chair in Pediatric Hematology/Oncology; Pediatrics) *– Regulation and congenital disorders of phagocyte oxidase and peroxidase gene expression*

Anthony R. Poteete, PhD (Molecular Genetics & Microbiology) *– Molecular mechanism of homologous recombination*

Janet M. Stavnezer, PhD (Molecular Genetics & Microbiology) *– Molecular mechanism and regulation of antibody class switching*

John L. Sullivan, MD (Pediatrics, Pathology, Molecular Medicine) *– Viral immunology and immunodeficiency diseases; HIV and Epstein-Barr virus*

Michael R. Volkert, PhD (Molecular Genetics & Microbiology) *– Regulation and function of DNA repair genes*

Raymond M. Welsh Jr., PhD (Pathology) *– Viral immunology and pathogenesis; defective virus; natural killer cells*

Associate Professors

Paul R. Clapham, PhD (Molecular Medicine) *– HIV receptors and cellular tropisms*

Paul R. Dobner, PhD (Molecular Genetics & Microbiology) *– Regulation of neuroendocrine gene expression*

Rachel M. Gerstein, PhD (Molecular Genetics & Microbiology) *– Developmental control of B-lymphocyte differentiation and V(D)J recombination*

Jon D. Goguen, PhD (Molecular Genetics & Microbiology) *– Function and regulation of virulence genes in the plague bacillus, Yersinia pestis*

JeanMarie Houghton, MD, PhD (Medicine) *– Host immune response to Helicobacter pylori infection, immune modulation of gastric cell signaling and growth regulation in response to Helicobacter infection*

Ronald M. Iorio, PhD (Molecular Genetics & Microbiology) *– Viral glycoprotein structure, function and antigenicity; receptor recognition and virus-induced fusion*

Duane D. Jenness, PhD (Molecular Genetics & Microbiology) *– Cell-surface receptors in Saccharomyces cerevisiae*

R. Paul Johnson, MD (Molecular Genetics & Microbiology) *– Immunologic responses in HIV pathogenesis*

Timothy F. Kowalik, PhD (Molecular Genetics & Microbiology) *– Regulation of cellular proliferation control during viral infection*

Egil Lien, PhD (Medicine) *– Role of toll-like receptors in host response to bacterial infections*

Peter M. Pryciak, PhD (Molecular Genetics & Microbiology) *– Function of yeast heterotrimeric G proteins in signal transduction and cell polarity*

Neal Silverman, PhD (Medicine) *– Immune signaling*

Robert T. Woodland, PhD (Molecular Genetics & Microbiology) *– Regulation of B cell survival; activator-dependent control of virus expression in infected lymphocytes*

Assistant Professors

Brian J. Akerley, PhD (Molecular Genetics & Microbiology) *– Biology and pathogenicity of Haemophilus influenzae*

Victor Boyartchuk, PhD (Molecular Genetics & Microbiology) *– Studies of the genetic factors controlling susceptibility to infectious diseases using animal model systems*

Christopher M. Sassetti, PhD (Molecular Genetics & Microbiology) *– Genetic and genomic approaches to understand tuberculosis pathogenesis*

Maria L. Zapp, PhD (Molecular Medicine) *– Regulation of retroviral and cellular mRNA transport*

Francesca Massi, MA, PhD
assistant professor of biochemistry & molecular pharmacology

In the study of proteins, Dr. Massi is well versed in utilizing nuclear magnetic resonance (NMR) spectroscopy, a powerful technique that is capable of monitoring protein motions with atomic resolution over a broad range of time scales. She first used this tool during her post-doctoral research on protein dynamics in the lab of Arthur G. Palmer III at Columbia University. In her research at UMMS, she combines NMR spectroscopy with computer simulation, which offers additional insight into the details of protein structure and dynamics in solution. Specifically, Massi's lab investigates the role of enzyme dynamics in catalysis; the contribution of conformational dynamics to molecular recognition among proteins and nucleic acids; and protein aggregation in amyloidosis. "Proteins are flexible molecules that often undergo conformational changes to perform biological functions. Therefore, knowledge of the internal dynamics of proteins is crucial to an understanding of how they function."

Massi, who earned her MA and PhD in chemistry at Boston University, joined GSBS in 2007 and has found the collaborative environment beneficial to her and the students' work. "The open lab space fosters sharing between groups because there aren't any strict boundaries between labs. The atmosphere here is truly collegial."

Program in Neuroscience

Neuroscience investigators focus on:

- the neural, molecular and genetic mechanisms that underlie nervous system development and function, learning and memory, addiction, glial responses to neuronal injury, and circadian rhythmicity;
- mechanisms of synaptic neurotransmitter release, analysis of how neurotransmitter receptors and membrane channels operate, and how drugs act on these processes to modify cellular function and behavior;
- magnetic resonance imaging technology to study and map changes in the brain associated with physiological stimuli as well as drugs of abuse; and
- disorders of the central nervous system, with special emphasis on neurodegenerative disorders, amyotrophic lateral sclerosis, autism spectrum disorders, mental retardation and other developmental disabilities.

The Program in Neuroscience has grown significantly since 2001. Key events in the expansion of neuroscience investigation on campus have been the formation of the Department of Neurobiology and the opening of the Irving S. and Betty Brudnick Neuropsychiatric Research Institute (BNRI) within the Department of Psychiatry. Both facilities allowed recruitment of new faculty, allowing rapid expansion. A simultaneous increase in the number of graduate students admitted to the GSBS further fueled rapid expansion in the program. Faculty recruitment has continued at the BNRI and in the Department of Neurobiology, and through the recent recruitment of Robert H. Brown Jr., DPhil, MD, as chair and professor of neurology. The Program in Neuroscience is interdepartmental, administered under the umbrella of the Department of Neurobiology. Participating faculty have primary appointments in several departments, with the largest concentration of faculty coming from the Departments of Neurobiology, Psychiatry, Cell Biology, Physiology and Neurology. The program maintains a schedule of seminars and intramural research presentations that ensures a cohesive program. This atmosphere is especially conducive to the scientific growth of graduate students obtaining their degrees in neuroscience.

Requirements for Specialization

Graduate students who specialize in neuroscience will acquire a broad background in the concepts of contemporary neuroscience, gain exposure to state-of-the-art techniques and will be provided with a foundation in the function of the nervous system through an integrated program of advanced coursework, laboratory research, and seminar and journal club attendance.

All GSBS graduate students within the BBS division must complete the Biomedical Sciences Core Curriculum, consisting of Biomedical Sciences I, II and III, Responsible Conduct of Scientific Research, Scientific Writing and at least three laboratory rotations in the first year. In the second year, students select the faculty mentor who will supervise thesis research. The Qualifying Exam is also taken in the second year of study. Thesis Research Advisory Committee meetings are required annually during thesis research. Tracking courses are used to monitor completion of the Qualifying Exam and annual Thesis Research Advisory Committee (TRAC) meetings.

In addition to the GSBS core curriculum, students in the Program in Neuroscience are required to take at least three Advanced Topics courses during their graduate career, of which one must be Introduction to Neuroscience. This introductory course is usually taken in the spring of the first year and covers topics ranging from development to ionic mechanisms underlying neuronal excitability to systems underlying cognition and behavior, and is designed to prepare students for specialized study in Advanced Topics courses. Several Advanced Topics courses are offered by program faculty each semester. Courses offered by other graduate programs can also be taken to meet the Advanced Topics course requirements. The Advance Topics courses are selected to yield a program of study tailored to meet the needs of each student.

Program in Neuroscience students are expected to attend the weekly Neuroscience Program Seminar Series lectures, featuring visiting experts from outside the university, and to participate in a seminar series in their home department. Students are also required to enroll in Journal Club in Neuroscience for at least two semesters. One presentation in Journal Club is usually used to meet the GSBS Teaching Requirement. Another way to satisfy the Teaching Requirement is to give a presentation in a departmental seminar series.

Courses in Neuroscience

Introduction to Neuroscience

This course gives an overview of the fundamental principles of molecular, cellular, developmental and integrated neuroscience, including state-of-the-art experimental approaches. Required for all students in the program.

Advanced Topics in Neuroscience

These courses offer in-depth instruction on cutting-edge research in contemporary neuroscience. Additional topics to be announced.

Stimulus-Secretion Coupling: An Exo(cyto)tic Point Of View

This course deals with one of the "hottest" topics in not only neuroscience, but also in cell biology: stimulus secretion coupling, i.e., the transduction of signals from the

environment into exocytotic responses. The course will encompass this process in a number of organisms: viruses, yeast, sponges, flies, worms, mice and even humans. Examples include sperm fertilization of eggs, asexual budding, DNA/RNA transfection, neuronal development, second-messenger-mediated aggregation in slime molds, immunological defense, hormonal release by endocrine cells and synaptic transmission in the brain. This field utilizes a broad synthesis of cutting-edge techniques including molecular biology, biophysics, imaging and electrophysiology. Students will be expected to read and present original papers in order to learn to evaluate their scientific contributions to an understanding of the molecular mechanisms underlying stimulus-secretion coupling.

Bases of Brain Disease

This advanced tutorial course will be an in-depth study of specific areas of the neurochemical, anatomical, cell biological and genetic basis of nervous system disease. It will teach students skills in reading literature critically and in the presentation of research material. Topics are divided into sections covering disorders of neuronal migration and development, neurodegenerative diseases and behavioral disorders. These topics cover the cell and molecular biological processes of brain function in health and disease.

Genetic Basis of Behavior

The genetics of behavior represent a focal point in contemporary neuroscience research. Genetic screens have been conducted to identify mutants affecting behavior in model systems, and this has converged with advances in understanding the neurobiological basis of behavior. This course will synthesize contemporary knowledge regarding genetic basis of behavior in model organisms (worms, flies and mice), including discussion of learning and memory, circadian rhythms, and social behaviors. Lectures will include descriptions of systems for identifying mutations, genes that have been identified, and how identification of these genes contributes to understanding the underlying neural mechanisms of behavior. The course format includes faculty lectures, student presentations and discussion of assigned readings.

Molecular and Cellular Basis of Neural Development

The nervous system is perhaps the most complex tissue in the human body. The formation and maintenance of this amazing structure entails sophisticated mechanisms that drive the specification of appropriate cell fates in and along the spatial and temporal axes, and the formation and fine-tuning of highly specific cell-cell contacts that are crucial for the organism to properly comprehend and manipulate its environment. In this course, students will present and discuss seminal papers that have unveiled important molecular and cellular aspects of nervous system development. Topics covered will include cell fate specification of neurons and glia, neuronal and glial differentiation, axon guidance, synaptogenesis and the fine tuning of the neural circuits through apoptosis and neurite pruning. Over the course of these studies, the students will gain an understanding of the fundamental mechanisms that are used to build nervous systems and the insights provided by model organisms.

Cell Physiology of Excitable Membranes

This course covers the fundamental principles of cell physiology with an emphasis on ion channels, synaptic transmission and contractile mechanisms. It is the first section of the first-year Medical School Human Physiology course and it lays the foundation for understanding both cell and organ function. However, unlike the way basic science courses are taught in medical schools, this course will deal with the principles and concepts underlying cell function rather than the absorption or rote memorization of detailed factual information. The material will be introduced through a series of lectures interspersed with a number of problem-set-based conference sections, the purpose of which is to exercise and acquire an understanding of the principles. NOTE: Intensive course. This course is a portion of the Medical School curriculum. It meets for 20 classes from January to February (based on the Medical School academic calendar), with classes on most days Monday through Friday, with each class lasting from one to three hours per day.

Tutorial in Neuroscience

Tutorials are arranged by students with individual faculty in the Neuroscience program and are designed to be flexible. They are usually one-on-one or small group meetings and in the format of discussions, but other configurations are possible. Meetings are usually once a week for a full semester, but more frequent or longer meetings for part of a semester are also possible. Subject matter is anything in the field of neuroscience, but should not be what the student is required to do as their rotation or thesis research, e.g., it should not be attending the lab meeting that all lab members attend, but may be a session to discuss “classic” papers even if related to the area of research. Other possibilities include discussion of a hot paper from last week’s top journals; Nobel laureates; grant writing and the NIH peer review system; how to use specific methods; and directed readings. Tutorials can have multiple faculty members. To allow flexibility, a generic tutorial is listed with David R. Weaver, PhD, as the faculty member, as Dr. Weaver approves the proposed tutorial activity. Students can enroll for multiple occurrences of Tutorial in Neuroscience.

Biophysics and Molecular Basis of Neuronal Conductance and Capacitance

This course covers the fundamental principles of neuronal physiology and biophysics: passive membrane characteristics; gating and permeation properties of membrane channels; structure and mechanisms of control; synaptic transmission; and regulation of channels and release. Note: This course is a literature-based course of the tutorial type, meeting one to 1.5 hours per week.

Tutorial in Neuroscience – fMRI

Neuroimaging, especially functional Magnetic Resonance Imaging (fMRI), is an area of growing interest among the neuroscience research community and an area of active research at the Medical School and Worcester Polytechnic Institute. Fruitful neuroimaging research is predicated on fluency with the fundamentals of imaging technology as well as fluency with the neuroscience topics related to the questions being addressed. The Center for Comparative Neuroimaging (CCNI) holds weekly Neuroimaging Seminar and Journal Club meetings to facilitate this synthesis of information by examining topics in current fMRI and related neuroimaging research. Students wishing to build a more detailed understanding of the challenges in current neuroimaging research (and strategies used to overcome them) may attend this seminar for credit. Students receiving credit will be required to present a topic of their choosing at a scheduled weekly meeting, and will have the support of the course mentors and CCNI faculty in the preparation of this talk.

Tutorial in Neuroscience – Drug Addiction

The study of addiction is very appealing to neuroscientists since, aside from its obvious societal and medical impact, it allows one to cover the breadth of the discipline from channel and membrane biophysics to psychology. In this course, an orientation lecture is presented by the instructor, after which students will present and discuss relevant literature.

Current Topics in Neuroscience: G protein-coupled receptors

G protein-coupled receptors (GPCRs) are the largest family of receptors on the cell membrane. They mediate >80% transmembrane signaling events, and are the major targets for pharmaceutical drug design. In the nervous system, GPCRs modulate neuronal excitability and synaptic transmission, and trigger signal transductions of sensory stimuli such as light and odors. In weekly meetings, this tutorial will expose the students to both classic and newly emerged works that have great impact on the understanding of GPCR signaling. The students may choose their favorite papers to read. The selected works can be about the structure of receptor; the specificity of G protein binding and downstream signaling; the G protein-independent signaling pathways; the spatial compartmentalization of signaling cascades; the desensitization, endocytosis and intracellular trafficking of the receptor; the roles of GPCR in neuronal disorders; the identification of orphan GPCRs; and other related topics.

Neuroscience Journal Club

The Journal Club is designed to give students an opportunity to present and discuss exciting new papers in neuroscience in an informal setting and is organized by the participating students together with the faculty advisor. Discussions may be supplemented by informal lectures from neuroscience faculty in their areas of expertise. The Journal Club meets approximately every week for one hour and is mandatory for second-year Program in Neuroscience students.

Program in Neuroscience Faculty

Program Director

David R. Weaver, PhD (Professor of Neurobiology)
– Molecular physiology of circadian rhythms

Professors

Neil Aronin, MD (Medicine)
– Huntington's disease

Robert H. Brown, Jr., DPhil, MD (Chair, Neurology) *– Amyotrophic lateral sclerosis*

Vivian Budnik, PhD (Neurobiology) *– Molecular mechanisms of synapse assembly and plasticity*

Roger J. Davis, PhD (H. Arthur Smith Chair in Cancer Research; Howard Hughes Medical Institute Investigator; Program in Molecular Medicine) *– Signal transduction by the epidermal growth factor receptor; mechanisms by which growth factors regulate cellular proliferation*

Susan B. Gagliardi, PhD (Cell Biology)
– Developmental genetics, experimental study of myelin, cytological and ultra-structural methods; medical education

Fen-Biao Gao, PhD (Neurology)
– Understanding neuronal microRNAs and frontotemporal dementia

Edward I. Ginns, MD, PhD (Director, Molecular Diagnostics Laboratory; Neurology) *– Molecular and clinical studies of psychiatric and neurologic disorders; gene mapping and pharmacogenetics*

Julie A. Jonassen, PhD (Physiology) *– Regulation of growth, differentiation and death of epithelial cells; neuroendocrinology; medical education*

Jean A. King, PhD (Psychiatry; Director, Center for Comparative Neuroimaging) *– Neurobiology of stress-induced neuropsychiatric disorders and aging; neuroimaging*

José R. Lémos, PhD (Physiology)
– Stimulus-secretion coupling at nerve terminals

William McIlvane, PhD (Director, Shriver Center; Psychiatry) *– Interdisciplinary studies of developmental disabilities*

Robert J. O'Connell, PhD (Physiology)
– Neuroscience of olfaction

David Paydarfar, MD (Neurology) *– Basis of oscillatory nerve activity; respiratory control*

Daniel A. Pollen, MD (Neurology)
– Neural correlates of conscious perception

Steven M. Reppert, MD (Higgins Family Professor of Neuroscience; Chair, Neurobiology)
– Molecular neuroethology

Joel D. Richter, PhD (Molecular Medicine)
– Translational control of synaptic plasticity, learning and memory

Evgeny I. Rogaev, PhD (Psychiatry; Brudnick Neuropsychiatric Research Institute)
– Molecular genetics of neuropsychiatric diseases and neurogeneration

Alonzo H. Ross, PhD (Biochemistry & Molecular Pharmacology) *– Phosphatidylinositol phosphatase, PTEN, CNS stem cells and NGF signal transduction*

Anthony J. Rothschild, MD (Irving S. and Betty Brudnick Chair in Psychiatry; Director, Center for Psychopharmacologic Research and Treatment; Psychiatry) *– Clinical studies of mood disorders, psychopharmacology, psychotic depression and sexual dysfunction; side effects of anti-depressants*

Gerald A. Schwarting, PhD (Cell Biology)
– Axon guidance in the developing olfactory system

William J. Schwartz, MD (Neurology) *– On the neurobiology of circadian timekeeping*

Joshua J. Singer, PhD (Physiology)
– Ion channel behavior and cellular physiological and biochemical processes

John V. Walsh Jr., MD (Physiology)
– Modulation of ion channel activity

Ajay K. Wakhloo, MD, PhD (Radiology)
– Stroke research

Zuoshang Xu, MD, PhD (Biochemistry & Molecular Pharmacology) *– Neuronal cytoskeleton and motor neuron disease*

Associate Professors

Schahram Akbarian, MD, PhD (Psychiatry; Director, Brudnick Neuropsychiatric Research Institute) *– Molecular biology of autism spectrum disorders*

Athena Andreadis, PhD (Cell Biology)
– Regulation of transcription and RNA splicing in the central nervous system; relation between cytoskeletal elements and dementia

Ingolf Bach, PhD (Program in Molecular Medicine) *– Neuronal cell fate specification*

Zheng-Zheng Bao, PhD (Medicine)
– Molecular mechanisms in vertebrate development

Paul R. Dobner, PhD (Molecular Genetics & Microbiology) *– Regulation of neuroendocrine gene expression*

William V. Dube, PhD (Psychiatry; Shriver Center) *– Developmental disabilities: Animal models and clinical studies*

Patrick Emery-Le, PhD (Neurobiology)
– Circadian rhythms and photoreception in Drosophila

Marc R. Freeman, PhD (Howard Hughes Medical Institute Early Career Scientist; Neurobiology)
– Unwrapping glial biology in Drosophila

Paul D. Gardner, PhD (Psychiatry, Brudnick Neuropsychiatric Research Institute)
– Molecular analyses of ion channel gene expression

Lawrence J. Hayward, MD, PhD (Neurology)
– Ion channelopathies; motor neuron disease

Daniel L. Kilpatrick, PhD (Physiology)
– Transcriptional control of neurogenesis

William R. Kobertz, PhD (Biochemistry & Molecular Pharmacology) *– Structure, function and modulation of ion channels*

John E. Landers, PhD (Neurology)
– Genetics of familial and sporadic ALS

Tzumin Lee, MD, PhD (Neurobiology)
– Neural circuitry formation and plasticity in Drosophila brain

Hong-Sheng Li, PhD (Neurobiology)
– Neuronal signal transduction and degeneration in the fly eye

Lawrence Lifshitz, PhD (Physiology)
– Computer vision and image processing

Haley E. Melikian, PhD (Psychiatry, Brudnick Neuropsychiatric Research Institute)
– Cocaine- and antidepressant-sensitive monoamine transporters

Ann R. Rittenhouse, PhD (Physiology)
– Calcium channels and neuronal plasticity

Charles G. Sagerström, PhD (Biochemistry & Molecular Pharmacology)
– Zebrafish developmental neurobiology

Scott Waddell, PhD (Neurobiology)
– Drosophila learning and memory

Jianhua Zhou, PhD (Medicine) *– Molecular pathogenesis of neurodegenerative diseases*

Ronghua ZhuGe, PhD (Physiology)
– Intracellular localized Ca2+ signaling

Research Associate Professor

James E. Crandall, PhD (Cell Biology)
– Neuronal migration in the embryonic cerebral cortex; migration, neurite elaboration and synaptogenesis; medical education

Assistant Professors

Mark J. Alkema, PhD (Neurobiology)
– C. elegans behavioral genetics

Claire Bénard, PhD (Neurobiology)
– Maintenance of nervous system architecture: making it is not good enough

Michael M. Francis, PhD (Neurobiology)
– Mechanisms of neuronal signaling in C. elegans

Kensuke Futai, PhD (Psychiatry)
– Molecular determinants of synapse formation and stabilization

Teresa V. Mitchell, PhD (Psychiatry, Shriver Center) *– Cross-modal development and plasticity*

Maria A. Morabito, PhD (Cell Biology)
– Regulation of excitatory synapses in development and disease

Andrew R. Tapper, PhD (Psychiatry, Brudnick Neuropsychiatric Research Institute)
– Neurobiology of addiction

Motojiro Yoshihara, PhD (Neurobiology)
– Synaptic physiology and activity-dependent plasticity

Nanyin Zhang, PhD (Psychiatry, Center for Comparative Neuroimaging)
– Functional Magnetic Resonance Imaging

Tera Filion
sixth-year student
Conducting research in the lab of Jie Song, PhD, assistant professor of orthopedics & physical rehabilitation and cell biology

Tera's interest in scientific research was piqued early in her academic career with an opportunity to partake in undergraduate research in a neuroimmunology laboratory—an experience that resulted in a first-author status on a publication, which fueled the desire to pursue an advanced degree. When applying to graduate programs, Tera sought out universities with strong translational research programs, which would allow her to focus on regenerative medicine. GSBS was a perfect fit.

"My research focuses on musculoskeletal tissue engineering, particularly on developing and testing 2-D and 3-D synthetic scaffolds for bone repair." Scaffolds are designed to recapitulate the structural and biochemical properties of the extracellular matrix of bone, and are capable of delivering therapeutic agents. "I test their efficacy in expediting the repair of hard-to-heal bony defects using various normal and diseased small animal models."

During her time here, Tera has published numerous papers, including one on tissue engineering for which she is first author, and she now collaborates with orthopedic surgeons and chemists. "The most notable part of being in the GSBS has been the opportunity to be a part of exciting research in such diverse areas of study. It has also been great to be able to travel around the country to share my research and learn from others in the field." Ultimately, Tera plans to use her experience with stem cells and biomaterials to pursue a career in regenerative medicine.

Master's and Pathways to Graduate Study Programs

Master of Science in Clinical Investigation

The Master of Science in Clinical Investigation (MSCI) is a two-year training program that includes one year of required graduate coursework and a second year of intensive mentored research and electives. Students are required to complete a structured series of courses, seminars and workshops in topic areas related to the design, conduct and analysis of clinical research. The core curriculum is enhanced with presentations by invited speakers, a monthly journal club, research conferences and ongoing contact with the trainees' mentors. During their second year, students must satisfactorily complete the write-up of their thesis research project. The MSCI Program offers two concentration tracks in the areas of population-based clinical research and bench-to-bedside translational research. These concentrations allow students to enhance their knowledge based on their current interests and career objectives. The program, which enrolled its first students in the fall of 2008, positions fellows for careers as independent clinical, public health and translational researchers and leaders in their fields. Candidates interested in enrolling in this program should have a strong interest in clinical investigation, with a particular emphasis on translational research, health services and outcomes research, and clinical epidemiology.

Eligible candidates for the MSCI include individuals who are trained in the medical sciences, primarily fully trained physicians, but also other doctoral-level health care workers (e.g., PharmD, PhD, DVM, DDS, DNP) who seek further training in pursuit of a career in clinical, public health or translational research.

Pathway to Graduate Study Program

For students seeking a career in biomedical research, the Pathway to Graduate Study Program (PGSP) in the GSBS at UMass Medical School (UMMS) offers an outstanding opportunity to enhance student academic preparedness and laboratory-based or clinical research experience. The results are graduates who are competitive for admission into top-tier graduate programs.

Admitted students take a core curriculum of graduate courses and a simultaneous year-long, mentored research experience. This allows students to focus on developing their research skills and acquiring the foundational academic knowledge necessary to undertake leading-edge biomedical research.

The PGSP prepares students with a bachelor's or master's degree in the physical or life sciences (if interested in Basic Biomedical Sciences study) or a master's degree in public health or related social science degree (if interested in

Clinical & Population Health Research) for doctoral study in the biomedical sciences. PGSP students interested in the Basic Biomedical Sciences undertake a year-long, mentored research project while studying foundational principles in molecular biophysics, molecular genetics and cell biology. PGSP students interested in Clinical & Population Health Research undertake a year-long, mentored research project while studying foundational principles in determinants of health and epidemiologic research methods.

At year's end, PGSP graduates* are assured admission into PhD programs of the GSBS for the following fall semester.

Requirements for Admission
U.S. citizens and permanent residents who have achieved sound, pre-doctoral academic performance in the biological and physical sciences, or who have received a master's degree in public health or in a related social science, but who seek to enhance their academic preparedness and research experience prior to embarking on a PhD, are eligible for admission to the PGSP.

Financial Support
PGSP students in good academic standing receive a stipend ($26,000 for academic year 2010-2011), health and dental insurance and tuition waiver. Curriculum fees are paid by the GSBS.

Application Procedures
Candidates for the PGSP begin the application process at the GSBS Web site. Requirements include submission of official transcripts from all undergraduate and graduate institutions attended, three letters of recommendation and Graduate Record Examination (GRE) results in verbal, quantitative and analytical areas.

Areas of Research
PGSP students may, under the direction of PGSP Director Brian Lewis, PhD, select a research mentor affiliated with any of the 11 graduate programs.

Core Curriculum
All PGSP students undertake a core curriculum. The curriculum syllabus is determined by the pathway selected by the student.

The Basic Biomedical Sciences Pathway
Students selecting the Basic Biomedical Sciences Pathway undertake a core curriculum consisting of Research Ethics, Molecular Biophysics, Molecular Genetics, Cell Biology and Scientific Writing. This is a blended, year-long curriculum comprising lectures, small group discussions and online instruction.

The curriculum emphasizes the importance of key fundamentals in contemporary biomedical sciences, including the forces that govern molecular interactions (Molecular Biophysics); the organization, expression and transfer of genetic information (Molecular Genetics); and the organization of these macromolecules and processes into self-replicating, self-regulating cellular structures (Cell Biology). The approach emphasizes the experimental basis of molecular biology and employs small group discussions to explore each topic in depth. Through discussion of the primary research literature, PGSP students will enhance their ability to critically read, analyze and evaluate research articles. Courses in Responsible Conduct of Research and Scientific Writing expose students to critical issues in research ethics and improve their ability to write clear and concise research proposals and research articles.

Students take two six-week research rotations, followed by a year-long laboratory research internship in which mentors expose students to every aspect of laboratory research. This includes background reading; hypothesis development; design of experiments that challenge the hypothesis; learning new laboratory methodologies and instrumentation; data collection; analysis and interpretation; research presentations at lab meetings; and writing the scientific paper.

To maximize success, PGSP students are assigned faculty and student mentors who meet with program participants on a regular basis, track their academic and research progress, and provide guidance regarding the transition to graduate study.

The Clinical & Population Health Research Pathway
PGSP students selecting the Clinical & Population Health Research Pathway undertake a core curriculum consisting of two, full-year courses: Determinants of Population Health and Epidemiology & Research Methods. Both courses consist of small group lectures and discussions, student papers and presentations, and hands-on exercises.

The curriculum provides an introduction to the multiple determinants of health (e.g., biology, structure and financing of health care, socioeconomic status, the physical environment, behavior and the interaction of these factors) and the principles of epidemiology, research design, sampling, hypothesis development and testing.

Students develop skills in using clinical and epidemiological databases and national health surveys. They also develop applied research skills during a year-long assignment for research mentors during which they contribute to the mentors' work, as well as develop an independent project.

To maximize success, PGSP students are assigned academic and research mentors who closely track their progress in the classroom and in their research. Mentors meet with program participants on a regular basis and are available for additional consultation as needed.

** with excellent performance*

Admission, Tuition and Financial Aid

REQUIREMENTS FOR ADMISSION

Each candidate for admission to the GSBS is expected to have a bachelor's degree in one of the physical or biological sciences. Senior undergraduates may be admitted pending successful completion of their baccalaureate programs. While no minimum grade point average is required, students applying for admission should have demonstrated strong performance in their undergraduate studies, particularly in their scientific coursework.

Basic & Biomedical Sciences Division Recommended Prerequisites

Mathematics – One year of calculus, including differential and integral calculus.

Biology – One year of basic course(s) in general biology, zoology or botany.

Chemistry – One year of general chemistry and one year of organic chemistry.

Biochemistry – One semester of biochemistry.

Physics – One year of general physics.

English – All applicants are expected to have proficiency in reading and writing in the English language. Applicants whose language of instruction has not been English must supply their TOEFL (Test of English as a Foreign Language) results.

Clinical & Translational Sciences Division

Applicants to the PhD Program in Clinical & Population Health Research are expected to have received a master's degree in Public Health, Clinical Research or in one of the social, psychological, physical or biological sciences, and completed adequate introductory coursework in biostatistics and epidemiology. Strong applicants may be admitted conditionally prior to completing such coursework. Additional admission information can be found at www.umassmed.edu/cphr.

Applicants to the Master of Science in Clinical Investigation program are expected to have a medical or nursing degree or a PhD in the social, psychological, physical or biological sciences. U.S. citizens, U.S. permanent residents and international students are eligible to apply. Additional admission information can be found at www.umassmed.edu/MSCI.

Application Process

All admissions take place through an admission process in which successful applicants are admitted to a division of the GSBS. Evaluation of applicants is done by the Graduate Admissions Committee of the division to which the applicant applies. Applicants accepted as regular graduate students will receive official notification from the Dean. No other statements, verbal or in writing, will constitute acceptance into the Graduate School of Biomedical Sciences.

Specific application materials include:

- Completed application for admission. Applicants should use the online application, which can be accessed at www.umassmed.edu/gsbs.
- Official transcripts from all undergraduate and graduate institutions attended.
- Results of the GRE in verbal, quantitative and analytical areas. (The UMMS code number is 3936. No department code is needed.) (GRE results not required for Master of Science in Clinical Investigation applicants.) Details may be obtained from the Educational Testing Service, GRE, www.gre.org.
- Three letters of recommendation from individuals who are able to assess the applicant's past academic performance and prospective success in graduate-level work. Recommenders are encouraged to use the online recommendation form contained within the online application. If they prefer, they must send a paper recommendation on official letterhead in a sealed envelope to the Graduate School's office address listed below.
- Application fee, currently $35.

Documents should be sent to:
Graduate School of Biomedical Sciences
Room S1-880
University of Massachusetts Medical School
55 Lake Avenue North
Worcester, MA 01655-0116

Please Note: Applications cannot be considered until all of these materials have been received. The deadline for receipt of completed applications to the Basic & Biomedical Sciences Division is December 15. The deadline for applications to the Program in Clinical & Population Health Research is January 15. The deadline for applications to the Master of Science in Clinical Investigation Program is February 1. Decisions will be made no later than April 15 for fall admission.

Basic & Biomedical Sciences Division Transfer Applicants

Those students who are currently or who have been previously enrolled in a doctoral program of study for one full year will be considered as potential transfer applicants to the Basic & Biomedical Sciences Division. Any credit for graduate-level courses taken elsewhere will be given upon approval by the Dean and a program director. Transfer applicants must submit the online application by April 15 for fall admission. Transfer applicants must complete the same online application as first-year students and must include in their personal statement a description of their past research experience, and an explanation of why they wish to leave their current institution and transfer to the University of Massachusetts Medical School.

Stipends

Entering full-time graduate students receive tuition and fee waivers and a competitive graduate stipend. Students who apply for and receive stipend support from external funding agencies can increase their annual stipend above the amount provided by the University of Massachusetts Medical School.

Academic Policies and Procedures

Grading System

Courses for graduate credit are graded on the following basis:

A - Excellent; outstanding performance
B - Satisfactory performance
C - Unsatisfactory, although not failing the course
F - Failure
W - Withdrawal (A grade of W may be given if the student withdraws before one-third of the course has been taken. After this time, W plus the letter grade at the time of withdrawal will be given.)
Pass/Fail - Research credits and certain seminar courses are evaluated on a pass/fail system.

Course Load

To be considered full-time students in the GSBS, students must register for at least nine credits per semester until 90 credit hours have accrued. Non-matriculated students may register for no more than six credits per semester.

Tuition and Fees

Current graduate tuition (2010), which is subject to change, per semester at the **University of Massachusetts is:**

Massachusetts residents.....$1,320
Non-residents $4,928

Graduate assistantship fees per year:

Curriculum fee.....$3,434
Support fee $45
Student Health Service.....$531*

*Health/hospitalization insurance and enrollment in the Student Health Service are mandatory for all students. For those not having personal policies, group health/hospitalization plans are available for the student, for student and spouse, and for student, spouse and dependent children. Single-student health insurance and Student Health Services fees are provided for all students, initially by the GSBS and later by the student's appropriate department/program.

Full-time graduate students who are recipients of graduate or research assistantships will be granted tuition charge waivers. Employees of the University of Massachusetts who are taking graduate courses for credit as non-matriculated students are eligible for tuition waivers.

Standards for Satisfactory Academic Progress
In order to remain a student of the GSBS in good academic standing, students may receive a C grade in no more than one course. Students who attain a C must remediate the course and achieve at least a grade of B. Any F grade will result in expulsion.

Probation
Students who receive a C grade in any GSBS course will be placed on probation. Students will remain on probation until they have successfully remediated the course.

Students who have received an incomplete on their Qualifying Exam will be placed on probation until they have successfully passed the exam.

A student who has received an overall evaluation of Marginal Pass in any research course will be placed on probation until the next evaluation. If the student's next overall evaluation is a Pass, the student will be removed from probation. If the student receives a second evaluation of Marginal Pass, the student may be dismissed from the school at the discretion of the Dean.

Academic Dismissal
Students who receive two C grades or any F grades will be dismissed from the school. Students who fail to pass the Qualifying Exam will be dismissed from the school. Students who fail to be accepted by any GSBS program or Thesis Advisor within the standard timeline will be dismissed from the school. Extensions may be granted by the Dean.

Administrative Dismissal
Any of the following conditions may warrant administrative dismissal:

- failure by a student to satisfy an overdue financial obligation to the University consisting of loans, fees, library charges or any other student charges that are established;
- failure to comply with administrative requirements such as registration or submission of health certificates;
- forgery, fraud or falsification of any official University form or document; and/or
- certified physical or mental health problems of a hazardous nature.

If dismissed, a student will cease to be enrolled and will not be allowed to complete the current semester or to register for future semesters and will receive no further material or notification concerning University affairs.

Leave of Absence
Students in good standing may request a leave of absence from the Dean for personal or other reasons for a period not exceeding one year. Students granted a leave of absence may have conditions for reinstatement set by the Dean.

Withdrawal
Students in good standing who formally withdraw from the GSBS may be reinstated into the program by petitioning the Graduate Admissions Committee and obtaining the approval of the Dean. Students who formally withdraw while on probation or who withdraw without notification to the Dean may not be reinstated without resubmission of an application for admission.

Honor Code
Students are embarking on a career in a profession that requires high standards of ethical conduct and honesty. It is expected that each student will make a personal commitment to respect the academic environment of UMMS and abide by an honor code exemplifying a standard of behavior that will form a firm basis for future professional conduct. This implies avoidance of any form of intellectual dishonesty as well as the demonstration of respect for the rights and well-being of others, including students, faculty, staff, patients and members of the community. It also implies a responsibility to take positive action to ensure that the failure of others to comply with these standards is not permitted. The intent is to provide an effective means of dealing with such cases while retaining an atmosphere of mutual trust. All allegations of academic misconduct, whether made by students, faculty or administrative personnel, are to be directed to the Dean. The Dean will convene an ad hoc Honor Code Committee to deal with the specific case. This committee will consist of three faculty members, one student representative and a representative of the Graduate Council. Students are notified in writing of the charges made against them and meet with the ad hoc committee to discuss the situation. Students have the right to know the charges brought against them, the right to review all evidence, the right to know who their accusers are and the right to present their own evidence. After all of the evidence has been reviewed, the committee will make its recommendation to the Dean as to which action is to be taken: dismissal of charges, reprimand, probation, suspension or expulsion. All information concerning allegations of academic misconduct is privileged and confidential.

Financial Aid

Students who believe their resources are insufficient can apply for school-administered financial aid. Students eligible for financial assistance include individuals either accepted for admission, or enrolled in good standing and making satisfactory academic progress. U.S. citizenship is also a prerequisite. Because financial aid is awarded annually, a yearly application is required for all recipients.

Melissa Moore, PhD
Howard Hughes Medical Institute Investigator, co-director of the RNA Therapeutics Institute and professor of biochemistry & molecular pharmacology

Dr. Moore, a self-described "project-oriented problem solver" and a collaborator at heart, is an expert in pre-messenger RNA and messenger RNA metabolism. She joined UMass Medical School from Brandeis University in September 2007. HHMI, which funds Moore's research in large part, gave her an enthusiastic thumbs-up about transferring her work to UMMS. "It was hardly necessary to explain why I wanted to come," she said. "HHMI seems to recognize that UMass Medical School is on a very fast upward trajectory toward becoming one of the world's leading medical research institutions."

The Moore lab is broadly interested in post-transcriptional gene regulation in eukaryotes via mechanisms involving RNA. Research currently focuses on four distinct but interconnected areas: structural and mechanistic analyses of spliceosomes; the effects that RNA processing events in the nucleus have on downstream mRNA metabolism in the cytoplasm; mRNA and rRNA surveillance systems; and RNA-based mechanisms that contribute to neurodegenerative disease.

Moore, who received her bachelor's degree in chemistry and biology from the College of William and Mary and her PhD in biological chemistry from MIT, completed postdoctoral research in the lab of Phillip Sharp, PhD, recipient of the 1993 Nobel Prize. She is the recipient of a Searles Scholars Award and a David and Lucile Packard fellowship, and, most recently, the William C. Rose Award from the American Society for Biochemistry and Molecular Biology.

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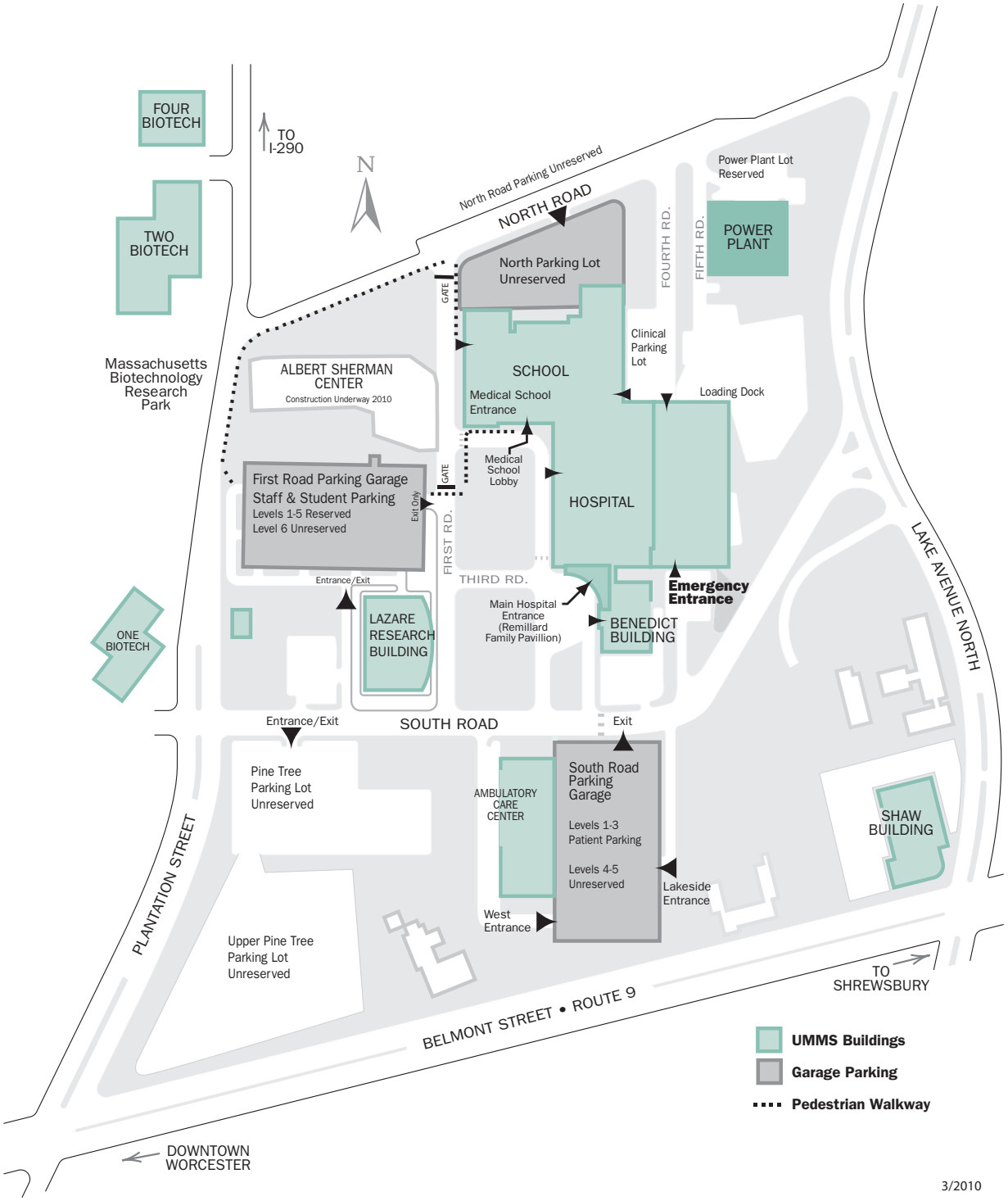
University of Massachusetts Worcester
Campus Map



University of Massachusetts Worcester
Regional Map