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Overview

Message from the Chancellor

Welcome to the University of Massachusetts Medical School (UMMS), an integral part of the five-campus UMass System and the Commonwealth’s only public medical school. Rooted in Worcester, entrenched in the region, embedded throughout the state and engaged across the globe, UMass Medical School is here for a reason!

We are here for our local and global communities, and we are especially here for our students, who add so much vitality and energy to our academic community. You have joined a special campus, marked by a collaborative orientation, defined by committed and dynamic faculty and distinguished by outstanding students like you who are imbued with a commitment to service, discovery and life-long learning.

As a student of the Graduate School of Biomedical Sciences (GSBS), you are a member of a valued and vibrant component of UMMS. GSBS lies at the heart of our world-class research enterprise, which consistently produces noteworthy and impactful advances in basic, translational and clinical research. Today, our dynamic research programs attract approximately $250 million in annual research awards, more than half of which come from federal funding sources such as the National Institutes of Health.

The GSBS offers a truly unique academic experience for its students. Throughout your educational journey here, you will be encouraged, enabled and empowered to pursue an advanced biomedical science degree and realize your professional aspirations. The school’s innovative and inter-disciplinary training and research programs are anchored and driven by internationally renowned faculty members, among them a Nobel Prize Winner in Medicine, a recipient of the Breakthrough Prize in the Life Sciences, a Lasker Award winner, seven investigators of the Howard Hughes Medical Institute, and five members of the National Academies.

The faculty and leadership of GSBS are invested in this campus, our public mission and, most importantly, your success as a graduate student. You will learn, train and conduct research in a supportive and nurturing environment where the collaborative gene is fully expressed. As the faculty-initiated graduate programs continue to grow and evolve to respond to new frontiers of science, GSBS remains steadfastly committed to its core responsibility of training the next generation of biomedical scientists, physician investigators, research educators and industry leaders who will be prepared to conduct research that elevates the human condition.

As UMMS reaches new heights in furtherance of our education and research missions in the years ahead, we will continue to be guided by principles that place the highest priority on respecting the dignity and diversity of every member of the campus community. We are committed to supporting your professional, intellectual and emotional growth so that you may fulfill your potential and achieve your personal and professional goals.

I invite you to read this catalogue and take advantage of the unique and outstanding opportunities described herein. Also, I wish you all the best for a most successful, fulfilling and rewarding educational experience at UMMS.

Michael F. Collins, MD
Chancellor
University of Massachusetts Medical School
Senior Vice President for the Health Sciences, University of Massachusetts
Message from the Dean

Welcome to the Graduate School of Biomedical Sciences at the University of Massachusetts Medical School. Our school’s mission is to provide students with outstanding research and academic training experiences that produce ground-breaking discoveries in biomedical sciences, culminate in the award of a doctoral degree and provide the foundation for a rewarding, professional career. Graduate study is an exciting and challenging calling in which you are never certain of the direction that your research will take but where the thrill of the scientific chase leads you to discoveries that transform our understanding of the human condition in health and in disease. Graduate study is also a journey of personal-discovery in which you will hone your professional skills as an analyst, problem solver and communicator.

We succeed in our mission to train the very best graduates by: 1) Identifying and recruiting outstanding graduate students and biomedical research faculty into state-of-the-art research facilities; 2) implementing challenging core and elective curricula, which probe the full breadth and depth of the biomedical sciences and which develop and refine the skills you will need to become an accomplished biomedical researcher; 3) immersing our students in the exploration, practice and discussion of biomedical sciences; and 4) tracking, mentoring and challenging our students at each stage of their career to extend their skills, accomplishments and self-expectations. Our educational philosophy requires that our students undertake a broad curriculum of study in order that they may be prepared for the future challenges of research. Identifying and solving important biological questions is paramount.

Students may select admission into an umbrella admissions program comprising 8 programs of specialization connected through a common molecular biological core curriculum. Students have ample opportunity to undertake research rotations in as many as six different laboratories before selecting their thesis research mentor and area of specialization at the end of year one.

Alternatively, students may seek admission to the Clinical & Population Health Research program in which students undertake a curriculum emphasizing the principles of epidemiology and the translation of basic knowledge into treatments at the bedside and across populations of patients. Students in this program typically select their thesis mentor upon matriculation. MD/PhD students may select thesis research in any GSBS program.

Once admitted to thesis research, students are mentored through completion by a committee of experts in the field. The product is a graduate who has profoundly affected their field of specialization and who is ready for the next step in a career of independent research. Our typical student completes their graduate studies in six years, publishes three to four research articles in high profile scientific journals, attends several national conferences to present their work and subsequently advances to postdoctoral research at elite institutions of higher learning or in renowned biotechnology organizations.

If you are excited by laboratory or public health research, are motivated to undertake a challenging curriculum to broaden and deepen your understanding of contemporary biomedical sciences and are determined to make your mark through ground-breaking discovery in biomedical research, we invite you to investigate opportunities for graduate study at our school.

Dean Anthony Carruthers, PhD
Professor of Biochemistry & Molecular Pharmacology

About UMass Medical School

The University of Massachusetts Medical School (UMMS) was founded in 1962 by proclamation of the governor and an act of the legislature to meet the health care needs of the residents of the Commonwealth of Massachusetts. Its mission is to serve
the people of the commonwealth through national distinction in health sciences education, research, public service and clinical care with its 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.

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 has Graduate Medical Education and Continuing Medical Education programs.

Beyond its core mission of distinction in health sciences education and public service, UMMS is a major center for biomedical research. Federal and private research grants and contracts reached $245 million in fiscal year 2014, 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 Nature in 1998, their research demonstrated that a particular form of ribonucleic acid, or RNA—the cellular material responsible for the transmission of genetic information—can silence targeted genes.

Educational Objective

The Graduate School of Biomedical Sciences offers ten programs of doctoral study and one Masters program in Clinical Investigation. The doctoral programs train students in their selected specialty area and emphasize the importance of a broad background in the basic biomedical sciences, in preparation for research with direct relevance to human disease. Graduates are equipped to collaborate with scientists and physicians involved in basic, translational and clinical research and are prepared to initiate careers as educators in schools of the health professions or in the biotechnology industry.

The basic and translational research programs emphasize the molecular basis of cellular, tissue and organismal biology in health and disease. The clinical research programs 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 400 very select students and 300 faculty members, the graduate school promotes interactions between faculty and students and emphasizes a personalized educational process.

Since accepting its first class in 1970, the primary responsibility of the School of Medicine has been to provide students with an accessible, comprehensive and
personally rewarding medical education of the highest quality and one which optimally prepares them to excel as tomorrow’s physicians; caring, competent, productive and self-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 emphasis on practice in the primary care specialties, in the public sector and in underserved areas of Massachusetts. In April 2015, UMass Medical School was ranked in the top 10 percent in primary care education among the nation’s 129 fully accredited medical schools by U.S. News & World Report in its 2009 issue of “America’s Best Graduate Schools.”

The Graduate School of Nursing offers master’s, post-master’s and doctoral degrees, providing education for registered professional and advanced practice nurses within nurse practitioner and nurse educator specialties. Subspecialty professional education and training is also offered in selected areas, while the doctoral program prepares nurse scientists for faculty, research and other nursing leadership positions.

Public Service Mission

Commonwealth Medicine

UMMS is distinguished by its unwavering support of public service. The Commonwealth Medicine division works in unison with state and local agencies, and non-profit and managed care organizations 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 UMMS’ depth and breadth of academic, research, management and clinical resources, Commonwealth Medicine assists health care providers in the public sector to optimize efficiency and effectiveness.

Commonwealth Medicine facilitates educational opportunities for UMMS students; the division partnered 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.

Research Mission

Currently supporting more than 300 investigators, the growth of the UMMS research enterprise has resulted in advancements 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; four members of the National Academy of Sciences; a member of the Royal Society; seven 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 research expertise lies 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, cardiovascular biology, imaging, and occupational and environmental health.
UMMS is at the forefront of the commonwealth's life sciences initiative. The institution received funding in 2007 and 2008 to establish an Advanced Therapeutics Cluster on campus that 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. 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 Massachusetts Human Embryonic Stem Cell Bank and the International Stem Cell Registry, two separate but complementary infrastructure programs that are fundamental to the advancement of today's cutting-edge biomedical research.

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**Statement of Non-Discrimination**

See: http://www.umassmed.edu/dio/equal-opportunity/ppg-discrimination/statement-of-nondiscrimination/

The University of Massachusetts Medical School (UMMS) does not discriminate on the basis of race, color, creed, religion, gender (including pregnancy, childbirth, or related medical conditions), age, sexual orientation, gender identity and expression, genetic information, national origin, covered veteran status, disability, ancestry or any other characteristic protected by law in employment, admissions, participation in its programs, services and activities, and selection of vendors who provide services or products to UMMS. Further, UMMS is firmly committed to ensuring that all who work, study, visit or
seek treatment here may do so in an environment free of harassment and/or discrimination.

All questions related to this notice may be directed to the Associate Vice Chancellor for Diversity and Inclusion. For further information about these regulations and our grievance procedures for the resolution of harassment and/or discrimination complaints, contact the Associate Vice Chancellor at:

Diversity and Inclusion Office
University of Massachusetts Medical School
55 Lake Avenue North (S1-710)
Worcester, MA 01655
Office Phone: 508 856-2179
Fax: 508 856-1810
Campus Life

Advising and support

Academic Advisors
First year GSBS students are assigned a general faculty advisor who assists the student in their integration into the UMMS and GSBS community.
First year students are advised on selection of research mentors and curriculum choices by the GSBS Associate Dean for Curriculum and Academic Affairs. Research mentors also advise students on curricular choices. All teaching faculty hold regular office hours for academic advisement of students. GSBS Teaching Assistants are also available to mentor students through their curriculum.
Second year students are advised by their Thesis Advisor(s), by their GSBS Program Director and by the GSBS Associate Dean for Curriculum and Academic Affairs. Second year students are mentored through the qualifying examination process by their Qualifying Examination Committee.
Third year students and beyond are mentored through their thesis research by their Thesis Research Advisory Committee and by their Thesis Research Advisor.

Career Advisors
The Center for Biomedical Career Development
http://www.umassmed.edu/gsbs/career/
takes an interdisciplinary, scholarly approach to develop, implement, and evaluate new career and professional development resources that support the training experience of Ph.D. students and postdoctoral scholars in the Graduate School of Biomedical Sciences.

The Center for academic Achievement
This program
http://www.umassmed.edu/oea/center-for-academic-achievement/
is open to all students at UMMS. Services include academic counseling, tutoring and a series of learning seminars which focus on test-taking, reading, memorization, communication and synthesizing information. The Assistant Dean and staff of the Center for Academic Achievement work with individual students to identify learning needs which can be met through tutorials designed with learning specialists, educational psychologists and graduate students. The academic achievement program at UMMS is oriented toward prevention of academic problems through systematic needs assessment, mobilization of resources and continuity of the support experience.

Campus
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’ clinical partner, UMass Memorial Medical Center. The Advanced Center for Clinical Education and Science (ACCES) building houses the
orthopedics, radiology and Cancer Center patient services, as well as the Heart and Vascular Center of Excellence and the Diabetes and Endocrinology Center of Excellence. The Albert Sherman Center is a new research facility on campus which houses the School of Medicine and Graduate School of Nursing learning Communities, the Advanced Therapeutics Cluster and other research programs and the Health and Fitness Center.

UMMS’ extended campus includes the Brudnick Neuropsychiatric Research Institute, and 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 Massachusetts Biologic Laboratories in Jamaica Plain and Mattapan.

A campus map is available at
http://www.umassmed.edu/about/directions/campusmap/

Campus parking
The campus offers ample parking for employees, students and visitors. Students are offered discounted parking rates.

Campus Safety
The University of Massachusetts Police Department in Worcester is committed to providing a safe and secure environment in which students, faculty, staff, patients and visitors can conduct their activities. The Department uses a community oriented philosophy, and Officers patrol the University & adjacent roads 24 hours a day, seven days per week in cruisers, on foot and on bikes.

All Police Officers are sworn under Massachusetts General Law Chapter 75. Section 32A, have the same law enforcement authority as Municipal Police, and are trained at Municipal Police Academies.

For more details see
http://www.umassmed.edu/publicsafety/

Clery Act
The Annual Report on Campus Security can be viewed at

Child care & parenting resources
The Employee Assistance Program can advise students on personalized child care referral for their families. See http://www.umassmed.edu/eap-20150120/resources/child-care/

Dining
The cafeteria and dining room are located on the first floor of the Albert Sherman Center. In addition, a cafeteria is located on UMass Memorial Medical Center–University Campus, which is contiguous with the School building. For more details see
Housing

Students of the Graduate School of Biomedical Sciences reside in the local community or commute, as housing facilities are not available on campus. The GSBS Office can provide additional housing details to students upon request. 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.

Information Technology

The Office of Information Technology assists GSBS students and faculty through its Academic Computing Services and Research Computing Services departments see http://www.umassmed.edu/it/

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 1,300 print journals and over 4,100 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 over 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 over 200 electronic books and subscribes to many electronic databases. MEDLINE, CINAHL, PsycINFO, and many evidence-based medicine databases are available through Ovid. In addition, the library subscribes to MDConsult, UpToDate, Web of Science, Micromedex 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.

For more details see http://library.umassmed.edu/index

Medical Services

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 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 provided by the student’s guardians (up to and including age 26), by the GSBS (year 1 of graduate study) or by the student’s thesis research advisor (years 2 of doctoral study and beyond).

For further details please see

http://www.umassmed.edu/studenthealth/

Student Services

The Graduate School of Biomedical Sciences office and the Offices Diversity and Equal Opportunity are on the first floor of the main school building. The Department of Student Services is on the third floor of the main school building. See

http://www.umassmed.edu/schoolservices/

Diversity and Inclusion

The Diversity and Inclusion Office helps minority students enjoy rewarding academic, professional and social experiences in what may be an unfamiliar environment. 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 Inclusion Office offer opportunities to socialize and network. The office also assists in supporting gay, lesbian, bisexual and transgendered students. See

http://www.umassmed.edu/dio/

Americans with Disabilities Act

According to the Americans with Disabilities Act (ADA) 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 complies with the Americans with Disabilities Act (ADA) of 1990 and Equal Employment Opportunity Commission 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 Inclusion Office, coordinates all student disability issues.

The Associate Vice Chancellor for School Services serves as the ADA Student
Coordinator. Once admitted, the student is responsible for notifying the Student ADA 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. However, accommodations cannot be applied retrospectively thus any student requiring academic accommodations is best served by seeking such accommodations prospectively. 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.

For further details please see

http://www.umassmed.edu/schoolservices/Matriculation-Services/ADA-Accommodations/

**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 Medical Education or the Diversity and Inclusion Office. The policy and procedure is also available in the Office of Student Affairs. The Diversity and Inclusion Office 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. See

http://www.umassmed.edu/dio/equal-opportunity/ppg-ats/

**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. See http://www.umassmed.edu/psychiatry/clinicalservices/studentcounseling/

Financial Aid

The Financial Aid Office at the University of Massachusetts Medical School is part of the division of School Services and administers Federal and Institutional student loans and gift aid for the Medical School, the Graduate School of Biomedical Sciences and the Graduate School of Nursing. Additionally, the Financial Aid Office collects campus-based loans and the Medical School Learning Contract.

Students who believe their resources are insufficient can apply for school-administered financial aid. To be eligible for financial assistance, students must be accepted for admission or enrolled in good standing and making satisfactory academic progress (GPA ≥ 3.0). U.S. citizenship is also a prerequisite. Because financial aid is awarded annually, a yearly application is required for all recipients. See http://www.umassmed.edu/financialaid/

Registrar

The Registrar's Office at the University of Massachusetts Medical School is part of the division of School Services and maintains all official academic records for enrolled and graduated students of the School of Medicine, The Graduate School of Biomedical Sciences and the Graduate School of Nursing. The office is responsible for all enrollment statistics, registrations, verification of attendance, management of all student records and issuance of official transcripts.

Other services include:

- Certification of student status for loan deferments
- Certification of student status for veterans education benefits
- Certification of graduation requirements

For more details see http://www.umassmed.edu/registrar/

Student Government

The GSBS student body annually elects the Graduate Student Body Committee. The purpose of the Graduate Student Body Committee is to represent the graduate student body of the University of Massachusetts Graduate School of Biomedical Sciences to the GSBS leadership, the University of Massachusetts Medical School faculty and administration, to the community, and to act as one of the student governments of the University of Massachusetts, Worcester campus.
Graduate Education

Admissions

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.

Recommended prerequisites for admission into the Umbrella programs and the PGSP program

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.

Recommended prerequisites for admission into the CPHR program and the CPHR track of the PGSP

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 to have 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 http://www.umassmed.edu/cphr.

Recommended prerequisites for admission into the MSCI

Applicants to the Master of Science in Clinical Investigation program are expected to have a medical or nursing degree, to be enrolled in the School of Medicine or to hold 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 http://www.umassmed.edu/MSCI.

Application Process

All admissions take place through an admission process in which successful applicants are admitted to the GSBS. Evaluation of applicants is undertaken by the appropriate Graduate Admissions Committee (Umbrella Admissions, CPHR, MSCI, MD/PhD or
PGSP admissions). Applicants accepted as 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 are 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 required to use the online recommendation form contained within the online application.
- The application fee is currently $80.

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 March 1. The deadline for applications to the Master of Science in Clinical Investigation and the Millennium PhD Programs is June 15. Decisions will be made no later than April 15 for fall admission.

Transfer Students

The GSBS does not accept transfer students who have been admitted into doctoral candidacy at other institutions. If such a student accompanies a newly recruited faculty member to UMMS, they must retain their matriculation status with their originating institution.

Pre-candidacy first and second year doctoral students matriculated elsewhere may petition the GSBS for admission by submitting an application to the GSBS in the usual way (see above). Admission is not guaranteed and students matriculating by this route may be required to take all mandatory GSBS courses in order to be eligible to take their qualifying examination.

Costs

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 according to guidelines established by the GSBS.
Tuition and Fees

Current graduate tuition (2015), 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 $195
- Student Health Service $697

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.

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1 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.
Academic Standards

Learning Objectives

The National Institute of General Medical Sciences has proposed that four areas of expertise are central to successful doctoral training programs. The GSBS has adopted, extended and integrated these learning objectives into our curriculum and research training programs. These are specifically assessed during the Qualifying Exam, at each annual TRAC meeting, and at the Dissertation Defense.

Scientific Knowledge and Critical Thinking: The GSBS graduate is conversant in a common set of biological/biomedical principles.

- Demonstrates substantial and up to date core knowledge of broad areas in basic biomedical, translational, or clinical research applicable to their area of study.
- Demonstrates the ability to accurately and critically evaluate their own scientific work and the work of others.

Research Skills and Problem Solving Ability: The GSBS graduate can identify important problems and knows how to address them.

- Demonstrates advanced understanding of a range of technical and conceptual approaches used in biomedical research
- Can design, carry out, and interpret research projects that generate new knowledge that advances the biomedical sciences and human health.

Specific Expertise: The GSBS graduate is competitive in their chosen field, interest area, specialty or discipline.

- Can articulate the significance of their own work to their chosen research area in both historical and forward-looking contexts.
- Demonstrates mastery of a range of technical and conceptual approaches used in their selected research area.

Communication: The GSBS graduate has the ability to successfully engage in written and oral discourse with peer and lay audiences.

- Demonstrates the oral, written and media communication skills required to be effective communicants, teachers and mentors of peers, future scientists and scientifically literate citizens

Ethics and Advocacy: The GSBS graduate applies the highest standards of ethics to

- Their research (data management, research subjects, stewardship of research funds)
- Their interactions with colleagues and the public
- And advocates for the role of science in medicine and society

Career Development: The GSBS graduate has the ability to choose from a range of career options

- Can articulate an appropriate set of desired potential career paths, and is aware
of the preparation and initiative required to pursue these paths

Mission

The Graduate School of Biomedical Sciences 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, teachers and advocates who will continue with this calling.

Technical standards

The following technical standards specify those attributes the faculty considers necessary for pre-doctoral or doctoral study at UMMS GSBS and therefore, are prerequisites for admission, progression and completion.

A student must possess aptitude, abilities, and skills in five areas:

- Observation
- Communication
- Sensory and Motor Function
- Intellectual, Conceptual, Integrative and Quantitative Abilities
- Behavioral and Social

More detailed descriptions of these standards are available in the GSBS handbook at: http://www.umassmed.edu/uploadedFiles/gsbs2/Students-Faculty/Student%20Handbook.pdf

Accommodations and use of an Intermediary

While accommodations can be made for some disabilities, applicants and students must be able to perform the duties of a student and researcher in an independent manner.

For more information see UMMS policies on Equal Opportunity and Americans with Disabilities:

http://www.umassmed.edu/content.aspx?id=70948&linkidentifier=id&itemid=70948
http://www.umassmed.edu/schoolservices/ada.aspx
http://www.umassmed.edu/uploadedFiles/gsbs2/Students-Faculty/Student%20Handbook.pdf

The use of an intermediary would result in the mediation of a student's judgment by another person's powers of selection and observation. Therefore, the use of an intermediary to assist the student in meeting the technical standards for admission,
continuation or completion would mean that a student’s judgment is mediated by another individual and this is not permitted.

**Academic Performance**

**Standards for Satisfactory Academic Progress**

In order to remain a student in good academic standing in the GSBS, students must maintain a GPA ≥ 3.0. Any student who receives a C grade or “Marginal Pass” in any course is no longer considered to be making satisfactory academic progress. Students who attain a C must remediate the course and achieve at least a grade of B. Students who receive a Marginal Pass or lower in their research must remediate by attaining a passing grade at their next and all subsequent research evaluations.

**Probation**

Students who receive a C, Marginal Pass or Failing grade in any GSBS course will be placed on probation. Students will remain on probation until they have successfully remediated the course.

Students who do not pass their Qualifying Exam outright but who are not judged to have failed their Qualifying Examination will be placed on probation until they have successfully passed the exam. The student is not admitted to doctoral candidacy until the examination is passed.

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 are not in good academic standing and who are not recommended for advancement to GSBS year 2 by the Academic Advancement Committee 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.

Students in doctoral research receiving a failing grade from their Thesis Research Advisory Committee at their annual meeting will be dismissed from the school.

**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. Return from leave of
absence can only occur at the beginning of a GSBS semester.

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 and success. 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 tolerated. The intent is to provide an effective means
of dealing with such cases while retaining an atmosphere of mutual trust.

The GSBS Honor Code is available in the GSBS Handbook. See

All allegations of academic misconduct, whether made by students, faculty or
administrative personnel, are to be directed to the GSBS Associate Dean for Curriculum
and Academic Affairs or to a designee of the GSBS Dean. The Associate Dean will
convene an Honor Code Committee to deal with the specific case.

The Honor Board shall consist of six members and three alternates. Five of the six
members and all three alternates are students appointed by the Graduate Student Body
Committee (GSBC). The sixth member is the Associate Dean or his/her designee who
shall act as the faculty advisor and serve ex officio.

It is the duty of the Honor Board to hear cases presented to it and render their findings
to the GSBS Dean, based on a clear and convincing standard of proof as to the validity
of the charge. The accused has the right to hear all evidence against him/her and to
present evidence to refute the charges. The Dean shall examine the evidence and the Honor Board’s findings and render a decision. The Honor Board may, at their discretion, make a recommendation for an outcome to the Dean, but the final decision will be made by the Dean.
Academic Procedures and Institutional Regulations

Institutional policies for UMMS GSBS students cover the following areas:

- Access, Solicitations, Demonstrations
- Access to UMass Medical School Facilities
- Alcohol Policy
- Alcohol and Drug Abuse (Summary of Legal Sanctions)
- Drug-Free Schools and Community Act Amendments of 1989
- Americans with Disabilities Act
- Academic Accommodations Committee
- Appropriate Treatment of Students
- Clery Act
- Consensual Amorous Relationships (Guidelines For)
- Credit Hour Definitions and Audit Process
- Faculty and Student Notifications
- Graduate School of Biomedical Sciences (GSBS) Course Credit Hour Assignments
- Credit Hour Audit Process
- Criminal Background Checks (CBC)/ Criminal Offender Records Information Checks (CORI) Checks
- Dress Code
- Electronic Mail Use Guidelines
- Hazing
  - Section 17
  - Section 18
  - Section 19
- Identification of Students
- International Travel under the auspices of the University of Massachusetts Medical School
  - International Travel Registration
  - International Travel Forms and Information
  - International Travel Insurance
- Jury Duty
- Logos, Usage of UMass Medical School Logos
- Patient Rights under HIPAA
- Confidentiality of Patient Information - Related Materials Used in Teaching
  - Breaches of Protected Patient Information
- Issues of Confidentiality
- Snow and Other Weather Emergencies Notification
- Financial Conflict of Interest Policy
- Faculty and Student Vendor Relations Conflict of Interest Policy

and are available at http://www.umassmed.edu/globalassets/graduate-school-of-biomedical-sciences/documents/institutional-policies-for-umms-gsbs-students-2015-2016.pdf
Academic Calendar

The GSBS Academic calendars are available at:
http://www.umassmed.edu/gsbs/studentsfaculty/calendars/academic_calendar/

Policies & Procedures

GSBS Operational policies are outlined in the GSBS Handbook for Students and Faculty. See

GSBS Governance is outlined in the Graduate School of Biomedical Sciences Bylaws available at
http://www.umassmed.edu/ofa/academic/governance-policies/

Privacy of Student Records

The Family Educational Rights and Privacy Act (FERPA) is a Federal law administered by the Family Policy Compliance Office in the U.S. Department of Education. 20 U.S.C. § 1232g; 34 CFR Part 99. FERPA applies to all educational agencies and institutions (e.g. schools) that receive funding under any program administered by the Department of Education.

In compliance with FERPA, the University of Massachusetts Medical School (UMMS) does not disclose personally identifiable information contained in student education records, except as authorized by law. Information about students’ rights under FERPA and UMMS implementation of FERPA is set forth in:
http://www.umassmed.edu/Registrar/FERPA/FERPA/

Graduation

Degrees are awarded by the University of Massachusetts Medical School in August, December, March and at the annual Commencement Exercises (Sunday following Memorial Day) upon recommendation of the Faculty.

Favorable faculty action is based upon approval by the Dissertation Examination Committee and the GSBS Dean.

A degree will not be awarded unless all financial obligations to the Institute are clear and there are no pending disciplinary actions. More information is available at
http://www.umassmed.edu/commencement/gettingready/gsbs/

Registration & Course Load

Registration

All GSBS students matriculated in a GSBS degree program are required to register
each GSBS semester (Fall, Spring, Summer) until they graduate. To remain eligible for a Tuition Waiver, students are required to register each semester for one of the following GSBS Research Courses: Laboratory Rotation, Pre-Qualifying Research, Thesis Research, or Graduate Research. All students are expected to contribute to the University’s academic, teaching and/or research functions as part of these courses. Students are not required to register while withdrawn or on a leave of absence. Failure to register may result in assessment of late fees, termination of stipend or dismissal from school.

For details regarding the registration process please see:

http://www.umassmed.edu/gsbs/studentsfaculty/registration/

Course Load

All GSBS students matriculated in a GSBS degree program are considered full-time students. As a general rule, prior to completion of nine semesters of enrollment a student will register for at least nine credits in the fall semester and in the spring semesters and at least four credits in the summer semester. After nine semesters of enrollment, a student registers for Graduate Research – GR990, unless the student has not yet accumulated 90 credits.

Prior to completion of nine semesters of enrollment the student must receive permission from the Dean to enroll in less than 9 credits in the fall and spring semesters and 4 credits in the summer semester.

Due to U.S. Department of State regulations, students in the United States on visas must always meet the minimal credit requirements.

To qualify for Financial Aid or a Stafford loan "in school" deferment, a student must be making satisfactory academic progress. Prior to nine semesters of enrollment a student must be registered for at least five credits per semester in the fall and spring semesters and at least two credits in the summer semester. After nine semesters of enrollment a student must be registered for Graduate Research – GR990.
Programs of Study

PhD programs

Mission

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;
- train the next generation of scientific leaders who will continue with this calling.

The research undertaken by our students and faculty ranges 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.

A great 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.

Students wishing to undertake interdisciplinary, basic biomedical or translational research typically apply for admission to the GSBS through our umbrella admissions process. See https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantLogin.asp?id=umass-med

Students who are interested in the MD/PhD program should submit 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.

Applicants interested in the Clinical & Population Health Research (CPHR) program typically hold a Masters in Public Health and should apply specifically for admission to the CPHR. See https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantLogin.asp?id=umass-med

Applicants interested in the Master of Science in Clinical Investigation (MSCI) program typically hold an MD or PhD degree and should apply specifically for admission to the MSCI. See
Umbrella Admissions Programs

Description

The objective of the Umbrella Admissions programs is to educate students in the theory and practice of molecular, cellular and organismal biology, with the goal of enabling them to apply this knowledge to the exploration of fundamental and translational biological research. The Umbrella Admissions program 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 and their application to problem solving.

Research toward the PhD dissertation may be done under the direction of a GSBS faculty member actively engaged in research in a basic or clinical science department. Students select a thesis advisor and research problem prior to completion of Year 1. At that time, the student and their thesis research advisor will discuss thesis research projects, plan an advanced curriculum of study and select one of the GSBS Umbrella Admissions Programs that will be most beneficial to the student’s development and research goals. Program selection will require approval by the appropriate GSBS Program director and by the GSBS Dean. The program director recommends and the Dean approves the appointment of the thesis advisor.

Course Requirements

Core Curriculum

This program of study 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. A scientific proposal writing course is also part of the core curriculum. Students should complete these core requirements in their first year, but no later than two years after admission.

Students are also required to take a Professionalism and Research Conduct (PARC) course which reviews ethical considerations in research, scientific writing, professional skills development and the preparation of Individual Development Plans for research, professional skills development and career planning. PARC is normally completed in Year 3. Career pathway workshops are scheduled annually.

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.

Advanced/Specialized Curriculum

All Umbrella Admissions students must undertake at least 1 Keystone Advanced Course (3 credit hours) and 1 Advanced Topic Course (2 credit hours or more). One of these courses is typically taken in spring of Year 1 and the others in spring and fall of Year 2. Some programs require as many as 3 elective courses and most programs specify a menu of courses from which a student must create their advanced curriculum.

The Qualifying Examination

Students in good academic standing in Year 2 will undertake the Qualifying Examination (QE) in which they develop a written research proposal (typically, but not always on their proposed thesis research) and then defend their research proposal before a Qualifying Examination Committee comprising GSBS faculty selected by the student’s Program Director and by the GSBS Dean. The QE evaluates the students development in 4 areas:

- Background knowledge
- Formulation of hypotheses, discovery goals and aims
- Experimental approach
- Document preparation and oral communication

Upon passing the QE, the student is admitted into doctoral candidacy and focuses on their doctoral research.

Prequalifying Research, Thesis Research and Graduate Research

Year 2 students register for and undertake prequalifying research in all semesters preceding and including the semester in which the QE is taken and passed. Thereafter, the student registers for Thesis Research. Year 4 students and beyond register for Graduate Research.

Periodic Thesis Research Advisory Committee Meetings

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 three other faculty members. If particularly knowledgeable in the research topic, an additional affiliate member may be appointed from the Colleges of Worcester Consortium or the University of Massachusetts at Amherst, Boston, Dartmouth or Lowell.

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 Umbrella Admissions program Requirements

The following requirements, including the interdisciplinary courses described below, apply to all Umbrella Admissions Program students. Specific requirements for specialization are detailed in Graduate Programs, Courses and Faculty Research Interests, beginning on page 33. Graduate Program Directors are responsible for overseeing these aspects of their programs.

First Year Students

All first-year students must take the Core Curriculum:

- Biomedical Sciences Block I
- Biomedical Sciences Block II
- Biomedical Sciences Block III
- Laboratory rotations (five or six rotations)
- One 2- or 3-credit advanced elective course
- Scientific Writing

Year 1 Credits: 30

Specialization - Year 2

Advanced and elective courses and rotations to be selected within guidelines set by the program of specialization.

Prequalifying Research

Thesis research

Qualifying Examination - Year 2

- Presentation and defense of an original research proposal

Year 2 Credits: 30

Total credits: 60

Year 3

Professionalism and Research Conduct (1 credit)
Year 3 and beyond

Thesis Research Advisory Committee meetings

All Year 3 students and beyond must hold annual fall Thesis Research Advisory Committee meetings in which they present and discuss their individual development plans for their research advancement, professional skills development and career planning.

Year 3 Credits: 31
Total credits: 91

Final Examination

Presentation and defense of the research dissertation

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 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.

Qualifying Exam

Following completion of the Graduate Core Class and at least two semesters of laboratory rotations students are eligible to take their qualifying exam. In addition, it is required that students complete (or are in the process of completing) two of the required Advanced Topics courses before taking the 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
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; design, chemical synthesis, and modification of natural and synthetic biopolymers; combinatorial chemistry; chemical genetics; rational drug design; ligand-receptor interactions; nanomaterials; 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 (NMR), but also including discussions of small angle X-ray scattering (SAXS) and cryo electron microscopy (cryo-EM). 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. All students that qualify in the BMP program are required to present a seminar annually and are automatically enrolled in the course. Non-BMP graduate students wishing to present in the seminar series should contact the BMP Program Director before enrolling.
Faculty

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

Professors
Ingolf Bach, PhD (Molecular Medicine) – Neuronal cell fate specification
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) – Glucose transporter structure, function and 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
Job Dekker, PhD (Biochemistry & Molecular Pharmacology, Program in Gene Function) – Spatial organization of genomes
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
Lawrence J Hayward, MD, PhD (Neurology) – Ion channelopathies, motor neuron disease, and neuromuscular channelopathies
Mitsuo Ikebe, PhD (Microbiology & Physiologic Systems) – 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 (Microbiology & Physiologic Systems) – 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

Dannel McCollum, PhD (Biochemistry & Molecular Pharmacology) – Signaling pathways controlling cell growth and division

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

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

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

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

Charles G. Sagerström, PhD (Biochemistry & Molecular Pharmacology) –
Transcriptional regulation in embryogenesis
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
Paul Thompson, PhD (Biochemistry & Molecular Pharmacology) - Techniques of chemical biology, biochemistry, and enzymology to develop inhibitors/drugs targeting disease associated enzymes as well as developing novel diagnostics for cancer
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
Daniel Bolon, PhD (Biochemistry & Molecular Pharmacology) – Role of molecular chaperones in biology and disease
Haley E. Melikian, PhD (Psychiatry) – Regulation and membrane trafficking of cocaine and antidepressant-sensitive monoamine transporters
Stephen C. Miller, PhD (Biochemistry & Molecular Pharmacology) – Chemical approaches to study and control of cell biology
Mary Munson, PhD (Biochemistry & Molecular Pharmacology) – Regulation of vesicle targeting and fusion
Peter M. Pryciak, PhD (Biochemistry & Molecular Pharmacology) – Function of yeast heterotrimeric G proteins in signal transduction and cell polarity
Sean Ryder, PhD (Biochemistry & Molecular Pharmacology) – RNA regulation in development and disease regulatory networks, mechanisms of specificity and ribonucleoprotein complex assembly
Scot A. Wolfe, PhD (Biochemistry & Molecular Pharmacology, Program in Gene Function) – Protein-DNA recognition; targeted genome modification; transcriptional regulatory networks in metazoans

Assistant Professors
David Grunwald, PhD (Biochemistry & Molecular Pharmacology) Viral Recombination
Gang Han, PhD (Biochemistry & Molecular Pharmacology) - Synthetic nanomaterials for siRNA delivery and biomolecule imaging.
Brian Kelch, PhD, (Biochemistry & Molecular Pharmacology) The structural mechanisms of the macromolecular machines that carry out DNA replication.

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

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

Research Associate 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 multimeric proteins and peptides using stopped-flow circular dichroism and fluorescence spectroscopies

Program in Bioinformatics & Computational Biology

Description

The Program in Bioinformatics & Computational Biology 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 genomics and epigenomics; gene regulatory regulatory networks; variations of the genome and comparative genomics; population genetics and molecular evolution; RNA expression and regulation; small silencing RNA biogenesis and function; protein-protein and protein-DNA interactions; 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. 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 Core Curriculum classes, students will take three Advanced Courses, two of which must be in Bioinformatics & Computational Biology. 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.

**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 key topics in modern bioinformatics and computational biology. The course is aimed not only at students specializing in bioinformatics, but also experimental students who would like to utilize bioinformatics tools in their daily research. The class starts with a primer on probability and statistics. It will then proceed to cover a broad range of machine learning techniques essential to modern bioinformatics, including linear regression, logistic regression, neural networks, random forests, support vector machines, Markov and hidden Markov models, and Bayesian networks. Topics at the intersection of biology and machine learning will also be covered, including a guest lecture by Prof. Elinor Karlsson on genome-wide association studies (GWAS). The course will include seventeen lectures and homework assignments. Reading and online teaching materials are assigned prior to each lecture. The homework is programming-based, and designed to both reinforce concepts discussed in lecture as well as introduce students to working with real biological data. Some experience with programming and statistics is desirable. All homework assignments will be primarily programmed in Python.

*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.

**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.

**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**

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

Job Dekker, PhD (Howard Hughes Medical Institute InvestigatorCo-Director Program in Systems Biology; Biochemistry & Molecular Pharmacology) – Spatial organization of genomes

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

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
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

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

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

Marian Walhout, PhD (Co-Director Program in Systems Biology; 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

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**

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

Manuel Garber, PhD (Program in Bioinformatics and Integrative Biology; Director Bioinformatics Core) - To study the evolution of transcriptional control and non-coding RNAs in mammals through development and analysis of sequence-based molecular biology approaches.

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

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
Elinor Karlsson, PhD (Program in Bioinformatics and Integrative Biology) - Using ancient signals of natural selection to understand how the human genome works, and translating this insight into better medical therapies.

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

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

Description

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 Molecular, Cell and 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 UMMS Cancer Center 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 the Core Course, students will take two specific courses: Histology and Tumor Pathology and Cancer Biology and Medicine. In addition, students may take an elective course of their choice in a related discipline.

Courses

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 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 Biology and Medicine**

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. The salient topics covered include stem cells, cell death mechanisms, 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. The course also includes an introduction to the basic principles of cancer therapy, including chemotherapy, immunotherapy and the use of systems biology to improve therapy. Faculty from the Department of Molecular, Cell and Cancer Biology and other basic science departments participate in the teaching of this course.

**Other Program Activities**

**Data Club**

The program has a forum referred to as ‘data club’ that is organized by the Department of Molecular, Cell and Cancer Biology. This forum meets weekly and it enables students to present their research to other students, post-docs and faculty. Data Club serves two important purposes: it provides students and post-docs with the experience of presenting their work in a public setting and it allows for constructive criticism of their data.

**Clinical Conferences**

These disease-based, monthly conferences, which are components of the UMMS Cancer Center, bring together clinicians and basic scientists to present their work and discuss areas of mutual interest and collaboration in translational cancer research. They provide an ideal forum for students to gain exposure to clinical cancer medicine and translational research. Our students are encouraged to attend one of these conferences relevant to their research and present their work. This involvement enables them to obtain feedback on the clinical significance of their work and guide future research. The ongoing clinical conferences include: Breast Cancer, Genomic Instability and Cancer, Leukemia and Lymphoma, and Prostate Cancer.

**Faculty**

**Program Directors**

Sharon B. Cantor, PhD (Molecular, Cell & Cancer Biology) – Hereditary breast cancer

Arthur M. Mercurio, PhD (Molecular, Cell & Cancer Biology) – Molecular cell biology of aggressive carcinomas
**Professors**

Andreas Bergmann, Ph.D. (Molecular, Cell & Cancer Biology) – Genetic control of programmed cell death (apoptosis) in *Drosophila*

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

Roger J. Davis, PhD (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 (Molecular, Cell & Cancer Biology) – 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

Jean Marie 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

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

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

Michelle A. Kelliher Ph.D. (Molecular, Cell & Cancer Biology) – Genetics and therapy of human leukemias

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

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

Peter E. Newburger, MD (Pediatrics) – Global analysis and regulation of phagocyte gene expression; mechanisms of translation of selenium-containing proteins such as glutathione peroxidase

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

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

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**
Lucio H. Castilla, PhD (Molecular, Cell & Cancer Biology) – Genetics of leukemia in mouse models

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

Timothy F. Kowalik, PhD (MAPS) – Regulation of cellular proliferation control during viral infection

Brian Lewis, PhD (Molecular, Cell & Cancer Biology) – Molecular genetics of pancreatic and liver cancers

Junhao Mao, PhD (Molecular, Cell & Cancer Biology) – Developmental signaling pathways and cancer

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

Merav Socolovsky, PhD, MBBS (Molecular, Cell & Cancer Biology) – Molecular mechanisms regulating the homeostasis of hematopoietic progenitors

Assistant Professors

Jennifer Benanti, PhD (Molecular, Cell & Cancer Biology) – Regulation of cell growth and division

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

Thomas Fazzio, PhD (Molecular, Cell & Cancer Biology) – Chromatin regulation in stem cells

Dohoon Kim, Ph.D. (Molecular, Cell & Cancer Biology) – Cancer cell metabolism

Michael Lee, PhD (Molecular Medicine; Program in Systems Biology) – Systems pharmacology of anti-cancer therapies

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

Wen Xue, PhD (Molecular Medicine; RNA Therapeutics Institute) – To functionally dissect cancer mutations in mouse models of liver cancer and lung cancer

Program in Cell Biology

Description

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; and cell motility. The Cell Biology Program faculty have expertise in many molecular and cellular techniques, including: 3-D image analysis; bioinformatics; immunofluorescence and confocal microscopy; electron microscopy;
protein chemistry; recombinant DNA; tissue engineering; stem cell research; transgenic animal models; in situ hybridization.

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**

The minimum course requirements for specialization in Cell Biology include one Keystone and one Advanced Topics course.

**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.

*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. A research paper or proposal is also required.

*Cellular Architecture and Disease*

This course explores the relationships between basic cellular structures, components and processes, from the membrane through the cytoplasm and into the nucleus, and
human diseases. Topics will be chosen from the recent literature to illustrate molecular and cellular aspects of cellular architecture and how defects contribute to disease. The format includes student presentations, faculty-student discussions of selected research papers, and a mini-proposal based on some aspect of the literature discussed in class.  

**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.  

**Tutorial in Cell Biology**

Tutorial arranged with individual faculty.  

**Seminar in Cell Biology**

Topics to be announced.  

**Faculty**

**Program Director**

Anthony N. Imbalzano, PhD (Professor, Cell & Developmental 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  

Andreas Bergmann, PhD (Molecular, Cell and Cancer Biology) – Genetic control of programmed cell death in Drosophila  

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

Roger W. Craig, PhD (Cell & Developmental 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 & Developmental Biology) – Cell and molecular biology of fertilization, secretory mechanisms, ion channel structure and function  

Susan B. Gagliardi, PhD (Cell & Developmental Biology) – Development, genetics and experimental study of myelin; cytological and ultra-structural methods  

Ellen Gravallese, MD (Medicine) – Rheumatoid arthritis and osteoporosis
Lawrence J. Hayward, MD, PhD (Neurology) – Ion channelopathies, motor neuron disease, and neuromuscular channelopathies

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

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

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

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

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

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

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

George B. Witman III, PhD (George F. Booth Chair in the Basic Sciences, Cell & Developmental Biology) – 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

**Associate Professors**

Daryl A. Bosco, PhD (Neurology) – Mechanisms of amyotrophic lateral sclerosis; protein misfolding

Daniel L. Kilpatrick, PhD (Microbiology & Physiological Systems) – Transcriptional control of neurogenesis

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

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

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

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 (Cell & Developmental Biology) – Molecular mechanisms of cell senescence and relationships to cancer and aging

**Assistant Professors**

Paul J. Fanning, PhD (Orthopedics & Physical Rehabilitation) – Mechanisms of mechanotransduction and their relation to health and disease states

Jaime Rivera, PhD (Cell & Developmental Biology) – Morphogenetic and molecular mechanisms in early mammalian development

**Emeritus**

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

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

**Affiliate Faculty**

Jane B. Lian, PhD (University of Vermont College of Medicine, Dept. Biochemistry) – Transcriptional control of bone tissue-specific genes regulating osteogenesis and gene therapy approaches for skeletal disorders

Gary S. Stein, PhD (University of Vermont College of Medicine, Dept. Biochemistry) – 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 (University of Vermont College of Medicine, Dept. Biochemistry) – Molecular mechanisms regulating expression of histone genes and other cell growth-related genes, especially at the transcriptional level

**Interdisciplinary Graduate Program**

**Description**

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.

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, provides students with opportunities to present their research to a large audience.

**Requirements for Specialization**
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, 3-credit Advanced Topics courses are required.

**Courses**

*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.

*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.

**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.

**Additional Coursework**

These courses do not fulfill the Advanced Topics requirements.

**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.

**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.

**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.

**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.

**Faculty**

**Graduate Directors**

Craig L. Peterson, PhD (Molecular Medicine; Biochemistry & Molecular Pharmacology) – Regulation of nuclear functions by chromatin and chromatin remodeling enzymes

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

**Professors**

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

Raffi Aroian, PhD (Molecular Medicine; Microbiology & Physiological Systems) - Cures for major diseases afflicting humankind, namely intestinal roundworms and bacterial pathogens

Eric Baehrecke, PhD (Molecular, Cell and Cancer Biology) – Cell death and autophagy
Leslie J. Berg, PhD (Pathology) – Molecular mechanisms regulating the homeostasis of hematopoietic progenitors

Andreas Bergmann, PhD (Molecular, Cell and Cancer Biology) - Genetic control of programmed cell death (apoptosis) in Drosophila

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

Vivian Budnik, PhD (Chair, 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

Paul R. Clapham, PhD (Molecular Medicine; Microbiology & Physiological Systems) – HIV receptors and cellular tropisms

Silvia Corvera, MD (Molecular Medicine; Cell & Developmental 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

Job Dekker, PhD (Co-Director, Program in Systems Biology; Biochemistry & Molecular Pharmacology) – Spatial organization of genomes

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

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

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

Katherine Fitzgerald, PhD (Medicine) – Innate immune signaling

Harvey M. Florman, PhD (Cell & Developmental Biology) – 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; Microbiology & Physiological Systems) – Gene therapy for cystic fibrosis, alpha-1 antitrypsine deficiency and other single gene defects

Jane Freedman, MD (Medicine) - Immunity, inflammation and circulation transcripts in atherothrombotic disease in a basic and high-throughput laboratory
Fen-Biao Gao, PhD (Neurobiology) - Understanding Frontotemporal Dementia and Neuronal microRNAs

Guangping Gao, PhD (Microbiology & Physiological Systems) – Adeno-associated virus vectors for gene therapy of genetic diseases

Ricardo Gazzinelli, DSc, DVM (Medicine)

Reid J. Gilmore, PhD (Biochemistry & Molecular Pharmacology) – Molecular mechanism of protein translocation

Douglas Golenbock, MD (Medicine; Microbiology & Physiological Systems) – 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 Cell & Cancer Biology; Biochemistry & Molecular Pharmacology; Surgery) – Eukaryotic gene function and expression

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

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

Anthony N. Imbalzano, PhD (Cell & Developmental 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; Molecular, Cell & Cancer Biology) – Regulatory mechanisms in Drosophila innate immunity

Allan Jacobson, PhD (Chair, Microbiology & Physiological Systems) – Post-transcriptional regulation of gene expression in yeast

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

Paul Kaufman, PhD (Molecular, Cell & Cancer Biology) – Assembly and function of eukaryotic chromosomes

John Keaney, MD (Medicine) – Cardiovascular Medicine

Michelle A. Kelliher, PhD (Molecular, Cell & Cancer Biology; Microbiology & Physiological Systems) – Genetic analysis of programmed cell death in the mouse

Anastasia Khvorova, PhD (Molecular Medicine; RNA Therapeutics Institute) - Develop and characterize novel RNA chemistries to promote efficient oligonucleotide internalization and tissue distribution

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 (Professor and Associate Dean of Basic and Biomedical Sciences Division & Vice-Provost of Admissions; Biochemistry & Molecular Pharmacology) – Genetic recombination and homologous recombinational DNA repair in human cells: Rad51-mediated DNA double-strand break repair

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

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

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

Nathan Lawson, PhD (Molecular, Cell & Cancer Biology) – Determining the signals responsible for blood vessel development using zebrafish

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

Stuart M. Levitz, MD (Medicine; Microbiology & Physiological Systems) – Interplay between host immune system and opportunistic fungal pathogens

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

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

Jeremy Luban, MD (Molecular Medicine) – Viral replication, pathogenesis, and immunity

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

Dannel McCollum, PhD (Biochemistry & Molecular Pharmacology) – Signaling pathways controlling cell growth and division

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

Arthur M. Mercurio, PhD (Molecular, Cell & Cancer Biology) – Mechanisms of carcinoma progression

Melissa J. Moore, PhD (Eleanor Eustis Chair of Cancer Research; Biochemistry & Molecular Pharmacology; Howard Hughes Medical Institute Investigator; RNA Therapeutics Institute) – Eukaryotic RNA processing and metabolism

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 & Developmental Biology; Molecular, Cell & Cancer
Biology; Pediatrics) – Molecular basis of phagocyte function and selenoprotein biosynthesis
Gregory J. Pazour, PhD (Molecular Medicine) – Function of the Mammalian Primary Cilium and Mechanisms of Eukaryotic Ciliary Assembly
Oliver J. Rando, MD, PhD (Biochemistry & Molecular Pharmacology) – Genomic approaches to chromatin structure and function, and to epigenetic inheritance
Nicholas Rhind, PhD (Biochemistry & Molecular Pharmacology) – Checkpoint regulation of the fission yeast cell cycle
Peter Rice, MD (Infectious Diseases and Immunology; Medicine) – Host interactions with Neisseria gonorrhoea
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
Charles G. Sagerström, PhD (Biochemistry & Molecular Pharmacology) – Gene expression in embryogenesis
Celia A. Schiffer, PhD (Biochemistry & Molecular Pharmacology; Professor and Director of Center for AIDS Research) - Structural basis for molecular recognition in HIV Protease
Neal Silverman, PhD (Medicine) – Signal transduction during the insect immune response
Erik Sontheimer, PhD (Molecular Medicine; RNA Therapeutics Institute) - Biology and mechanism of RNA-based gene regulation; CRISPR interference; RNA-directed genome editing and gene control
Greenfield Sluder, PhD (Cell & Developmental Biology) – Checkpoint controls for entry into and exit from mitosis; spindle organization; centrosome formation, function and reproduction
Lawrence Stern, PhD (Pathology; Biochemistry & Molecular Pharmacology) – Molecular recognition in the immune system
William E. Theurkauf, PhD (Molecular Medicine) – Control of chromosome segregation in early development
Paul Thompson, PhD (Biochemistry & Molecular Pharmacology) - Techniques of chemical biology, biochemistry, and enzymology to develop inhibitors/drugs targeting disease associated enzymes as well as developing novel diagnostics for cancer
Marian Walhout, PhD (Program in Systems Biology) – Mapping transcription regulatory
circuits in the nematode 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 & Developmental Biology) – 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
Phillip D. Zamore, PhD (Gretchen Stone Cook Chair in Biomedical Sciences; Howard Hughes Medical Institute Investigator; Biochemistry & Molecular Pharmacology; RNA Therapeutics Institute) – Dissecting the RNAi and miRNA Pathways

Associate Professors
Laura Alonso, MD (Medicine) - Regulation of pancreatic beta cell mass
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
Michael H. Brodsky, PhD (Molecular, Cell & Cancer Biology) – Drosophila p53 and DNA damage-induced apoptosis
Sharon Cantor, PhD (Molecular, Cell & Cancer Biology) – Hereditary breast cancer
Lucio H. Castilla, PhD (Biochemistry & Molecular Pharmacology; Molecular, Cell & Cancer Biology) – Genetics of leukemia in mouse models
Francis K. Chan, PhD (Pathology) – The Role of Programmed Cell Death in Immune Functions and Diseases
Jason J. Chen, PhD (Medicine) – Proliferation and apoptosis of cells expressing papillomavirus oncogenes
Marcus Cooper, MD (Medicine) – Manipulation of transcriptional pathways to reduce obesity
Miguel Esteves, PhD (Neurology) – Treatment of neurodegenerative lysosomal storage diseases
Thomas Fazzio, PhD (Molecular Medicine) – Chromatin regulation in stem cells
Manuel Garber, PhD (Molecular Medicine; Bioinformatics & Integrative Biology) - Immune transcriptional response
Paul D. Gardner, PhD (Psychiatry) – Molecular studies of neurotransmitter receptor gene expression
Rachel M. Gerstein, PhD (Microbiology & Physiological Systems) – 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

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

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

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

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

Timothy F. Kowalik, PhD (Microbiology & Physiological Systems) – Regulation of cellular proliferation control during viral infection

Brian Lewis, PhD (Molecular, Cell & Cancer Biology) – Molecular genetics of pancreatic and liver cancers

Daniel Libraty, MD (Medicine) – Human cellular immune responses contributing to pathogenesis and/or protective immunity in emerging viral diseases

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

Carlos Lois MD, PhD (Neurobiology) – Assembly of brain circuits and the cellular mechanisms of behavior

Stephen Lyle, MD, PhD (Molecular, Cell & Cancer Biology) – Stem cells and cancer

Pranoti Mandrekar, PhD (Medicine) – Macrophage activation in liver diseases

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

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

Ann Moormann, PhD (Molecular Medicine) – Pediatric immunology

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

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

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

Sean Ryder, PhD (Biochemistry & Molecular Pharmacology) – Post-transcriptional regulation of maternal mRNAs in early development

Leslie Shaw, PhD (Co-Director of the UMass Breast Cancer Program; Molecular, Cell & Cancer Biology) - Mechanisms of tumor metastasis

Merav Socolovsky, MD, PhD (Molecular, Cell and Cancer Biology) - Molecular
mechanisms regulating the homeostasis of hematopoietic progenitors

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

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

Scot A. Wolfe, PhD (Biochemistry & Molecular Pharmacology) – Creating artificial DNA-binding domains for targeted gene regulation and gene modification

**Assistant Professors**

Usha Acharya, PhD (Molecular, Cell & Cancer Biology) – Molecular genetics of lipid metabolism and signaling

Jeffrey Bailey, MD, PhD (Transfusion Medicine; Program in Systems Biology) – Computational and Experimental Analysis of the Role of Segmental Duplication and Copy Number Variation in Human Disease

Jennifer Benanti, PhD (Molecular, Cell & Cancer Biology) – Regulation of cell growth and division

Claire Bénard, PhD (Neurobiology) – Molecular mechanisms of nervous system maintenance and protection

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

Kensuke Futai, PhD (Psychiatry) - The roles of Inhibitory neurons in neuropsychiatric diseases

Elinor Karlsson, PhD (Molecular Medicine) - Infectious disease resistance in humans

Michael Lee, PhD (Molecular Medicine; Program in Systems Biology) – Systems pharmacology of anti-cancer therapies

Vladimir Litvak, PhD (Microbiology & Physiological Systems) – Gene regulatory circuits in the transcriptional and epigenetic control of antiviral immunity

Anuja Mathew, PhD (Medicine) – T cell responses to acute viral infections

Rene Maehr, PhD (Molecular Medicine) – Autoimmune destruction of insulin producing, pancreatic beta cells results in Type I Diabetes (T1D)

Hayla Sluss, PhD (Molecular, Cell & Cancer Biology) – Tumor suppressors and metabolic control

Caterina Strambio De Castillia, PhD (Molecular Medicine) - Dissecting the interplay between HIV-1 and human cells during viral entry

Eduardo Torres, PhD (Molecular, Cell & Cancer Biology) – Aneuploidy’s affects on cellular physiology and metabolism and how it influences cell evolution

Amy Walker, PhD (Molecular Medicine) – How is transcriptional regulation of lipogenesis linked to diet and environment in C. elegans and mammals
Yong-Xu Wang, PhD (Molecular Cell & Cancer Biology) – Transcriptional control of energy metabolism and metabolic diseases by the nuclear receptor PPAR subfamily

Wen Xue, PhD (Molecular Medicine; RNA Therapeutics Institute) – To functionally dissect cancer mutations in mouse models of liver cancer and lung cancer

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

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

Contributing Faculty

Professors

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

John L. Sullivan, MD (Pediatrics; Molecular Medicine; Microbiology & Physiological Systems; 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

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

Assistant Professors

Madelenia Martin, MD (Pediatrics)

Immunology & Microbiology Program

Description

The IMP Program features cutting-edge research in:

- Innate immunity and inflammation
- Host responses to infection and vaccine development
- Fundamental molecular and cellular immunology
- The mechanisms underlying bacterial and viral pathogenesis
- Diabetes and transplantation immunology
- Autoimmunity
- Systems biology of host-pathogen dynamics

Immunology, virology, and bacterial pathogenesis are interdisciplinary biomedical fields that employ methods ranging from molecular biology to clinical trials. The Immunology & Microbiology Program (IMP) is administered by an interdepartmental group that includes faculty with diverse research interests, including the molecular and cellular basis of innate immunity, adaptive immunity, molecular mechanisms of viral replication, host-pathogen interactions, and the control of viral, bacterial and parasitic infections.

The major purpose of the Program is to recruit talented and highly motivated graduate
students and postdoctoral fellows and give them first-rate preparation for competitive careers in academic research and industry. Currently there are approximately 50 graduate students in the program, and program faculty are training 80 – 100 postdoctoral fellows.

Graduate students in IMP 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, Infection and Immune Response, 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 at least one of three courses: Advanced Virology, Advanced Molecular and Cellular Immunology, or Advanced Bacterial Pathogenesis. Advanced courses emphasize reading and critical analysis of recent research papers. Additional training in the second year includes seminars, journal clubs, and tutorials all of which 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, IMP students should take the Keystone Advanced Topics Course in Infection and Immune Response (755) in the spring of their first year, and, in the second year, at least one advanced Immunology, Virology, or Microbiology course. Equivalent advanced topics courses can be substituted with permission from the IMP directors. All students, except for those in the final stages of their dissertation research, are required to take Graduate Student Seminar each fall semester, and Immunobiology and Microbiology Seminar and Discussion for two semesters. An equivalent guest scientist seminar program can be substituted for one of these semesters, with permission of the Program Director.

Additional information about application for admission, entrance requirements and the school-wide program can be found at www.umassmed.edu/gsbs/futurestudents/overview.aspx. Specific questions about the Program in Immunology and Microbiology should be directed to the Program Directors.

Courses

**Infection and Immune Response**

Infectious disease is among the strongest agents of natural selection, and adaptations constituting the armament of pathogens and the defense of the host involve many of the most fascinating mechanisms in biology. This course presents a modern view of the basic principles of immunology, bacterial pathogenesis, and virology, providing background for advanced course work in microbiology, microbial pathogenesis and immunology. We will focus on three themes; (1) basic properties of microbes and, the mammalian host defenses that have evolved to respond to them, (2) the interplay - in both dynamic and evolutionary sense - between host defenses and microbial virulence, and (3) the mechanisms of pathogenesis during infection. Comparative clinical and
epidemiological pictures of selected diseases will be presented, and will serve as a framework for development of key molecular, cellular, and physiological concepts. Students taking this course will be eligible to continue advanced studies in the Immunology and Microbiology program. Spring. J. Goguen & E. Lien 3 credits. Prerequisites: Core Course Blocks I and II.

**Advanced Molecular & Cellular Immunology**

Some of 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, generate hypotheses, and design experiments to answer them through writing a research proposal. Topics to be covered include: principles of innate immunity, 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. J. Kang. Fall. 3 credits. Prerequisites: Core Course and BBS-755.

**Advanced Animal Virology**

This is a paper reading-based course discussing in depth new findings in animal virology, including viral biochemistry and molecular biology, genetics, oncogenesis, and pathogenesis. The course will be team-taught by UMMS faculty. The course will begin with introductory lectures to provide background for more advanced readings. Students will then cover different specific areas chosen by the professors in detail with paper readings. At the end of the course the students will write a research proposal and present it to the class and faculty. A. Brass. Fall. 3 credits. Prerequisite: Core Course and BBS 755.

**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 contributing much 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 to be investigated will be based on interests of the class. Students will 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 to bacterial pathogenesis research, the format of this course is intended to assist students with preparation for qualifying examinations. The participating faculty will introduce topics, provide background information, and meet individually with students to provide constructive criticism of in-class presentations. The majority of class time will be devoted to open discussion. J.Goguen Fall. 2 credits. Prerequisites: Core Course, BBS
Graduate Student Seminar in Immunology & Microbiology
Advanced IMP graduate students present seminars on their thesis research. E. Huseby. Fall. 1 credit. Prerequisites: One of the following advanced courses: BBS 821, BBS 822, or BBS 823

Immunobiology & Microbiology Seminar & Discussion
Leading researchers from outside the institution present a weekly seminar on a basic or clinical immunology and microbiology topic. Prior to the seminar, students read papers suggested by the seminar speaker and discuss the papers in class. Following the seminar, graduate students meet with the speaker for a discussion of the formal seminar. This course surveys the most important areas of basic and clinical immunology or microbiology including, but not limited to, innate immunity, antigen presentation; gene rearrangements; and expression of the genes for antigen receptors, 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. This course must be taken twice. Best taken in second and third year. F. Chan, Spring. 2 credits. Prerequisite: One of the following advanced courses: BBS 821, BBS 822, or BBS 823.

Immunology/Virology/Bacteriology Tutorial
Recommended for students between first and second year. Students in the class will read one primary and one review paper the week before each class. The topics, paper, and review will be chosen by two student mentors. In a brief presentation, the mentors describe the current state of the field and summarize the review. The class is split into two groups, pro and con. Each group presents arguments for their opinion. The purpose is to have more discussion of positives and negatives of technique, systems and conclusions while broadening knowledge of Immunology and Microbiology. N. Silverman. Summer. 1 credit. Prerequisites: Core Course and BBS 755.

Laboratory Rotation in Immunology, Virology or Bacteriology
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. Student participate in an ongoing research project, gain familiarity with concepts underlying the research, acquire a working knowledge of techniques used in the research, and write a report and present an oral summary of the results of the research. IV Faculty. 3-4 credits each.

Qualifying Examination
N. Silverman, T. Morrison, B. McCormick Fall, Spring, and Summer. Variable credits up to 4.

Thesis Research in Immunology or Microbiology
IMP Faculty. Variable credits.
Requirements and Tracks

The Immunology/Microbiology Program offers a curriculum designed to provide an excellent background in this specialized area, while complementing the overall core curriculum. To provide you with background knowledge in immunology, virology and bacteriology as well as to sharpen your skills in developing and testing hypotheses, IMP program offers several advanced level courses. A typical curriculum for students in the IMP program is given below. Three tracks are indicated depending upon your focus, virology, immunology or bacteriology. Thesis work and other credits are as described for the Graduate School.
# Year 1

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<th>Virology Track</th>
<th>Immunology Track</th>
<th>Bacteriology Track</th>
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## Year 2

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<td>BBS 821 Mol &amp; Cell Immunology</td>
<td>BBS823 Advanced Bacterial Pathogenesis</td>
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* In addition, students can elect additional advanced topics course from any program, that may further support their training and educational goals.

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## Year 3 to Graduation

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* Required of all IMP students
Faculty

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

Program Vice-Director
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

Immunology Director
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

Virology Director
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

Microbiology Director
Beth McCormick, PhD (Microbiology and Physiological Systems) Mucosal inflammation, host:pathogen interactions, and cancer biology.

Professors
Samuel Behar, MD, PhD (Microbiology & Physiological Systems)
Leslie Berg, PhD (Pathology) Molecular mechanisms regulating the homeostasis of hematopoietic progenitors
Paul Clapham, PhD (Program in Molecular Medicine) HIV receptors and cellular tropisms
Richard Ellison, MD (Medicine) Research that focuses on the broad areas of identification and treatment of nosocomial infections, infections in the ICU setting, sepsis, and clinical care of patients with HIV disease
Robert Finberg, MD (Medicine) Relationships between host cell surface proteins and infectious agents; basis of cellular activation mediated by cell surface protein
Katherine Fitzgerald, PhD (Medicine) Innate immune signaling
Terence Flotte, MD (Pediatrics) Gene therapy for cystic fibrosis, alpha-1 antitrypsine deficiency and other single gene defects
Guangping Gao, PhD (Microbiology & Physiological Systems) Adeno-associated virus vectors for gene therapy of genetic diseases
Ricardo Gazzinelli, DSc, DVM (Medicine) Cognate innate immune receptors and development of vaccines for protozoan parasites
Douglas Golenbock, MD (Medicine) Toll receptors; pathophysiology of sepsis and pelvic
inflammatory disease

Heinrich Gottlinger, MD, PhD (Molecular, Cell and Cancer Biology) Molecular biology of HIV-1

Dale Greiner, PhD (Program in Molecular 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

Jean Marie 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

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 Kelliher, PhD (Molecular, Cell and Cancer Biology) Genetic analysis of programmed cell death in the mouse

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

Evelyn 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

Edward Leiter, MD, PhD (Medicine) GI endocrine cells in health and disease

Stuart Levitz, MD (Medicine) Interplay between host immune system and opportunistic fungal pathogens

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

Jeremy Luban, MD (Program in Molecular Medicine) Viral replication, pathogenesis, and immunity

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

Beth McCormick, PhD (Microbiology & Physiological Systems) Molecular and cellular mechanisms by which bacterial pathogens induce mucosal inflammation

John 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

Trudy Morrison, PhD (Microbiology & Physiological Systems) Structure and intracellular
processing of viral glycoproteins

Peter Newburger, MD (Pediatrics) Global analysis and regulation of phagocyte gene expression; pattern recognition receptor expression and function in neutrophils

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

Peter Rice, MD (Medicine) Research that involves the identification of unique determinants present on bacterial surfaces that may serve as suitable vaccine candidates to protect against infection in humans

Kenneth Rock, MD (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

Ann Rothstein, PhD (Medicine)

Katherine Ruiz De Luzuriaga, MD (Program in Molecular 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; 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 development of prophylactic and therapeutic vaccine strategies for HIV

Christopher Sassetti, PhD (Microbiology & Physiological Systems) Genetic and genomic approaches to understand tuberculosis pathogenesis

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

Liisa Selin, MD, PhD (Pathology)

Leonard Shultz, PhD (Medicine)

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

Lawrence Stern, PhD (Pathology) Molecular recognition in the immune system

Susan Swain, PhD (Pathology)

Gyongyi Szabo, MD, PhD (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)

Michael Volkert, PhD (Microbiology & Physiological Systems) Regulation and function of DNA repair genes

Raymond Welsh, PhD (Pathology) Viral immunology and pathogenesis; natural killer
and cytotoxic T cells in murine model systems; T cell apoptosis and memory

Robert Woodland, PhD (Microbiology & Physiological Systems) Signaling mechanisms maintaining B lymphocyte growth, survival and immune responsiveness; HIV vaccine development using humanized chimeric mice

Bruce Woda, MD (Pathology) Hematopathology

Associate Professors

Michael Brehm, PhD (Program in Molecular 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 (Ka Ming) Chan, PhD (Pathology) The Role of Programmed Cell Death in Immune Functions and Diseases

Jason Chen, PhD (Medicine) Proliferation and apoptosis of cells expressing papillomavirus oncoproteins

Manuel Garber, PhD (Program in Molecular Medicine) Immune transcriptional response

Rachel Gerstein, PhD (Microbiology & Physiological Systems) 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

Jon Goguen, PhD (Microbiology & Physiological Systems) 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 fibrinogen 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, Infectious Diseases) Pathogenesis of heterologous flavivirus infections in human and murine model systems; T cell responses to novel virus vaccines.

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

Duane Jenness, PhD (Microbiology & Physiological Systems) Cell-surface receptors in Saccharomyces cerevisiae

Timothy Kowalik, PhD (Microbiology & Physiological Systems) Regulation of cellular proliferation control during viral infection

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 microbial activation and evasion of innate immune responses via Toll-like receptors

Pranoti Mandrekar, PhD (Medicine) Innate immune activation in liver diseases and cancer
Ann Moormann, PhD, MPH (Program in Molecular Medicine) Viral immunology and epidemiology

Madelyn Schmidt, PhD (Microbiology & Physiological Systems) Gene therapy approaches for treatment of immune deficiency disease and cancer; mechanisms regulating B lymphocyte homeostasis; mechanisms of RNA virus persistence in B lymphocytes

David Serreze, BS, MS, PhD (Medicine)

Merav Socolovsky, MD, PhD (Molecular, Cell and Cancer Biology) Molecular mechanisms regulating the homeostasis of hematopoietic progenitors

Jennifer Wang, MD (Medicine) Viral immunology

**Assistant Professors**

Jeffrey Bailey, MD, PhD (Medicine) Genetic variation in infectious disease susceptibility and pathogenesis, concentrating on the role of segmental duplication and copy number variation

Abraham Brass, MD, PhD (Microbiology & Physiological Systems)

David Grunwald, PhD (Biochemistry & Molecular Pharmacology) Viral Recombination

John Harris, MD, PhD (Medicine)

Vladimir Litvak, PhD (Microbiology & Physiological Systems) Gene regulatory circuits in the transcriptional and epigenetic control of antiviral immunity

Kenan Murphy, PhD (Microbiology & Physiological Systems)

Carol Schrader, PhD (Microbiology & Physiological Systems) The role of base-excision repair and DNA mismatch repair proteins in DNA breaks formed during immunoglobulin class switch recombination

Maria Zapp, PhD (Program in Molecular Medicine) Regulation of nuclear transport of viral and cellular mRNAs by cellular factors

**Program in Neuroscience**

**Description**

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;
- 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 Graduate Program in Neuroscience is the linchpin that brings together many components of the neuroscience community at UMass Medical School. Like the Graduate Program, the neuroscience community at UMMS is truly interdepartmental and interdisciplinary. A critical and unique feature of the research environment at UMass Medical School is that departmental affiliations affect letterheads but not interactions or collaborations. This atmosphere is especially conducive to the scientific growth of graduate students obtaining their degrees in neuroscience.

Participating faculty have primary appointments in several departments, with the largest concentration of faculty coming from the Departments of Neurobiology, Psychiatry, and Neurology. Clusters of neuroscientists are located in many other Departments, Centers and Institutes on the Worcester campus (see below). This diversity of affiliations reflects the diversity of research interests in the Program, which range from investigation of basic mechanisms of neuronal function in model organisms and identifying novel disease genes to development of therapies for neurodegenerative diseases and improving clinical care for children with developmental disabilities.

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 acquire 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 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. Students in the third year and beyond are also required to complete an annual Individual Development Plan, and the TRAC meeting will include discussion of progression toward both research and professional development goals.

In addition to the GSBS core curriculum, students in the Program in Neuroscience are required to take at least three (3) 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 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 semester of “Communicating Neuroscience: Learning by Doing” can be used in place of one semester of Neuroscience Journal Club. 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

Keystone Courses

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. This is the Program’s Keystone Advanced Topics Course. Coordinator: David Weaver. Offered Spring, annually. BBS 760.

Other Advanced Topics Courses

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. This is an Advanced Topics Course. Coordinator: Jose Lemos. Offered Fall, odd years. BBS 746.

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. This is an Advanced Topics Course. Coordinator: Zuoshang Xu. Offered Fall, even years. BBS 782.

**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. This is an Advanced Topics Course. Coordinator: Mark Alkema. Offered Fall, even years. BBS 783.

**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. This is an Advanced Topics Course. Coordinator: Marc Freeman. Offered Fall, odd years. BBS 784.

**Other Courses in Neuroscience (Not Advanced Topics Courses)**

**Neuroscience Journal Club**

Neuroscience Journal Club gives students the opportunity to present and discuss exciting new papers in neuroscience in an informal setting consisting of the participating students together with a faculty advisor. Presentations occur weekly. Many presentation topics are coupled to the Neuroscience Seminar series. Students are also expected to attend the Neuroscience Program Seminar series and to meet with external speakers (at least 70% of the time). Program in Neuroscience students must take 2 semester of Neuroscience Journal Club. (BBS 838 can be used to substitute for one semester of Neuroscience Journal Club). This is not an advanced topics course. BBS 808.

**Communicating Neuroscience: Learning by Doing**

This course will demonstrate the major elements that distinguish a great presentation, and identify areas in which each student can improve their own presentations through peer critiques and self-assessment. Importantly, this class will allow students many
opportunities to apply those critiques, and see their skills improve throughout the course. Neuroscience Program students are required to take two semesters of Neuroscience Journal Club as a graduation requirement, but this course will substitute for one semester of Journal Club toward that Program requirement. This is not an Advanced Topics course. Coordinator: Marc Freeman. BBS 838.

**Special Topics in Neuroscience – fMRI: Visualizing the Brain at Work**

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. This is not an Advanced Topics course. Coordinator: Constance Moore. BBS 815.

**Special Topics 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. This is not an Advanced Topics course. Coordinator: Andrew Tapper. BBS 849.

**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 Dr. David Weaver as the faculty member, as Dr. Weaver approves the proposed tutorial activity. Students can enroll for multiple occurrences of Tutorial in Neuroscience. This is not an Advanced Topics course. Coordinator: David Weaver. BBS 848.
Faculty

Program Director

David R. Weaver, PhD (Professor of Neurobiology) – Molecular physiology of circadian rhythms

Professors

Neil Aronin, MD (Medicine) – Huntington’s disease
Ingolf Bach, PhD (Program in Molecular Medicine) – Neuronal cell fate specification
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. Rothchild, 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

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
Adjunct Faculty

Professor

Carlos Lois, PhD (Neurobiology) (California Institute of Technology) – Assembly of neuronal circuits, neuronal replacement, and the cellular mechanisms of behavior.

Program in Translational Sciences

Description

A major goal of biological research is to acquire insight and tools to solve problems in medicine. The new program in Translational Sciences was developed to address this goal and train graduate students to bring the power of cutting-edge biological tools to bear upon clinical problems. Program faculty members possess broad expertise in both basic and clinical research and are drawn from 15 different academic departments and programs at UMMS.

The program incorporates several unique features to provide focused training at the interface between basic and clinical sciences. Program students are co-mentored with both a basic scientist and a clinical scientist. Regular meetings with both mentors will ensure that the student gains a broad understanding of the application of basic biological methods to clinical problems. A new course has been developed to provide students with an understanding of the principles of translational science and tools for carrying out translational research. Additional program specific activities are planned to include yearly retreats, a seminar program and opportunities to interact directly with clinicians.

Requirements for Specialization

Students in the Translational Science program must successfully complete the GSBS core course, the Translational Science Molecular Basis of Disease advanced topics course and two additional GSBS advanced topics course that are relevant to the student’s research.

Translational Science students will complete three semesters of laboratory rotations (either half semester or full semester) in the first year to explore options for dissertation research. Students in this program will be encouraged to use this opportunity to investigate both basic science and clinical science laboratories. At the end of the first year, students will select a dissertation advisor and a co-advisor who, together, will guide the student’s research.

Qualifying Exam

The qualifying examination is arranged in consultation with the Graduate Director and can only be taken after successful completion of the GSBS core course, at least two of the advanced topics courses and at least three laboratory rotations. The qualifying exam includes an original research proposal (based on the student’s planned thesis research or another topic of the student’ choosing) and an oral presentation and defense of this proposal. Preparation for the qualifying exam is done in consultation with one of the graduate program co-directors.

Courses in Translational Science

Quantitative Informatics in Biology and Medicine

The goal of this course is to introduce GSBS graduate students to the informatics approaches spanning bioinformatics to Medical informatics and epidemiology. The course is organized in three blocks, including fundamental tools of bioinformatics, application of bioinformatics and genomics and finishes with a block on clinical research informatics. Components of the course include didactic lectures, student classroom presentations, problem sets and an individual
research proposal. This course is being given for the first time in the fall of 2011 and will be presented annually.

**Molecular Basis of Disease**

The goal of this course is to introduce GSBS graduate students to the molecular understanding of disease. The course will consist of five-week blocks investigating neurodegenerative disease, cardiovascular disease and diabetes. The students will then finish the course by developing a written research proposal into an important unanswered question.

**Faculty**

**Program Director**

William Royer, PhD (Biochemistry & Molecular Pharmacology) – Structural basis for inter-subunit communication and macromolecular interactions in biology; currently focusing on the impact of C-terminal binding proteins on cell fate and cancer and interferon regulatory factors in innate immunity

Pranoti Mandrekar, PhD (Medicine) – Innate immune activation in liver diseases and cancer

**Professors**

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

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

Eric H. Baehrecke, Ph.D. (Molecular, Cell and Cancer Biology) Autophagy (self-eating) is a conserved process that is used to deliver cytoplasmic materials, including organelles and proteins, to the lysosome for degradation. Autophagy has been implicated in several human disorders, including neurodegeneration and cancer. The Baehrecke lab studies the regulation and function of autophagy.

Bruce A. Barton, PhD, (Quantitative Health Sciences) rBiostatistics and health services research, director, and quantitative methods core

Robert H. Brown, MD, DPhil, (Neurology) ch, director, and quantitative methods core, including Anthony Carruthers, PhD (Biochemistry & Molecular Pharmacology) - Glucose transporter structure, function and regulation

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

Roger Davis, PhD (Program in Molecular Medicine) The Davis laboratory studies responses to biological stress that are mediated by the cJun NH2-terminal kinase (JNK) signaling pathway during the development of cardiovascular disease, cancer, and diabetes. The goal of the research program is to identify new therapeutic approaches for the treatment of these diseases.

Michael Czech, PhD (Program in Molecular Medicine) The Czech laboratory group uses gene silencing and genome editing techniques to identify, characterize and validate molecules and cellular pathways that mediate metabolic dysfunction in diseases such as obesity, type 2 diabetes and atherosclerosis.
Stephen Doxsey, PhD (Program in Molecular Medicine) The Doxsey lab is focused on the process of cell division, more specifically on how the mitotic spindle functions to ensure proper segregation of replicated chromosomes to the two daughter cells. We are also interested in following up on our recent work showing that the centrosomes/spindle poles control endosome recycling and endosomes control spindle pole assembly. Finally, we are trying to gain a better understanding of how defects in cell division contribute to cancer, primordial dwarfisms, microcephaly and cystic organ development.

Kate Fitzgerald, PhD (Medicine) Research in the Fitzgerald lab is focussed on understanding the molecular basis of the inflammatory response in the innate immune system.

Jane Freedman (Medicine) The major research initiatives in Dr. Freedman's laboratory emphasize the regulation of pathways contributing to atherothrombotic disease and how these factors contribute to acute coronary syndromes. She oversees two research programs; the first is a basic science laboratory that examines the role of immunity, infection, and inflammation on atherothrombotic disease. The second facility uses high-throughput, nano-chip, and RNaseq technologies to study gene expression and provide translational data for a wide range of projects.

Terence Flotte, MD (Dean, School of Medicine) Our lab is focused on developing recombinant adeno-associated virus (rAAV) gene therapy vectors for clinical gene therapy of single gene disorders, including genetic emphysema due to alpha-1 antitrypsin deficiency. We also study anti-capsid immunity in the context of rAAV-based gene therapy in humans.

Jean A. Frazier, MD, (Psychiatry) Research addresses a variety of scientific problems relevant to advancing the understanding, diagnosis and treatment of individuals with neurodevelopmental disorders.

Fen-Biao Gao, Ph.D. (Neurology) The long-term goal of my laboratory is to contribute significantly to the development of therapeutic approaches for frontotemporal dementia and related disorders through molecular understanding of underlying pathogenic mechanisms using both *Drosophila* and mammalian experimental systems. We are most interested in disease-causing mutations in CHMP2B, C9ORF72 and progranulin.

Guangping Gao, PhD (Gene Therapy) Gao lab focuses on the following areas of recombinant adeno-associated virus (rAAV)-mediated gene therapy: 1). AAV capsid biology and capsid engineering, 2). rAAV vector genome engineering and host interactions, 3). Modulation of transgene immunity in rAAV gene transfer and 4). Applications of rAAV in neurodegenerative diseases, vectored ImmunoProphylaxis, miRNA therapeutics and somatic therapeutic genome editing.

Dale Greiner, Ph.D. (Molecular Medicine) Our laboratory focuses on the study of human immunity and autoimmunity using humanized mice to investigate human immune responses without putting individuals at risk.

Robert Goldberg, PhD, (Quantitative Health Sciences) Cardiovascular epidemiology; preventive cardiology; epidemiologic methods
Douglas Golenbock, MD, (Medicine) Toll receptors; pathophysiology of sepsis and pelvic inflammatory disease

Lawrence Hayward, MD, PhD. (Neurology) - Neuromuscular Disorders (including motor neuron disease, myopathies, and ion channelopathies); Cellular and Animal Models of ALS; Nuclear Function and Epigenetics

David Harlan, MD (Medicine) - Dr. David Harlan (Medicine) is focusing on better understanding of beta cell biology, and his clinical research focuses on developing better diabetes care delivery models. He is working on engineering human pancreatic islet endocrine cell subsets (e.g. insulin producing beta cells) and his clinical research focuses on developing better diabetes care delivery models. His research is centered on developing novel communication tools to better engage patients in their own care.

Allan Jacobson, Ph.D. (Microbiology and Physiological Systems) - Regulation of mRNA stability and translation; Therapeutic nonsense suppression; Small molecule modulation of post-transcriptional control mechanisms

Catarina Kiefe, MD, PhD (Quantitative Health Sciences) - Regulation of mRNA stability and translation;

Anastasia Khvorova, PhD (RNA Therapeutics Institute) - Medicinal chemistry of therapeutic oligonucleotides. In particular, her lab is interested in expanding chemical diversity of siRNA for treatment of neurodegenerative disorders.

Jean King, Ph.D. (Psychiatry) - Our group utilizes magnetic resonance imaging and non-invasive techniques to better understand the neural underpinnings of psychiatric and neurological conditions, in both human and animal models. We focus on functional connectivity, structural properties (diffusion tensor imaging), and neurochemical markers (magnetic resonance spectroscopy) of these disease processes as well as treatment development/response. Topics of interest intersect with issues of cognition, mood, risk/resilience and vulnerability to drugs of abuse.

Katherine Luzuriaga, MD (Pediatrics) - As a physician-scientist, I use scientific investigation to inform the development of prevention and treatment strategies for persistent viral infections in children. HIV pathogenesis studies focus on the genetic and biologic characterization of viruses that are transmitted from women to their infants and on defining the effects of early combination antiretroviral therapy on HIV latent reservoirs. Epstein Barr virus pathogenesis studies focus on defining the role of EBV-specific immune response (neutralizing antibodies, CD8+ T cells) in controlling viral replication and on evolution of the viral quasispecies.

Pranoti Mandrekar, PhD (Medicine) - The research program of the Matthews group is focused on the mechanisms by which globular proteins fold rapidly and efficiently to their native functional conformations. Employing a combination of protein engineering and sophisticated spectroscopic techniques interfaced to ultra-rapid mixing devices, we probe folding reactions from the micro- to kilosecond time range for a variety of motifs of motifs.
and efficiently to their native fquisition of the native structure. These same insights are also relevant to understanding the role of mutations in partitioning the unfolded protein into deleterious misfolding reactions that can lead to pathology, including ALS.

Beth McCormick (Microbiology and Physiological Systems) - Dr. McCormick's academic career has been largely dedicated to gastrointestinal research and she has made seminal contributions toward the understanding of how enteric bacteria (commensal, pathogenic, or probiotic) colonize the intestine and interact with the host. Dr. McCormick's research is largely centered on her discovery of a novel innate immune pathway involving an hepxillin A3-mediated neutrophilic infiltration. This is a conserved mechanism present at mucosal surfaces that is acts as a sensor for protection from pathogenic bacteria but if this pathway is not properly controlled can also drive a damaging inflammatory response with severe pathological outcomes. Her work in this topic area has advanced the finding of a novel set of therapeutic targets that are currently being exploited for potential clinical intervention, and in addition, led to the discovery of a new paradigm in bacterial pathogenesis involving type III secretion systems.

Arthur Mercurio (Molecular, Cell and Cancer Biology) - We are interested in the initiation and progression of epithelial-derived tumors (carcinomas), especially aggressive, poorly differentiated tumors. Our research projects emphasize molecular cell biology but they derive from the analysis and clinical behavior of carcinomas. Our goal is to identify mechanisms that account for the loss of differentiation and the highly aggressive behavior of these tumors, and to exploit these mechanisms to improve prognosis and therapy. A major focus of this work is to define mechanisms that control the genesis and function of cancer stem cells with an emphasis on the role of integrin and VEGF signaling.

Melissa Moore, PhD, (Biochemistry & Molecular Pharmacology) Eukaryotic RNA processing and metabolism

Ira Ockene MD, (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

Gary Ostroff, Ph.D. (Molecular Medicine) The Ostroff lab focuses on targeted drug delivery of nucleic acids (siRNA, miRNA, mRNA and DNA) to modulate inflammation, proteins and peptides for vaccine delivery and small molecules (antibiotics, innate immune adjuvants and terpenes) for infection control. The goal is to develop next generation products with improved potency and reduced side effects.

David Paydarfar, MD, (Neurology) Basis of oscillatory nerve activity; respiratory control

Craig Peterson, Ph.D. (Molecular Medicine) Our research is focussed on the role of chromosome structure on transcription and genome stability pathways, with particular emphasis on ATP-dependent chromatin remodeling enzymes. We employ a combination of molecular genetics, genomics, chromatin biochemistry, and biophysical methodologies.

William Royer, PhD (Biochemistry & Molecular Pharmacology) –illiam Royer, PhD (Biochemistry & Molecular Pharmacology) focussed on the role of chromosome structure on transcription and genome stability pathways, with particular emphasis on ATP-dependent chromatin remodeling
enzymes. The Silverman lab is focused on deciphering the molecular mechanisms involved in the innate immune response. In particular, research focuses on the recognition of microbial pathogens by germline encoded receptors and the ensuing signal transduction cascade. *Drosophila melanogaster* is often used a model system for discovery and detailed molecular work with the goal of subsequent translation to human systems.

Chris Sassetti, PhD (Microbiology and Physiological Systems) By understanding the biology that underlies tuberculosis pathogenesis, my lab hopes to rationally design more effective therapies for this disease.

Celia Schiffer, PhD, (Biochemistry & Molecular Pharmacology) Structural basis for molecular recognition in HIV and HCV Protease

Gyongyi Szabo, MD, PhD (Medicine) The Szabo Laboratory studies the translational aspects of inflammation in liver diseases in alcoholic and non-alcoholic steatohepatitis and in hepatitis C virus infection. Our goal is to identify disease specific cellular or molecular targets and biomarkers to improve therapeutic and diagnostic options in these disease by using animal models and human specimens

Zhiping Weng, PhD (Bioinformatics; Biochemistry & Molecular Pharmacology) Dr. Weng develops and applies computational algorithms for analyzing genomic, epigenomic and transcriptomic data, in particular, high-throughput sequencing data associated with experiments that detect regulatory regions of the genome, nucleosome positioning, genomic locations of histone modifications and histone variants, DNase I hypersensitivity, DNA methylation, small silencing RNAs and genome resequencing. She collaborates closely with experimentalists to study a wide variety of biological problems.

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

**Associate Professors**

Daryl Bosco, Ph.D. (Neurology) We are interested in understanding how disease-causing mutations and aberrant post-translational modifications cause proteins to misfold and become toxic in neurodegenerative disorders such as ALS. We are also investigating the normal and pathogenic roles of FUS and other ALS-linked proteins in cellular stress response, particularly in the context of stress granule assembly.

Judson Brewer, MD PhD (Medicine and Psychiatry) -Mindfulness-based intervention, including Mindfulness-based Stress Reduction, app- and web-based mindfulness training for addictions such as smoking, stress eating etc.; neurobiological mechanisms of mindfulness using modalities such as fMRI and EEG

Marc R. Freeman, PhD (Howard Hughes Medical Institute Early Career Scientist; Neurobiology) – Unwrapping glial biology in Drosophila

Manuel Garber, PhD. (Program in Molecular Medicine) e Associate professor of molecular medicine and bioinformatics and integrative biology, and director of the Bioinformatics Core

Rachel Gerstein, PhD (Microbiology and Physiological Systems) We investigate pathogenesis and new treatments for Non-Hodgkin's B cell Lymphoma. We identified epigenetic suppression of the senescence regulator SMURF2 as a novel pathway promoting c-myc over-expression in
Diffuse Large B cell Lymphoma (DLBCL). Current efforts are aimed at further defining this pathway in DLBCL as well investigating the basis of metastasis and chemotherapeutic resistance in a range of B cell Lymphomas.

Timothy Kowalik, PhD (Microbiology and Physiological Systems) The Kowalik laboratory studies basic and translational science aspects of viral infections, in particular infections caused by cytomegalovirus and influenza virus. Our goals are to better understand the disease process associated with these infections and to use our basic research program to improve antiviral therapies and vaccines.

Brian Lewis, PhD (Molecular, Cell and Cancer Biology) - A primary goal of our laboratory is to elucidate the molecular mechanisms essential for the development and progression of pancreatic and hepatocellular carcinomas, with the goal of informing novel treatment strategies for these malignancies. We perform a combination of in vivo studies utilizing genetically engineered mouse models, cell culture phenotypic assays performed on primary cell cultures and cancer cell lines, and molecular biology and biochemical approaches to address these questions.

Haley Melikian, PhD (Psychiatry) Our laboratory is interested in the molecular mechanisms that regulate presynaptic dopamine reuptake by the dopamine transporter (DAT). DAT is the primary target for addictive and therapeutic psychostimulants, and DAT regulatory mechanisms may have a significant impact on monoamine-related neuropsychiatric disorders, including ADHD and addiction. The lab uses a variety of biochemical, molecular and in vivo approaches to explore these possibilities, including RNAi, chemo-genetics and optogenetics.

Stephen Miller, PhD (Biochemistry & Molecular Pharmacology) Work in the Miller lab applies organic chemistry and optical imaging to the non-invasive interrogation of fundamental biological processes and disease states in live cells and animals.

Mary Munson, Ph.D. (Biochemistry and Molecular Pharmacology) My laboratory is interested in understanding the basic mechanisms of intracellular membrane trafficking—how do proteins, lipids and RNA move around inside the cell to the correct destination organelles, or get secreted to the outside of the cell? We study exocytosis, endocytosis and mRNA transport, which are highly regulated, fundamental processes for cell growth, division, polarity and communication. Our multidisciplinary research uses a wide variety of techniques (from biochemistry and structural biology, microscopy (fluorescent and EM), to cell biology and genetics/CRISPR) in several different organisms. Interests include the role of trafficking in yeast, the differentiation and function of neutrophils and platelets, the development of neurodegenerative diseases, and in viral and bacterial pathogenesis.

Sean Ryder, PhD (Biochemistry & Molecular Pharmacology) Mechanisms that govern post-transcriptional regulation of gene expression during development and complex disease, including: 1. Post-transcriptional regulatory mechanisms involved in axis polarization and cell fate specification during Caenorhabditis elegans embryogenesis. 2. Post-transcriptional mechanisms that guide oligodendrocyte differentiation and myelin formation in the vertebrate central nervous system. 3. Identification of small molecule inhibitors of RNA-binding protein function using high throughput screening approaches.

Jill Zitzewitz, PhD (Biochemistry & Molecular Pharmacology) Our lab studies the folding
of a set of ALS-linked proteins to understand how misfolding contributes to disease pathogenesis. By leveraging our biophysical understanding of the unique protein conformations that link productive folding and function to misfolding and dysfunction in disease, we can develop small molecule therapeutics to inhibit misfolding and biomarkers to follow disease progression.

**Assistant Professors**

Jeffrey Bailey MD, Ph.D. (Medicine) Bailey lab is interested in infectious disease genetics and tropical disease. Our work focuses on how gene duplication and conversion affect the interplay of host and pathogen assessing such features as host immunity, pathogen virulence, and pathogen drug resistance. We mainly work on malaria with current funding to understand the role of host copy number variation to protect against severe disease and the study of copy number variation and drug resistance in the parasite. All of this work leverages high-throughput genomics and improving computational approaches in the analysis of the host and pathogen. (website: baileylab.umassmed.edu/)

Kristina M. Deligiannidis, M.D (Psychiatry and Obstetrics & Gynecology) Clinical and translational depression & anxiety research; reproductive psychiatry; neuropsychopharmacology; psychoneuroendocrinology; multi-modal neuroimaging.

Claudio Punzo, Ph.D. (Ophthalmology and Gene Therapy Center) The Punzo Lab is interested in developing translational approaches to treat photoreceptor degenerative diseases that lead to blindness. Some of these disease are inherited such as Retinitis Pigmentosa while other are multi factorial such as Age-related Macular Degeneration.

Chinmay Trivedi, MD, PhD (Medicine, Cardiovascular Medicine) Congenital heart defects are the most common type of birth defects in the United States. An underlying pathology is often improper differentiation of progenitor cells during early cardiogenesis. Using animal disease models, the goal of the Trivedi laboratory is to identify fundamental cellular processes and epigenetic mechanisms involved in human congenital heart diseases. Mechanistic insights into embryonic cardiac growth pathways could pave the way to regenerate the injured embryonic and adult heart.

Konstantin Zeldovich, PhD (Bioinformatics & Integrative Biology, Biochemistry & Molecular Pharmacology) – Molecular evolution and protein folding using computer simulations and theory
Doctoral Programs with directed admissions pathways
Clinical & Population Health Research

Description

Key frameworks required to address current health care challenges demonstrate the need for a new paradigm for research that attempts to understand health and disease in a complex set of contextual environments in which risk and causal factors for disease are nested one within another, along with environmental factors, genetic factors, lifestyle behaviors and social contexts. Increasingly complex conceptual models and sophisticated study designs and statistical methodology are required to tackle research problems. It also calls for a new paradigm of research conduct. In response to this need, the Clinical and Population Health Research provides rigorous training in epidemiology, biostatistics and health services research training. The goal is to prepare individuals to be independent investigators and team scientists intending to pursue careers focused on reducing the risk of disease, improving health care and conducting important and relevant research that may be translated into practice and policy. Students may tailor their coursework to provide a concentration in: Aging, Behavioral Epidemiology, Cardiovascular Disease, Health Disparities, or Pharmacoepidemiology.

Typically, 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 one-year of introductory coursework in biostatistics and epidemiology.

Requirements for Specialization

Underscoring the proposed research and training activities is expertise in epidemiological, statistical, experimental, and quasi-experimental research methods, cutting-edge analytic techniques for analysis of large datasets, economic evaluations, state-of-the-art patient reported outcomes methods, health informatics, community engagement, and intervention research to promote health equity and to change patient and provider behavior. The program has a competency-based curriculum which builds upon the methodological foundation of epidemiology and biostatistics, but extends beyond this core foundation to incorporate the basics in social science theory pertinent to health services research and epidemiology. Students will achieve competence in seven core areas:

1) theory and context,
2) study design,
3) analysis, interpretation, and presentation of data,
4) ethics,
5) information and data acquisition and management,
6) bias, and
7) effective scientific communication.

Opportunities for achieving these competencies are provided through core and elective
courses. All students are required to take one year of advanced epidemiology and biostatistics, ethics, and a proposal development seminar. Students complete a teaching assistantship which provides a mentored educational experience. Students are required to select a minimum of two theory courses, three substantive electives, and 8 additional methods credits tailored to their research goals. Students must actively participate in journal clubs, seminars, grand rounds, and workshops throughout their training experience.

Beyond performance in courses and research assistantships, four evaluation milestones are required: comprehensive project, written qualifying exams, dissertation proposal development and defense, and dissertation defense. For the comprehensive project held in the summer of the first year, doctoral students must complete an independent project using existing data sources. The project will allow the student to demonstrate competence in organizing, pacing, and producing a research project within a set time frame. The manuscript undergoes internal peer review and students will revise and resubmit their manuscript draft. Each student gives a professional oral presentation and defends their work. The written qualifying exam takes place in early January of their second year. Each student is provided the opportunity to demonstrate methodological competence in fundamental and advanced epidemiological methods and biostatistics and their defined substantive area as evaluated via the written qualifying exams. The reading list for this portion of the exam will be the texts and materials covered in the core epidemiology and biostatistics courses and additional materials deemed relevant for the student’s defined substantive area. The oral qualifying exam occurs after the student completes writing their dissertation proposal – typically in the early summer of the second year. The purpose of the oral exam is to provide a forum for hearing the justification and design of the proposed doctoral research. However, the examination is not simply a presentation of a thesis proposal as questions related to substantive and methodological issues in the student’s specialization may be asked. After completing the three dissertation research papers, the final evaluation milestone is the dissertation defense.

Courses In Clinical & Population Health Research

Introduction To Epidemiology And Biostatistics

This course reviews basic principles of epidemiology and biostatistics. Didactic instruction, readings, and problem sets (including lab-based analyses) are utilized to more fully understand epidemics and their causes, as well as various study designs including cross-sectional studies, case-control studies, cohort designs, and randomized clinical trials. The fundamental principles of statistics, the scientific method, and hypothesis testing will be reviewed in depth. Students without a year of epidemiology and biostatistics are required to take this course before entering CTS603A and CTS602A.

Epidemiology & Research Methods

The overall objective of this course is for students to learn principles of epidemiologic methods and their application for analysis and interpretation of public health data. This course provides advanced introductory training for conducting epidemiologic investigations of disease etiology, health care services, and for interpretation of
published epidemiologic studies. By the end of this course, students should be sufficiently familiar with epidemiologic research methods to begin to apply these methods to their own work.

**Advanced Epidemiology & Research Methods**

This class extends material covered in the fall semester to include additional study designs and techniques used in epidemiologic research. Students learn about DAGs, case only study designs, ecological study designs, matching techniques applied to cohort and case control designs, bias adjustment and additional techniques to improve the efficiency of study designs. Students read primary literature related to methodological advances in epidemiology.

**General Linear Models**

This course will provide a foundation for statistical thinking in clinical and population health research. Students completing this course should have a working knowledge of statistical models used for estimation and inference; understand advanced statistical techniques; be able to develop modeling strategies and analysis plans for specific research questions; and, be prepared to implement those plans and summarize and interpret findings. This is a classroom-based course and students are expected to actively participate in class discussions. Practical statistical knowledge is gained through the conduct of in-class workshops where students are required to gain hands-on experience in statistical problem solving and analysis.

**Statistical Methods For Survival And Longitudinal Data Analysis**

This course will provide a foundation for statistical thinking in clinical and population health research involving time to event data and longitudinal data. Students completing this course should have a working knowledge of statistical models used for estimation and inference; understand advanced statistical techniques; be able to develop modeling strategies and analysis plans for specific research questions; and, be prepared to implement those plans and summarize and interpret findings involving time to event data and longitudinal data.

**Research Ethics For Clinical Research**

This course covers basic human subject’s research issues, including NIH guidelines, required certification, and Institutional Review Board processes and procedures. In addition, 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.

**Scientific Writing**

This course teaches students how to develop a peer reviewed scientific manuscript, through the review of elements of style, authorship, and extent of information that needs to be incorporated into a scientific research paper. Students will learn how to develop the elements that go into a successful scientific manuscript, submit an article for peer review and respond to reviewers' concerns. During each session, students will critique the work of others enrolled in the course to obtain hands on experience in the write-up of the introduction, methods, results, and discussion sections of a manuscript. This course will also teach students how to put together a successful oral, as well as poster,
scientific presentation.

**Systematic Review**

The purpose of this class is to learn how to conduct a systematic review including developing a question of appropriate scope and clinical relevance, development of abstraction tool, selection of articles, and drafting of all sections of the review including tables and figures. The end product will be a journal style and length systematic review in the topic area of the students’ substantive interest area that is 75% of the way to being ready for submission to a peer-reviewed journal.

**Grant Writing**

This course is designed to familiarize trainees with the grants review process and NIH grant proposal requirements. The course will include detailed overviews of the grant process, participation in several mock proposal review sessions, and completion of each of the written components of a grant including specific aims, background and significance, preliminary studies, and design methods. Students should invoke their mentor in the development of their grant proposal to the extent possible.

**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 an NIH R03 grant proposal, and at the end of the semester the student is 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 3-member Thesis Research Advisory Committee (TRAC) in making decisions regarding their proposal and receive their input throughout the semester, so that the student will be prepared to defend the proposal soon after the semester is completed. The course will also be useful as an introduction to NIH proposal writing.

**Advanced Topics In Biostatistics**

This course will cover an advanced topic in Biostatistics (for example, Longitudinal Data Analysis, Survival Analysis, Graphical Information Systems and Spatial statistics). The purpose of the course is to provide students with immersion in one particular area of biostatistics, providing the theoretical background necessary and the practical "hands-on" data analyze experience.

**Biomedical Informatics**

This course offers an overview of the field of biomedical informatics. In this course, concepts from computer and information science are combined with current issues in research, training and clinical practice. The course will provide a broad overview of electronic health records, decision support systems, standards, security and confidentiality, evidence-based medicine, information retrieval, bioinformatics, public health informatics, imaging informatics, and consumer health informatics.
Team Science
Students will learn how to create and sustain cohesive research teams, develop a productive program of research, develop good mentor and mentee relationships, engage in transdisciplinary science, understand the NIH Roadmap, and hear about different forms of clinical and community research from local investigators who conduct it.

Topics In Molecular Medicine
This course covers a variety of current topics centered on specific diseases with a molecular aspect to either diagnosis or treatment. The course is aimed at developing skills necessary for understanding and discovering how changes in gene function can cause human disease. The course includes a series of topics that use inherited disease processes to illustrate the physiological consequences of molecular, cellular, and genetic phenomena. The course emphasizes the acquisition of skills in interpreting scientific literature and synthesizing this knowledge with real-world patient care. In this way, students learn interesting state-of-the-art material while developing skills and expertise in integrative biology and molecular medicine.

Design Of Clinical Trials
The course is intended for the research scientist in training. The goal is to sharpen the methodologic skills in designing experimental studies for clinical investigators. The course addresses theoretical and practical methods in designing clinical trials with emphasis on design implications and development of individual study protocols. The course focuses on designing intervention studies to achieve research objectives by selecting appropriate study samples, end points and trial designs. Specific topics include efficacy versus effectiveness trials and critiquing clinical trial protocols, with emphasis on evaluating strengths and weaknesses of the trial design.

Advanced Analytical Methods For Health Outcomes Research
This advanced methods course is focused on learning methods for addressing confounding and bias. The goals for this course are: 1) to become comfortable recognizing and discussing bias and confounding; 2) to gain experience in using a variety of techniques that help in identifying and minimizing bias and confounding; and 3) to be able to assess the potential impact of residual bias and confounding on study results.

Randomized Clinical Trials In Behavioral Research
Preventable diseases, including cardiovascular disease, diabetes and others, are now the top causes of morbidity and mortality in the US. Behavioral interventions attempt to improve physical and/or mental health using behavioral, social, and cognitive strategies. Randomized trials testing behavioral interventions have unique methodological challenges that must be carefully dealt with to insure their impact on health outcomes. This course will cover methodological issues such as control group selection, internal and external validity, treatment fidelity, participant adherence, recruitment, and blinding. Other challenges reviewed in class include adoption, implementation, dissemination, and reimbursement in clinical and community settings. Students will also learn how to design pilot trials and about the preliminary data necessary when proposing behavioral
randomized trials in grant applications.

**Designing And Conducting Health Surveys**

This course introduces students to the foundations of survey methods. The course is designed to introduce students to the use of surveys in public health. Self-reported data, collected using various survey methods, are used to estimate behavioral risks, disease prevalence, access to medical care, health literacy, and physical activity.

**Measurement And Instrumentation In Clinical Research**

This is an advanced, graduate-level course that focuses on measurement theory and the processes of instrument evaluation, refinement and development. This course explores the use of quantitative and qualitative procedures to measure clinically important variables. In addition, emphasis is posited upon the interaction of conceptual, methodological, cultural and pragmatic considerations that are essential to understand when measuring variables among clinical populations.

**Health Literacy In Research And Practice**

This course focuses on examining and analyzing the concept of health literacy, with an emphasis on the relationship of health literacy to one’s ability to manage and optimize their health. The association of health literacy to health disparities and health outcomes will be explored. Challenges in conducting health literacy research and challenges inherent in providing quality care to those with limited health literacy will be examined. Evidence based individual and organizational approaches to mitigate the effects of limited health literacy will be addressed.

**Introduction To The U.S Healthcare System: How Policies And Practice Affect Health**

This course provides an in-depth look at the US healthcare system and its role in maintaining the health of US adults and provides a foundation for understanding and conducting health services research. We will introduce the constructs of structure, process, and outcomes of care to understand and evaluate health care quality and cost. Students will learn how health care policies and payment practices affect the accessibility, effectiveness and cost of care, and be introduced to studies using large administrative datasets that are not specifically designed for research. Students are expected to demonstrate basic knowledge and skills in course topics through class presentations, exercises and papers.

**Design And Conduct Of Studies Of Chronic Disease**

This course provides students with an overview of several chronic diseases of major public health and clinical importance, major chronic disease risk factors, and an in-depth understanding of the application of various epidemiological methods to design and conduct clinical/epidemiological studies on chronic disease and their primary and secondary prevention. The course will discuss fundamental concepts in chronic disease epidemiology, common research methods used in the design and conduct of studies of chronic disease epidemiology, and the application of these methods for the major chronic diseases affecting industrialized countries. Specific chronic diseases to be covered will vary from year to year but will include such diseases as cardiovascular disease, cancer, chronic pulmonary disease, chronic kidney disease, diabetes, and
musculoskeletal disorders.

**Analysis Of Health Care And Population-Based Datasets**

Epidemiologic, health services, and social/behavioral science researchers often conduct secondary analyses of existing population-level public health and health care datasets in order to estimate the prevalence of and associations between risk factors, behaviors, disease states, and other health-related outcomes. Benefits of using these datasets include their representative sampling frames allowing generalizability to larger populations, timeliness, and lower cost. In addition, computer technology also makes it possible to link some databases providing even richer sources of information. There are also several technical and methodological concerns that need to be considered in conducting secondary analyses. In this course, students will become familiar with the wealth of existing population-based public health, electronic medical record data, and claims data. Topics including advantages and disadvantages of using existing data, complex sampling and weighting, and obtaining limited-access data will be discussed. Using a population-based dataset, students will develop an analytic plan and draft a manuscript to answer a research question of their choosing. Students will build on their understanding of epidemiologic methods and analytic skills in the context of class assignments and an applied project.

**Principles Of Psychiatric Epidemiology**

This course provides an in-depth look at the psychiatric epidemiological research and is aimed at masters and doctoral level students or junior faculty in need formal training in psychiatric epidemiology. The course is structured to provide students with the methodological skills required for the study of psychiatric illnesses, an historical perspective through a comprehensive analysis of seminal works in the field, and application of these concepts to available data resources. This course will provide the foundation necessary to understand and conduct psychiatric epidemiology research. Students are expected to demonstrate basic knowledge and skills in course topics through small group presentations and by designing and executing an independent scientific research report.

**Social Epidemiology**

The goal of the course is to equip you to design and carry out analyses of the social determinants of health that are theoretically and methodologically sound. Secondary goals within the framework of this overall goal include: the ability to critically evaluate primary literature; the ability to interpret disparate findings in light of one another; the ability to formulate concise, clear research questions; the ability to apply appropriate methodology to turn data into answers to that question; and the ability to communicate your ideas clearly to professional and lay audiences. We will cover the main societal causes implicated in affecting the health of human populations, including class hierarchy, racism, gender hierarchy, heteronormativity, and ableism. Starting from a baseline of observing these social forces reflected in health disparities, we will spend most of our time examining the fundamental causes behind observed health disparities, and focused on methodologic approaches to measuring and interpreting these forces and their effects, on both minority and dominant populations. Students will define a research question, develop a literature review related to that question, and design and
execute an analysis of that question, resulting in a publication-quality paper by the end of the semester.

**Public Health Genomics**

This course provides an in-depth look at the contribution of human genetic variation in public health and is aimed at masters and doctoral level students or junior faculty. The course is structured to provide students with the methodological skills required for the study of common and rare genetic variants, an historical perspective through a comprehensive analysis of seminal works in the field, and application of these concepts to available data resources.

**Behavioral Determinants**

The purpose of this class is to learn models of disease prevention, multi-level determinants of health behaviors, and major theories of health behavior change and their application to interventions to address major public health problems.

**Qualitative Methods For Health Research**

This course examines uses of qualitative methods in mixed-qualitative or mixed-qualitative/quantitative health studies. Essential qualitative research components are explored: study community; theory; rigor; research questions; data collection methods; writing open-ended questions; sampling; data analysis; publishing; and writing proposals. Students apply concepts covered in class by collecting data for written assignments.

**Pharmacoepidemiology**

The purpose of this class is to learn pharmacoepidemiology, including: rigorous methodologic approaches to the measurement of medication exposure, adherence and adverse events; pharmacoepidemiologic study design; choices for pharmacoepidemiology data resources; and the role of quality of life measurements and pharmacoeconomics.

**Place And Health**

The influence of “place” on population health, including physical environment (e.g. air, water, soil, food), built environment (e.g. neighborhood structure, traffic, green space), social environment (e.g. cohesion, safety, deprivation, segregation), and legal and civic structure (e.g. policy, law, representation) are explored. Students learn to implement (and critique) methodologic approaches that are particularly adapted to understanding how individuals and places interact, specifically multilevel thinking and modeling, and spatial analytic methods. The course equips students to design and carry out analyses of the role of “place” in epidemiologic research. Secondary goals within the framework of this overall goal include: the ability to critically evaluate primary literature; the ability to interpret disparate findings in light of one another; the ability to formulate concise, clear research questions; the ability to apply appropriate methodology to turn data into answers to that question; and the ability to communicate your ideas clearly to professional and lay audiences.
Faculty

Program Director, Associate Dean, Clinical and Population Health Research

Kate L. Lapane, PhD MS (Quantitative Health Sciences) - pharmacoepidemiology, epidemiologic methods, aging, nursing home research

Professors

Jeroan Allison, MD, MS (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

Arlene S. Ash, PhD, (Quantitative Health Sciences) – Professor and division chief, biostatistics and health services research, advanced statistical methods, trial design

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

Bruce A. Barton, PhD, (Quantitative Health Sciences) – Biostatistics and health services research, director, and quantitative methods core

Edwin D. Boudreaux, PhD, (Emergency Medicine) – Psychiatry and Quantitative Health Sciences

Carol A. Bova, PhD, (Graduate School of Nursing) – Interventions aimed at the primary care needs of HIV-infected adults; HIV prevention among African immigrants

Edward W. Boyer, MD, PhD, (Emergency Medicine) – Artificial intelligence approaches to predicting human behavior, combinatorial interventions for HIV treatment and substance abuse and identifying real-time drug use in natural environments

Adel Bozorgzadeh, MD, (Surgery) – Liver transplantation outcomes

Robert H. Brown, MD, DPhil, (Neurology) – Amyotrophic lateral sclerosis, translational science

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

Michael P. Czech, PhD, (Program in Molecular Medicine) – discovery of molecular mechanisms, analysis of human adipose tissues, prevention and treatment of type 2 diabetes
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

Richard T. Ellison, MD, (Medicine) – research that focuses on the broad areas of identification and treatment of nosocomial infections, infections in the ICU setting, sepsis, and clinical care of patients with HIV disease

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

Patricia Franklin, MD, MBA, MPH (Orthopedics and Physical Rehabilitation) – Patient reported health outcomes; measuring cost and quality of care; total joint replacement outcomes; e-Health interventions; worksite prevention

Jean A. Frazier, MD, (Psychiatry) – Research addresses a variety of scientific problems relevant to advancing the understanding, diagnosis and treatment of individuals with neurodevelopmental disorders

Robert J. Goldberg, PhD (Quantitative Health Sciences) – Cardiovascular epidemiology; preventive cardiology

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

David M. Harlan, MD, (Medicine) – Research in tolerance mechanisms and organ/tissue transplantation, autoimmune illnesses, especially insulin dependent diabetes mellitus, human beta cell biology, and Improving diabetes care delivery systems

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

David C. Hoaglin, PhD, (Quantitative Health Sciences) – Biostatistics and health services research

Julia V. Johnson, MD, (Obstetrics and Gynecology) – Obstetrical outcomes research

Thomas K. Houston, MD, (Quantitative Health Sciences) – Division chief, health Informatics and Implementation science
Catarina Kiefe, MD, PhD (Quantitative Health Sciences) – Health care quality measurement and outcomes research

Jason J. Kim, PhD, (Program in Molecular Medicine) – Research obesity, diabetes and its complications using elegant metabolic procedures and transgenic mouse models of altered metabolism

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

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

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

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

Peter A. Rice, MD, (Medicine) – Research that involves the identification of unique determinants present on bacterial surfaces that may serve as suitable vaccine candidates to protect against infection in humans

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

Amy K. Rosen, PhD, (Quantitative Health Sciences) – Veterans health, quality improvement in the VA, health services research

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

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)

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

John E. Ware, PhD, (Quantitative Health Sciences) – Division chief, outcomes measurement science

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

Hong Yu, PhD, (Quantitative Health Sciences) – Health Informatics and Implementation Science

Douglas M. Ziedonis, MD, MPH, (Psychiatry) – addiction psychiatrist internationally recognized for his research and leadership in addressing co-occurring addiction and mental illness, in particular tobacco and also food addiction

**Associate Professors**

Ronald N. Adler, MD, (Family Medicine and Community Health) – Tools for chronic disease management

Susan Andrade, DSc, (Medicine) – Pharmacoepidemiology

Steven B. Bird, MD, (Emergency Medicine) – Medical education, metacognition, toxicology and organophosphorus pesticides

Diane R. Blake, MD, (Pediatrics) – Contraceptive management, GLBT health, primary care

Judson Brewer, MD, PhD, (Medicine) – Smoking cessation, mindfulness
Chad E. Darling, MD, (Emergency Medicine) – Cardiovascular research and delirium diagnosis

Catherine E. Dube, EdD, (Quantitative Health Sciences) – Epidemiology of chronic diseases and vulnerable populations, nursing home research, communication

Hua Fang, PhD, (Quantitative Health Sciences) – Biostatistics and health services research

Carl Fulwiler, MD, PhD (Psychiatry) – Forensic populations and co-occurring mental health and addictions

Manuel Garber, PhD, (Program in Molecular Medicine) – Associate professor of molecular medicine and bioinformatics and integrative biology, and director of the Bioinformatics Core

Leslie Harrold, MD, MPH, (Orthopedics and Physical Rehabilitation) – rheumatologist, epidemiologist, and a health services researcher

Sharone Green, MD (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

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

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

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

Eric O. Mick, ScD, (Quantitative Health Sciences) – Epidemiology of chronic diseases and vulnerable populations, psychiatric epidemiology, ADHD

Constance M. Moore, PhD, (Psychiatry) – Associate director of translational imaging, comparative NeuroImaging

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

Ann M. Moormann, PhD, (Program in Molecular Medicine) – Pediatric immunity to infectious diseases focusing on Plasmodium falciparum malaria and Epstein Barr Virus (EBV), molecular epidemiology, Global Health Research, and the etiology of endemic Burkitt lymphoma in Africa
Jane Owens (Saczenski), PhD, (Medicine) – Neuroepidemiologist with research interests in vascular disease and the risk for cognitive decline and dementia

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, skin cancer prevention

Sharina D. Person, PhD, (Quantitative Health Sciences) – Biostatistics and health services research, health disparities research

Allison B. Rosen, MD, MPH, SCD, (Quantitative Health Sciences) – Biostatistics and health services research, value in healthcare

Jennifer Tjia, MD, MSCE (Quantitative Health Sciences) – 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

Assistant Professors

Karim Alavi, MD, (Surgery) – Surgical outcomes research

Mara M. Epstein, ScD, ScM, (Medicine) – cancer epidemiology, inflammation and cancer, prostate cancer and hematological cancers

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

Timothy P. Hogan, PhD, (Quantitative Health Sciences) – Health informatics and implementation science

William M. Jesdale, PhD, (Quantitative Health Sciences) – Epidemiology of chronic diseases and vulnerable populations, environmental health, health disparities research, LGBT health

Jennifer LaFemina, MD, (Surgery) – Surgical outcomes research

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

Ann Lawthers, DSc, (Family Medicine and Community Health) – research in developing measures of quality that yield actionable results, training others in quality measurement and management techniques, and evaluating the quality of care delivered to vulnerable populations

Louise Maranda, PhD, (Quantitative Health Sciences) – Biostatistics and health services research

Paulo Martins, MD, PhD, FAST, (Surgery) – research interest on transplant immunobiology, especially on Ischemia Reperfusion Injury, and Immunosenescence, transplant outcome specifically on the use of extended criteria donors
Kristin Mattocks, PhD, MPH, (Quantitative Health Sciences) – Health informatics and implementation science; associate chief of staff for research and development, VA Central Western Massachusetts

Barbara C. Olendzki, MPH, RD, LDN, (Medicine) – Research in effect of diet and other lifestyle factors on obesity, diabetes, and heart disease, the IBD-AID: Anti-inflammatory Diet for Inflammatory Bowel Disease, and improving methods of dietary assessment in epidemiological studies

Heena P. Santry, MD, (Surgery) – Surgical outcomes research

Eric G. Smith, MD, MPH, (Psychiatry) – Mental health, veterans health, opioids

Molly Waring, PhD (Quantitative Health Sciences) – Epidemiology of chronic diseases and vulnerable populations, maternal child health, weight loss in the post-partum period

Ralph J. Zottola, PhD, (Quantitative Health Sciences) – Health informatics and implementation science

MD/PhD

Description

The MD/PhD Program is an integrated training program 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
- 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.

Requirements for Specialization

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. Prior to the start of medical school, each incoming student is required to complete a lab rotation with a faculty member in GSBS. 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 second laboratory rotation and participate in an intensive research literature course designed to answer a clinical question utilizing basic, translational and clinical research concepts. Following the second year of medical school, MD/PhD students enter the third year clinical clerkship experience (CCE) for 16 weeks prior to shifting to a research lab with their selected mentor 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 to complete their 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. MD/PhD students are eligible for graduate student stipends ($30,000 for 2015/2016) 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 mstp@umassmed.edu.

Curriculum
During the first two years, students take the standard pre-clinical courses offered to first- and second-year students in the School of Medicine. All students must also take:

**Developing Solutions to Research Problems**
The goal for the course is to expose MD-PhD students to areas of basic and translational research, and to the knowledge skills necessary to conduct research in these areas in a manner that enables their intellectual contribution to the University’s academic and research functions. To meet this goal, the course material will provide the foundational knowledge relevant to modern basic biomedical research. This will take place through scheduled didactic sessions by course faculty followed by interactive question and answer period.

Upon completion of this course, the MD-PhD students should be able to:

- Name and describe the major classes of macromolecules that regulate cellular functions, and recognize the distinct properties of each class.
- Give examples of how macromolecules from each class interact in both normal cellular physiology and in disease.
- Define and explain essential technical and conceptual investigative approaches used in predominant areas of basic, clinical and translational research.

**Developing Solutions to Research Problems**
The goal for the course is to expose MD-PhD students to areas of basic and translational research, and to the knowledge skills necessary to conduct research in these areas in a manner that enables their intellectual contribution to the University’s academic and research functions. To meet this goal, the student will work directly with a selected member of the research faculty for a minimum of one hour per week over the course of the semester (15 hours total). The focus and experimental methodologies of the investigators research will be explored in-depth through analysis of the primary literature and participation in individual and/or group discussion.

Upon completion of this course, the MD-PhD students should be able to:

- Identify papers in the primary research literature that relate to specific questions of biomedical relevance, and explain the basis for their relevance.
- Assess the general biomedical research area, and the clinical and translational implications of the research activity of specific investigators at this institution.
- Articulate novel questions related to a specific area of active investigation that
could be the basis of a viable thesis project.

**Developing Solutions to Research Problems**

The goal for the course is to expose MD-PhD students to areas of basic and translational research, and to the knowledge skills necessary to conduct research in these areas in a manner that enables their intellectual contribution to the University’s academic and research functions. To meet this goal, the student will work directly with a selected member of the research faculty, which can include but is not limited to their PhD thesis mentor, for a minimum of one hour per week over the course of the semester (15 hours total). They will discuss experimental strategies to address questions of basic, clinical, and/or translation importance. These can include, but are not limited to, work that advances the student’s personal research toward publication or presentation.

Upon completion of this course, the MD-PhD students should be able to:

- Propose feasible experimental strategies, including application of appropriate techniques, assessment of potential contingencies and pitfalls, and identification of alternative approaches, for investigation of novel research questions.
- When presented with two or more reports from the primary literature that reach conflicting conclusions about similar questions, evaluate the evidence and defend the merits of a particular argument. This includes an articulation of the major conclusions from each report, and an identification and evaluation of experiments that support the conclusions.
- Articulate the contribution of their personal research to knowledge in the broader area of interest.

**Introduction to Translational Medicine**

The MD/PhD program stresses the importance of clinical involvement throughout the graduate years. The first goal of this course is to provide students with a continuous link to clinical skills and to familiarize students with different clinical settings. Sessions should reinforce clinical skills learned from the first two years of the medical curriculum plus the 16 weeks of clerkship in Care of Family and Care of Adults prior to research studies.

The students will engage in clinical experiences for a minimum 10 hours in the fall and spring semesters and five hours during the summer semester. The students can round with physicians on the ward services, attend an outpatient clinic, or participate in supervised freestanding clinics in the local area. The second goal of this section of the course is to ease the transition back to the clinical years of medical school by each student working with a designated clinical preceptor who will supervise two returning MD-PhD students as they perform complete interviews, physical examinations, oral presentations, and write ups on hospitalized patients. Students will be evaluated by their faculty in these skills and a summary report will be generated at the end of the course.

**MD/PhD Seminar Series**

This seminar series is a monthly event, organized by the MD/PhD students, and
participation is required for all years in the program. The seminar assists students in developing communications competency through these presentations. Every month, two upper level graduate students present their research project. A moderator will maintain the 20 minute timeframe and facilitate the discussion. An anonymous critical evaluation is provided by each of the students’ colleagues electronically.

Students on the Clinical & Population Health Research Track must take the CPHR core curriculum during the first 14 months of doctoral study. Students on the Basic Biomedical Sciences Research Track may be advised to take elements of the Core Curriculum and/or one or more Advanced Topics courses offered by the Umbrella Admissions Programs.

**Qualifying Examination**

All MD-PhD students must take the Qualifying Examination within the first 6 months of entering PhD study. The purpose of the qualifying exam is to evaluate the student’s readiness for graduate level scientific study and to gauge the student’s potential for successful completion of the Ph.D. dissertation. The Qualifying Exam Committee conducts this evaluation primarily based on the student’s preparation and defense of an original research proposal as well as general knowledge of biomedical science and reasoning ability. The student’s performance in any coursework (medical school or graduate school classes) may also be considered as well as laboratory performance during rotations and beyond.

**Faculty**

**Program Directors**

Gyongyi Szabo, MD, PhD, (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)

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

**Professors**

Schahram Akbarian, MD, (Psychiatry) The prefrontal cortex and schizophrenia; dopaminergic signaling and chromatin remodeling in neurons; genetic models for Rett disorder

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

Victor Ambros, PhD, (Program in Molecular Medicine) Molecular and genetic control of animal development; microRNA regulatory mechanisms

Neil Aronin, MD, Medicine) Huntington's disease
Samuel Behar, MD, PhD, (Microbiology & Physiological Systems)
Leslie Berg PhD, Pathology Molecular mechanisms regulating the homeostasis of hematopoietic progenitors
Adel Bozorgzadeh, MD, Surgery Liver transplantation outcomes
Robert Brown, MD, DPhil, (Neurology) Amyotrophic lateral sclerosis
Vivian Budnick, PhD, (Neurobiology) Molecular mechanisms of synapse assembly and plasticity
Anthony Carruthers, PhD, (Biochemistry & Molecular Pharmacology) Mechanisms of glucose transport and glucose transport regulation
Robin Clark, PhD, (Family Medicine & Community Health) Economic evaluation; mental health and substance abuse policy; health care financing
Michael Czech, PhD, (Program in Molecular Medicine) Discovery of molecular mechanisms, analysis of human adipose tissues, prevention and treatment of type 2 diabetes
Roger Davis, PhD, (Program in Molecular Medicine) Signal transduction by the epidermal growth factor receptor; mechanisms by which growth factors regulate cellular proliferation
Stephen Doxsey, PhD, (Program in Molecular Medicine) The role of the centrosome in microtubule nucleation, spindle assembly and cancer
Patrick Emery, PhD, (Neurobiology) Circadian rhythms and their synchronization in Drosophila
Katherine Fitzgerald, PhD, (Medicine) Innate immune signaling
Patricia Franklin, MD, MBA, MPH Orthopedics & Physical Rehabilitation Patient reported health outcomes; measuring cost and quality of care; total joint replacement outcomes; e-Health interventions; worksite prevention
Marc Freeman, PhD, Neurobiology Unwrapping glial biology in Drosophila
Guangping Gao, PhD, (Microbiology & Physiological Systems) Adeno-associated virus vectors for gene therapy of genetic diseases
Robert Goldberg, PhD, (Quantitative Health Sciences) Cardiovascular epidemiology; preventive cardiology; epidemiologic methods
Douglas Golenbock, MD, (Medicine) Toll receptors; pathophysiology of sepsis and pelvic inflammatory disease
Michael Green, MD, PhD, (Molecular, Cell and Cancer Biology) Eukaryotic gene regulation and cancer molecular biology
Dale Greiner, PhD, (Program in Molecular 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
Lawrence Hayward, MD, PhD, (Neurology) Ion channelopathies, motor neuron disease, and neuromuscular channelopathies

Jean Marie 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

Y. Tony Ip, PhD, (Program in Molecular Medicine) Regulatory mechanisms in Drosophila innate immunity

Allan Jacobson, PhD, (Microbiology & Physiological Systems) Post-transcriptional regulation of gene expression in yeast

Stephen Jones, PhD, (Cell and Developmental Biology) Analysis of signal transduction and cancer using genetically modified mice

Paul Kaufman, PhD, (Molecular, Cell and Cancer Biology) Assembly and function of eukaryotic chromosomes

John Keaney, Jr. MD, (Medicine) Cardiovascular Medicine

Michelle Kelliher, PhD, (Molecular, Cell and Cancer Biology) Genetic analysis of programmed cell death in the mouse

David Kennedy, PhD, Psychiatry

Anastasia Khvorova, PhD, (Program in Molecular Medicine) Develop and characterize novel RNA chemistries to promote efficient oligonucleotide internalization and tissue distribution

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

Jason Kim PhD, (Program in Molecular Medicine) Research obesity, diabetes and its complications using elegant metabolic procedures and transgenic mouse models of altered metabolism

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

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

Evelyn 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

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

John Landers, PhD, (Neurology) Genetics of familial and sporadic ALS
Jeanne Lawrence, PhD, Cell and Developmental Biology Developmental genetics including chromosome mapping and the functional organization of DNA and RNA within the interphase nucleus

Nathan Lawson, PhD, (Molecular, Cell and Cancer Biology) Determining the signals responsible for blood vessel development using zebrafish

Stuart Levitz, MD, (Medicine) Interplay between host immune system and opportunistic fungal pathogens

Jane Lian, PhD, (Orthopedics & Physical Rehabilitation) Molecular mechanisms regulating skeletal development and metastasis of cancer cells to bone

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

Jeremy Luban, MD, (Program in Molecular Medicine) Viral replication, pathogenesis, and immunity

Dannel McCollum, PhD, (Biochemistry & Molecular Pharmacology) Signaling pathways controlling cell growth and division

Arthur Mercurio, PhD, (Molecular, Cell and Cancer Biology) Mechanisms of carcinoma progression

Melissa Moore, PhD, (Biochemistry & Molecular Pharmacology) Eukaryotic RNA processing and metabolism

Trudy Morrison, PhD, (Microbiology & Physiological Systems) Structure and intracellular processing of viral glycoproteins

Peter Newburger, MD, (Pediatrics) Global analysis and regulation of phagocyte gene expression; pattern recognition receptor expression and function in neutrophils

Ira Ockene, MD, (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 Ockene, PhD, MEd, MA, (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

David Paydarfar, MD, (Neurology) Basis of oscillatory nerve activity; respiratory control

Gregory Pazour, PhD, (Program in Molecular Medicine) Function of the Mammalian Primary Cilium and Mechanisms of Eukaryotic Ciliary Assembly

Craig Peterson, PhD, (Program in Molecular Medicine) Roles of the SWI/SNF complex and chromatin in regulation of eukaryotic gene expression

Oliver Rando, MD, PhD, (Biochemistry & Molecular Pharmacology) Genomic approaches to chromatin structure and function, and to epigenetic inheritance
Steven Reppert, MD, (Neurobiology) Molecular neuroethology
Nicholas Rhind, PhD, (Biochemistry & Molecular Pharmacology) Checkpoint regulation of the fission yeast cell cycle
Joel Richter, PhD, (Program in Molecular Medicine) Regulation of maternal mRNA expression in early development
Kenneth Rock, MD, (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
Ann Rothstein, PhD, (Medicine)
William Royer, PhD, (Biochemistry & Molecular Pharmacology) X-ray crystallographic imaging of macromolecular structures; structural basis for inter-subunit communication and macromolecular interactions
Katherine Ruiz De Luzuriaga, MD, (Program in Molecular 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; 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; development of prophylactic and therapeutic vaccine strategies for HIV
Christopher Sassetti, PhD, (Microbiology & Physiological Systems) Genetic and genomic approaches to understand tuberculosis pathogenesis
Celia Schiffer, PhD, (Biochemistry & Molecular Pharmacology) Structural basis for molecular recognition in HIV Protease
William Schwartz, MD, (Neurology) The neurobiology of circadian timekeeping
Liisa Selin, MD, PhD, Pathology
Neal Silverman, PhD, (Medicine) Signal transduction during the insect immune response
Erik Sontheimer, PhD, (Program in Molecular Medicine) Biology and mechanism of RNA-based gene regulation; CRISPR interference; RNA-directed genome editing and gene control
Janet Stein, PhD, (Cell and Developmental Biology)
Lawrence Stern, PhD, (Pathology) Molecular recognition in the immune system
William Theurkauf, PhD, (Program in Molecular Medicine) Control of chromosome segregation in early development
Paul Thompson, PhD, (Biochemistry & Molecular Pharmacology) Techniques of chemical biology, biochemistry, and enzymology to develop inhibitors/drugs targeting disease associated enzymes as well as developing novel diagnostics for cancer
Carole Upshur, EdD, (Family Medicine & Community Health) Mental health integration in primary care; chronic pain; delivery of care to disadvantaged populations

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

Raymond Welsh, PhD, (Pathology) Viral immunology and pathogenesis; natural killer and cytotoxic T cells in murine model systems; T cell apoptosis and memory

Zhiping Weng, PhD, (Biochemistry & Molecular Pharmacology) Bioinformatics and computational genomics

Robert Woodland, PhD, (Microbiology & Physiological Systems) Signaling mechanisms maintaining B lymphocyte growth, survival and immune responsiveness; HIV vaccine development using humanized chimeric mice

Hong Yu, PhD, (Quantitative Health Sciences) Health Informatics and Implementation Science

Phillip Zamore, PhD, (Biochemistry & Molecular Pharmacology) Dissecting the RNAi and miRNA Pathways

Associate Professors

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

Daryl Bosco, PhD, (Neurology) Mechanisms of amyotrophic lateral sclerosis; protein misfolding

Lucio Castilla, PhD, (Molecular, Cell and Cancer Biology) Genetics of leukemia in mouse models

Marcus Cooper, MD, (Medicine) Manipulation of transcriptional pathways to reduce obesity

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

David Guertin, PhD, (Program in Molecular Medicine) Nutrient and growth factor sensing pathways in cancer and development

Timothy Kowalik, PhD, (Microbiology & Physiological Systems) Regulation of cellular proliferation control during viral infection

Brian Lewis, PhD, (Molecular, Cell and Cancer Biology) Molecular genetics of pancreatic and liver cancers

Egil Lien, PhD, (Medicine) Mechanisms for microbial activation and evasion of innate immune responses via Toll-like receptors

Stephen Lyle, MD, PhD, (Molecular, Cell and Cancer Biology) Stem cells and cancer

Constance Moore, PhD, (Psychiatry) Magnetic resonance spectroscopy in neuropsychiatric diseases and animal models.

Ann Moormann, PhD, MPH, (Program in Molecular Medicine) Viral immunology and epidemiology
Mary Munson, PhD, (Biochemistry & Molecular Pharmacology) Regulation of vesicle targeting and fusion

Peter Pryciak, PhD, (Biochemistry & Molecular Pharmacology) Function of yeast heterotrimeric G proteins in signal transduction and cell polarity

Sean Ryder, PhD, (Biochemistry & Molecular Pharmacology) Post-transcriptional regulation of maternal mRNAs in early development

Leslie Shaw, PhD, (Molecular, Cell and Cancer Biology) Mechanisms of tumor metastasis

Merav Socolovsky, MD, PhD, (Molecular, Cell and Cancer Biology) Molecular mechanisms regulating the homeostasis of hematopoietic progenitors

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

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

Fumihiko Urano, MD, PhD, (Program in Molecular Medicine)

Jens Walz, MD, (Anesthesiology)

Scot Wolfe, PhD, (Molecular, Cell and Cancer Biology) Creating artificial DNA-binding domains for targeted gene regulation and gene modification

_**Assistant Professors**_

Jeffrey Bailey, MD, PhD, (Medicine) Genetic variation in infectious disease susceptibility and pathogenesis, concentrating on the role of segmental duplication and copy number variation

Abraham Brass, MD, PhD, (Microbiology & Physiological Systems)

Brian Kelch, PhD, (Biochemistry & Molecular Pharmacology) The structural mechanisms of the macromolecular machines that carry out DNA replication.

Michael Lee, PhD, (Program in Molecular Medicine) Systems pharmacology of anticancer therapies

Anujia Mathew, PhD, (Medicine) T cell responses to acute viral infections

Christian Muller, PhD, (Pediatrics)

Read Pukkila-Worley, MD, (Medicine)

Chinmay Trivedi MD, PhD, (Medicine)

Donghai Wang, PhD, (Molecular, Cell and Cancer Biology) Transcriptional control of energy metabolism and metabolic diseases by the nuclear receptor PPAR subfamily

_**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 UMass-affiliated residents,
residency graduates and fellows who seek more rigorous biomedical research 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

Masters Programs

MSCI

Description

The Master of Science in Clinical Investigation (MSCI) is a training program that prepares students for conducting independent research. Typically, the MSCI is completed over two years with one year of required graduate coursework and a second year of intensive mentored research and electives. For medical students or residents, this may be completed over one summer followed by an intense year of coursework and research. All 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. Students are expected to attend events relevant to their research to enhance the core curriculum (e.g., seminars, grand rounds, and journal clubs offered on the UMMS campus, research conferences, workshops) and to have ongoing contact with their mentors regarding their research. All students must conduct and defend a 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 positions students 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.

Requirements for Specialization

Eligible candidates for the MSCI degree 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. Medical students at UMMS are also eligible candidates if willing to take a one-year leave of absence from medical school to complete the MSCI.

**Courses the Master’s in Clinical Investigation Program**

*Introduction to Epidemiology and Biostatistics*

This course reviews basic principles of epidemiology and biostatistics. Didactic instruction, readings, and problem sets (including lab-based analyses) are utilized to more fully understand epidemics and their causes, as well as various study designs including cross-sectional studies, case-control studies, cohort designs, and randomized clinical trials. The fundamental principles of statistics, the scientific method, and hypothesis testing will be reviewed in depth. Students without a year of epidemiology and biostatistics are required to take this course before entering CTS603A and CTS602A.

*Epidemiology & Research Methods*

The overall objective of this course is for students to learn principles of epidemiologic methods and their application for analysis and interpretation of public health data. This course provides advanced introductory training for conducting epidemiologic investigations of disease etiology, health care services, and for interpretation of published epidemiologic studies. By the end of this course, students should be sufficiently familiar with epidemiologic research methods to begin to apply these methods to their own work.

*Advanced Epidemiology & Research Methods*

This class extends material covered in the fall semester to include additional study designs and techniques used in epidemiologic research. Students learn about DAGs, case only study designs, ecological study designs, matching techniques applied to cohort and case control designs, bias adjustment and additional techniques to improve the efficiency of study designs. Students read primary literature related to methodological advances in epidemiology.

*General Linear Models*

This course will provide a foundation for statistical thinking in clinical and population health research. Students completing this course should have a working knowledge of statistical models used for estimation and inference; understand advanced statistical techniques; be able to develop modeling strategies and analysis plans for specific research questions; and, be prepared to implement those plans and summarize and interpret findings. This is a classroom-based course and students are expected to actively participate in class discussions. Practical statistical knowledge is gained through the conduct of in-class workshops where students are required to gain hands-on experience in statistical problem solving and analysis.

*Statistical Methods For Survival And Longitudinal Data Analysis*

This course will provide a foundation for statistical thinking in clinical and population health research involving time to event data and longitudinal data. Students completing this course should have a working knowledge of statistical models used for estimation.
and inference; understand advanced statistical techniques; be able to develop modeling strategies and analysis plans for specific research questions; and, be prepared to implement those plans and summarize and interpret findings involving time to event data and longitudinal data.

**Research Ethics For Clinical Research**

This course covers basic human subject's research issues, including NIH guidelines, required certification, and Institutional Review Board processes and procedures. In addition, 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.

**Scientific Writing**

This course teaches students how to develop a peer reviewed scientific manuscript, through the review of elements of style, authorship, and extent of information that needs to be incorporated into a scientific research paper. Students will learn how to develop the elements that go into a successful scientific manuscript, submit an article for peer review and respond to reviewers' concerns. During each session, students will critique the work of others enrolled in the course to obtain hands on experience in the write-up of the introduction, methods, results, and discussion sections of a manuscript. This course will also teach students how to put together a successful oral, as well as poster, scientific presentation.

**Systematic Review**

The purpose of this class is to learn how to conduct a systematic review including developing a question of appropriate scope and clinical relevance, development of abstraction tool, selection of articles, and drafting of all sections of the review including tables and figures. The end product will be a journal style and length systematic review in the topic area of the students’ substantive interest area that is 75% of the way to being ready for submission to a peer-reviewed journal.

**Grant Writing**

This course is designed to familiarize trainees with the grants review process and NIH grant proposal requirements. The course will include detailed overviews of the grant process, participation in several mock proposal review sessions, and completion of each of the written components of a grant including specific aims, background and significance, preliminary studies, and design methods. Students should invoke their mentor in the development of their grant proposal to the extent possible.

**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 an NIH R03 grant proposal, and at the end of the semester the student is 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 3-member Thesis
Research Advisory Committee (TRAC) in making decisions regarding their proposal and receive their input throughout the semester, so that the student will be prepared to defend the proposal soon after the semester is completed. The course will also be useful as an introduction to NIH proposal writing.

Advanced Topics In Biostatistics
This course will cover an advanced topic in Biostatistics (for example, Longitudinal Data Analysis, Survival Analysis, Graphical Information Systems and Spatial statistics). The purpose of the course is to provide students with immersion in one particular area of biostatistics, providing the theoretical background necessary and the practical "hands-on" data analyze experience.

Biomedical Informatics
This course offers an overview of the field of biomedical informatics. In this course, concepts from computer and information science are combined with current issues in research, training and clinical practice. The course will provide a broad overview of electronic health records, decision support systems, standards, security and confidentiality, evidence-based medicine, information retrieval, bioinformatics, public health informatics, imaging informatics, and consumer health informatics.

Team Science
Students will learn how to create and sustain cohesive research teams, develop a productive program of research, develop good mentor and mentee relationships, engage in trans-disciplinary science, understand the NIH Roadmap, and hear about different forms of clinical and community research from local investigators who conduct it.

Topics In Molecular Medicine
This course covers a variety of current topics centered on specific diseases with a molecular aspect to either diagnosis or treatment. The course is aimed at developing skills necessary for understanding and discovering how changes in gene function can cause human disease. The course includes a series of topics that use inherited disease processes to illustrate the physiological consequences of molecular, cellular, and genetic phenomena. The course emphasizes the acquisition of skills in interpreting scientific literature and synthesizing this knowledge with real-world patient care. In this way, students learn interesting state-of-the-art material while developing skills and expertise in integrative biology and molecular medicine.

Design Of Clinical Trials
The course is intended for the research scientist in training. The goal is to sharpen the methodologic skills in designing experimental studies for clinical investigators. The course addresses theoretical and practical methods in designing clinical trials with emphasis on design implications and development of individual study protocols. The course focuses on designing intervention studies to achieve research objectives by selecting appropriate study samples, end points and trial designs. Specific topics include efficacy versus effectiveness trials and critiquing clinical trial protocols, with emphasis on evaluating strengths and weaknesses of the trial design.
**Advanced Analytical Methods For Health Outcomes Research**

This advanced methods course is focused on learning methods for addressing confounding and bias. The goals for this course are: 1) to become comfortable recognizing and discussing bias and confounding; 2) to gain experience in using a variety of techniques that help in identifying and minimizing bias and confounding; and 3) to be able to assess the potential impact of residual bias and confounding on study results.

**Randomized Clinical Trials In Behavioral Research**

Preventable diseases, including cardiovascular disease, diabetes and others, are now the top causes of morbidity and mortality in the US. Behavioral interventions attempt to improve physical and/or mental health using behavioral, social, and cognitive strategies. Randomized trials testing behavioral interventions have unique methodological challenges that must be carefully dealt with to insure their impact on health outcomes. This course will cover methodological issues such as control group selection, internal and external validity, treatment fidelity, participant adherence, recruitment, and blinding. Other challenges reviewed in class include adoption, implementation, dissemination, and reimbursement in clinical and community settings. Students will also learn how to design pilot trials and about the preliminary data necessary when proposing behavioral randomized trials in grant applications.

**Designing And Conducting Health Surveys**

This course introduces students to the foundations of survey methods. The course is designed to introduce students to the use of surveys in public health. Self-reported data, collected using various survey methods, are used to estimate behavioral risks, disease prevalence, access to medical care, health literacy, and physical activity.

**Measurement And Instrumentation In Clinical Research**

This is an advanced, graduate-level course that focuses on measurement theory and the processes of instrument evaluation, refinement and development. This course explores the use of quantitative and qualitative procedures to measure clinically important variables. In addition, emphasis is posited upon the interaction of conceptual, methodological, cultural and pragmatic considerations that are essential to understand when measuring variables among clinical populations.

**Health Literacy In Research And Practice**

This course focuses on examining and analyzing the concept of health literacy, with an emphasis on the relationship of health literacy to one’s ability to manage and optimize their health. The association of health literacy to health disparities and health outcomes will be explored. Challenges in conducting health literacy research and challenges inherent in providing quality care to those with limited health literacy will be examined. Evidence based individual and organizational approaches to mitigate the effects of limited health literacy will be addressed.

**Introduction To The U.S Healthcare System: How Policies And Practice Affect Health**

This course provides an in-depth look at the US healthcare system and its role in
maintaining the health of US adults and provides a foundation for understanding and conducting health services research. We will introduce the constructs of structure, process, and outcomes of care to understand and evaluate health care quality and cost. Students will learn how health care policies and payment practices affect the accessibility, effectiveness and cost of care, and be introduced to studies using large administrative datasets that are not specifically designed for research. Students are expected to demonstrate basic knowledge and skills in course topics through class presentations, exercises and papers.

**Design And Conduct Of Studies Of Chronic Disease**

This course provides students with an overview of several chronic diseases of major public health and clinical importance, major chronic disease risk factors, and an in-depth understanding of the application of various epidemiological methods to design and conduct clinical/epidemiological studies on chronic disease and their primary and secondary prevention. The course will discuss fundamental concepts in chronic disease epidemiology, common research methods used in the design and conduct of studies of chronic disease epidemiology, and the application of these methods for the major chronic diseases affecting industrialized countries. Specific chronic diseases to be covered will vary from year to year but will include such diseases as cardiovascular disease, cancer, chronic pulmonary disease, chronic kidney disease, diabetes, and musculoskeletal disorders.

**Analysis Of Health Care And Population-Based Datasets**

Epidemiologic, health services, and social/behavioral science researchers often conduct secondary analyses of existing population-level public health and health care datasets in order to estimate the prevalence of and associations between risk factors, behaviors, disease states, and other health-related outcomes. Benefits of using these datasets include their representative sampling frames allowing generalizability to larger populations, timeliness, and lower cost. In addition, computer technology also makes it possible to link some databases providing even richer sources of information. There are also several technical and methodological concerns that need to be considered in conducting secondary analyses. In this course, students will become familiar with the wealth of existing population-based public health, electronic medical record data, and claims data. Topics including advantages and disadvantages of using existing data, complex sampling and weighting, and obtaining limited-access data will be discussed. Using a population-based dataset, students will develop an analytic plan and draft a manuscript to answer a research question of their choosing. Students will build on their understanding of epidemiologic methods and analytic skills in the context of class assignments and an applied project.

**Principles Of Psychiatric Epidemiology**

This course provides an in-depth look at the psychiatric epidemiological research and is aimed at masters and doctoral level students or junior faculty in need formal training in psychiatric epidemiology. The course is structured to provide students with the methodological skills required for the study of psychiatric illnesses, an historical perspective through a comprehensive analysis of seminal works in the field, and application of these concepts to available data resources. This course will provide the
foundation necessary to understand and conduct psychiatric epidemiology research. Students are expected to demonstrate basic knowledge and skills in course topics through small group presentations and by designing and executing an independent scientific research report.

**Social Epidemiology**

The goal of the course is to equip you to design and carry out analyses of the social determinants of health that are theoretically and methodologically sound. Secondary goals within the framework of this overall goal include: the ability to critically evaluate primary literature; the ability to interpret disparate findings in light of one another; the ability to formulate concise, clear research questions; the ability to apply appropriate methodology to turn data into answers to that question; and the ability to communicate your ideas clearly to professional and lay audiences. We will cover the main societal causes implicated in affecting the health of human populations, including class hierarchy, racism, gender hierarchy, heteronormativity, and ableism. Starting from a baseline of observing these social forces reflected in health disparities, we will spend most of our time examining the fundamental causes behind observed health disparities, and focused on methodologic approaches to measuring and interpreting these forces and their effects, on both minority and dominant populations. Students will define a research question, develop a literature review related to that question, and design and execute an analysis of that question, resulting in a publication-quality paper by the end of the semester.

**Public Health Genomics**

This course provides an in-depth look at the contribution of human genetic variation to public health and is aimed at masters and doctoral level students or junior faculty. The course is structured to provide students with the methodological skills required for the study of common and rare genetic variants, an historical perspective through a comprehensive analysis of seminal works in the field, and application of these concepts to available data resources.

**Behavioral Determinants**

The purpose of this class is to learn models of disease prevention, multi-level determinants of health behaviors, and major theories of health behavior change and their application to interventions to address major public health problems.

**Qualitative Methods For Health Research**

This course examines uses of qualitative methods in mixed-qualitative or mixed-qualitative/quantitative health studies. Essential qualitative research components are explored: study community; theory; rigor; research questions; data collection methods; writing open-ended questions; sampling; data analysis; publishing; and writing proposals. Students apply concepts covered in class by collecting data for written assignments.

**Pharmacoepidemiology**

The purpose of this class is to learn pharmacoepidemiology, including: rigorous methodologic approaches to the measurement of medication exposure, adherence and adverse events; pharmacoepidemiologic study design; choices for
pharmacoepidemiology data resources; and the role of quality of life measurements and pharmacoeconomics.

**Place And Health**

The influence of “place” on population health, including physical environment (e.g. air, water, soil, food), built environment (e.g. neighborhood structure, traffic, green space), social environment (e.g. cohesion, safety, deprivation, segregation), and legal and civic structure (e.g. policy, law, representation) are explored. Students learn to implement (and critique) methodologic approaches that are particularly adapted to understanding how individuals and places interact, specifically multilevel thinking and modeling, and spatial analytic methods. The course equips students to design and carry out analyses of the role of “place” in epidemiologic research. Secondary goals within the framework of this overall goal include: the ability to critically evaluate primary literature; the ability to interpret disparate findings in light of one another; the ability to formulate concise, clear research questions; the ability to apply appropriate methodology to turn data into answers to that question; and the ability to communicate your ideas clearly to professional and lay audiences.

**Faculty**

**MSCI Program Director, Division Chief, Epidemiology**

Robert J. Goldberg, PhD (Quantitative Health Sciences) – Cardiovascular epidemiology; preventive cardiology

**Professors**

Jeroan Allison, MD, MS (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

Arlene S. Ash, PhD, (Quantitative Health Sciences) – Professor and division chief, biostatistics and health services research, advanced statistical methods, trial design

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

Bruce A. Barton, PhD, (Quantitative Health Sciences) – Biostatistics and health services research, director, and quantitative methods core

Edwin D. Boudreaux, PhD, (Emergency Medicine) – Psychiatry and Quantitative Health Sciences

Carol A. Bova, PhD, (Graduate School of Nursing) – Interventions aimed at the primary care needs of HIV-infected adults; HIV prevention among African immigrants
Edward W. Boyer, MD, PhD, (Emergency Medicine) – Artificial intelligence approaches to predicting human behavior, combinatorial interventions for HIV treatment and substance abuse and identifying real-time drug use in natural environments

Adel Bozorgzadeh, MD, (Surgery) – Liver transplantation outcomes

Robert H. Brown, MD, DPhil, (Neurology) – Amyotrophic lateral sclerosis, translational science

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

Michael P. Czech, PhD, (Program in Molecular Medicine) – discovery of molecular mechanisms, analysis of human adipose tissues, prevention and treatment of type 2 diabetes

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

Richard T. Ellison, MD, (Medicine) – research that focuses on the broad areas of identification and treatment of nosocomial infections, infections in the ICU setting, sepsis, and clinical care of patients with HIV disease

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

Patricia Franklin, MD, MBA, MPH (Orthopedics and Physical Rehabilitation) – Patient reported health outcomes; measuring cost and quality of care; total joint replacement outcomes; e-Health interventions; worksite prevention

Jean A. Frazier, MD, (Psychiatry) – Research addresses a variety of scientific problems relevant to advancing the understanding, diagnosis and treatment of individuals with neurodevelopmental disorders

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

David M. Harlan, MD, (Medicine) – Research in tolerance mechanisms and organ/tissue transplantation, autoimmune illnesses, especially insulin dependent
diabetes mellitus, human beta cell biology, and Improving diabetes care delivery systems

Stephen O. Heard, MD (Anesthesiology, Surgery) – Catheter-related bloodstream 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

David C. Hoaglin, PhD, (Quantitative Health Sciences) – Biostatistics and health services research

Julia V. Johnson, MD, (Obstetrics and Gynecology) – Obstetrical outcomes research

Thomas K. Houston, MD, (Quantitative Health Sciences) – Division chief, health Informatics and Implementation science

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

Jason J. Kim, PhD, (Program in Molecular Medicine) – Research obesity, diabetes and its complications using elegant metabolic procedures and transgenic mouse models of altered metabolism

Kate L. Lapane, PhD MS (Quantitative Health Sciences)-pharmacoepidemiology, epidemiologic methods, aging, nursing home research

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

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

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
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

Peter A. Rice, MD, (Medicine) – Research that involves the identification of unique determinants present on bacterial surfaces that may serve as suitable vaccine candidates to protect against infection in humans

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

Amy K. Rosen, PhD, (Quantitative Health Sciences) – Veterans health, quality improvement in the VA, health services research

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

Anthony J. Rothschild, MD (Irving S. and Betty Brudnick Chair in Psychiatry; Psychiatry) – Pharmacoeconomics; 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

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)

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

John E. Ware, PhD, (Quantitative Health Sciences) – Division chief, outcomes measurement science

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

Hong Yu, PhD, (Quantitative Health Sciences) – Health Informatics and Implementation Science
Douglas M. Ziedonis, MD, MPH, (Psychiatry) — addiction psychiatrist internationally recognized for his research and leadership in addressing co-occurring addiction and mental illness, in particular tobacco and also food addiction

**Associate Professors**

Ronald N. Adler, MD, (Family Medicine and Community Health) — Tools for chronic disease management

Susan Andrade, DSc, (Medicine) — Pharmacoepidemiology

Steven B. Bird, MD, (Emergency Medicine) — Medical education, metacognition, toxicology and organophosphorus pesticides

Diane R. Blake, MD, (Pediatrics) — Contraceptive management, GLBT health, primary care

Judson Brewer, MD, PhD, (Medicine) — Smoking cessation, mindfulness

Chad E. Darling, MD, (Emergency Medicine) — Cardiovascular research and delirium diagnosis

Catherine E. Dube, EdD, (Quantitative Health Sciences) — Epidemiology of chronic diseases and vulnerable populations, nursing home research, communication

Hua Fang, PhD, (Quantitative Health Sciences) — Biostatistics and health services research

Carl Fulwiler, MD, PhD (Psychiatry) — Forensic populations and co-occurring mental health and addictions

Manuel Garber, PhD, (Program in Molecular Medicine) — Associate professor of molecular medicine and bioinformatics and integrative biology, and director of the Bioinformatics Core

Leslie Harrold, MD, MPH, (Orthopedics and Physical Rehabilitation) — rheumatologist, epidemiologist, and a health services researcher

Sharone Green, MD (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

Stephanie 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

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

Eric O. Mick, ScD, (Quantitative Health Sciences) – Epidemiology of chronic diseases and vulnerable populations, psychiatric epidemiology, ADHD

Constance M. Moore, PhD, (Psychiatry) – Associate director of translational imaging, comparative NeuroImaging

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

Ann M. Moormann, PhD, (Program in Molecular Medicine) – Pediatric immunity to infectious diseases focusing on Plasmodium falciparum malaria and Epstein Barr Virus (EBV), molecular epidemiology, Global Health Research, and the etiology of endemic Burkitt lymphoma in Africa

Jane Owens (Saczynski), PhD, (Medicine) – Neuroepidemiologist with research interests in vascular disease and the risk for cognitive decline and dementia

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, skin cancer prevention

Sharina D. Person, PhD, (Quantitative Health Sciences) – Biostatistics and health services research, health disparities research

Allison B. Rosen, MD, MPH, SCD, (Quantitative Health Sciences) – Biostatistics and health services research, value in healthcare

Jennifer Tjia, MD, MSCE (Quantitative Health Sciences) – 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

**Assistant Professors**

Karim Alavi, MD, (Surgery) – Surgical outcomes research

Mara M. Epstein, ScD, ScM, (Medicine) – cancer epidemiology, inflammation and cancer, prostate cancer and hematological cancers

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

Timothy P. Hogan, PhD, (Quantitative Health Sciences) – Health informatics and implementation science

William M. Jesdale, PhD, (Quantitative Health Sciences) – Epidemiology of chronic diseases and vulnerable populations, environmental health, health disparities research, LGBT health

Jennifer LaFemina, MD, (Surgery) – Surgical outcomes research
Nancy R. LaPelle, PhD (Medicine) – Tobacco treatment; cancer screening/prevention; child health

Ann Lawthers, DSc, (Family Medicine and Community Health) – research in developing measures of quality that yield actionable results, training others in quality measurement and management techniques, and evaluating the quality of care delivered to vulnerable populations

Louise Maranda, PhD, (Quantitative Health Sciences) – Biostatistics and health services research

Paulo Martins, MD, PhD, FAST, (Surgery) – research interest on transplant immunobiology, especially on Ischemia Reperfusion Injury, and Immunosenescence, transplant outcome specifically on the use of extended criteria donors

Kristin Mattocks, PhD, MPH, (Quantitative Health Sciences) – Health informatics and implementation science; associate chief of staff for research and development, VA Central Western Massachusetts

Barbara C. Olendzki, MPH, RD, LDN, (Medicine) – Research in effect of diet and other lifestyle factors on obesity, diabetes, and heart disease, the IBD-AID: Anti-inflammatory Diet for Inflammatory Bowel Disease, and improving methods of dietary assessment in epidemiological studies

Heena P. Santry, MD, (Surgery) – Surgical outcomes research

Eric G. Smith, MD, MPH, (Psychiatry) – Mental health, veterans health, opioids

Molly Waring, PhD (Quantitative Health Sciences) – Epidemiology of chronic diseases and vulnerable populations, maternal child health, weight loss in the post-partum period

_Instructor_

Ralph J. Zottola, PhD, (Quantitative Health Sciences) – Health informatics and implementation science

**Pathway Programs**

**Pathway to Graduate Study**

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 with excellent performance 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
- 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.
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Directions
The UMass Worcester Campus is located in Worcester Massachusetts just north of Route 9, on the west side of Lake Quinsigamond, between Plantation Street and Lake Avenue North. The campus is easily accessible from many major highways. See:

http://www.umassmed.edu/about/directions/

Directions to the University Campus of UMass Worcester By Automobile

From the Mass Pike:

**Eastbound:** At exit 10, take I-290 east to exit 21, turn right at end of ramp and follow Plantation Street south.

**Westbound:** At exit 11, turn left onto Route 122 north for one mile, turn right at third light onto Sunderland road, left at first light onto Lake Avenue for 2.5 miles and cross Route 9. Make U-turn at second break in divider, then turn right into campus.

From I-495:

**Northbound:** At exit 23, take Route 9 west. Follow Route 9 west for approximately 11 miles. After crossing the Lake Quinsigamond bridge, take first right onto Lake Avenue.

**Southbound:** At exit 25, take I-290 west to exit 22, turn right at end of ramp, at second traffic light turn left at onto Plantation Street and proceed south.

From I-190:
At the merge with I-290 Shrewsbury exit (watch for exit ramp on left), take I-290 east to exit 21, turn right at end of ramp and follow Plantation Street south.

From I-290:

**Eastbound:** At exit 21, turn right at end of ramp and follow Plantation Street south.

**Westbound:** At exit 22, turn right at end of ramp, at second traffic light turn left onto Plantation Street and proceed south.
University Campus Map
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