

BIOTECHNOLOGY AND BIOMEDICAL SCIENCE (MS, GRADUATE CERTIFICATE)

BIOTECHNOLOGY AND BIOMEDICAL SCIENCE (MS) BIOTECHNOLOGY (GRADUATE CERTIFICATE)

Faculty

Steven Ackerman (Biology Department), PhD, *University of Pennsylvania* • Molecular Biology

Kamaljit Bawa (Biology Department), PhD, *Punjab University* • Plant Ecology and Genetics

Gregory Beck (Biology Department), PhD, *State University of New York, Stony Brook* • Immunology • Cytokine Evolution

Kenneth Campbell (Biology Department), PhD, *University of Michigan* • Cell Physiology • Endocrinology

Robert Chen (Environmental Sciences Program), PhD, *University of California, San Diego* • Organic Geochemistry • In Situ Instrumentation

Adan Colón-Carmona (Biology Department), PhD, *University of California, Irvine* • Plant Signal Transduction • Molecular Biology

Ron Etter (Biology Department), PhD, *Harvard University* • Ecology and Evolution

William Hagar (Biology Department), PhD, *Temple University* • Photosynthesis

Linda Huang, PhD, *California Institute of Technology* • Signal Transduction and Regulation of Cell Morphology

Richard Kesseli (Biology Department), PhD, *University of California, Davis* • Plant Population Genetics • Molecular Genetics

Kenneth Kleene (Biology Department), PhD, *University of Washington* • Developmental Molecular Biology

Alexia Pollock, PhD, *University of Virginia* • Neuropharmacology • Neuroanatomy

William Robinson (Environmental Sciences Program), PhD, *Northeastern University* • Aquatic Toxicology

Michael Shiaris (Biology Department), PhD, *University of Tennessee* • Microbiology • Ecology

Rachel Skvirsky (Biology Department), PhD, *Harvard University* • Molecular Genetics • Microbiology

Robert Stevenson (Biology Department), PhD, *University of Washington* • Comparative Animal Physiology

Manickam Sugumaran (Biology Department), PhD, *Indian Institute of Science* • Protein Chemistry • Enzymology • Insect Biochemistry

Ying Tan, PhD, *Yale University* • Molecular Evolution

Brian White (Biology Department), PhD, *Massachusetts Institute of Technology* • Science Education

Richard White (Biology Department), PhD, *Washington University* • Vision Physiology

Garrison Wilkes (Biology Department), PhD, *Harvard University* • Plant Genetics and Evolution

The Program

The Program in Biotechnology and Biomedical Science offers both the master of science degree in biotechnology and biomedical science, and a graduate certificate in biotechnology.

Facilities

The modern facilities of the University's Biology Department support current research techniques in biotechnology and biomedical science. Graduate students can work in special, well-equipped research laboratories with amino acid analyzers, computer facilities, controlled environment chambers, electron microscopes, electrophysiological equipment, high-speed and refrigerated centrifuges, spectrophotometers, high-pressure liquid chromatography systems, immunoanalysis, polymerase chain reaction and DNA sequencing facilities, real-time PCR, and radiation counters. Excellent tissue culture facilities are available for graduate student research.

The Master of Science Degree

Students learn the theory and acquire the laboratory techniques used in biotechnology and biomedical science—two high-technology areas of expanding national and local importance. The program provides a firm foundation in the principles underlying modern biotechnological techniques and integrates this theoretical understanding with intensive training in a variety of laboratory skills and in computer applications to biotechnology.

The curriculum of the program consists of required courses in biology and biophysics, a required two-semester research experimentation course (BIOL 696), and elective courses in biology, chemistry, environmental sciences, and physics. Work in these courses is particularly appropriate for students with interests in the emerging fields of biotechnology, molecular genetics, tissue culture, and advanced computerized laboratory technology.

The program can accommodate cooperative arrangements with various private and public sector laboratories, in which some students will do supervised research as interns. Interchange between these laboratories and the University will ensure that all students receive training that is congruent with the needs of the private and public sectors.

Degree Requirements

On admission, the student will be assigned an academic advisor, who must be a full-time member of the Biology Department faculty. Within six months, the student and academic advisor will choose an Academic Advisory Committee (AAC) and will submit this proposed committee for approval to the Biology Graduate Program Director (GPD) and the Biology Graduate Committee, which oversees all aspects of graduate study in biotechnology and biomedical science.

The AAC will comprise the academic advisor and two additional members in the student's area of interest. The student, in consultation with the AAC, will plan an appropriate course of study. The AAC will monitor the student's progress. The academic advisor and the student will provide a yearly progress report to the GPD and the Biology Graduate Committee. With the approval of the GPD, the student can change his or her academic advisor or rearrange his or her AAC.

Course Work

Thirty credits are required for the master of science degree in biotechnology and biomedical science.

All students must complete the following courses:

BIOL 650 (Scientific Communication)
BIOL 696 (Research Experimentation)

Note: Two semesters of BIOL 696 must be taken.

Biotechnology and Biomedical Science

All students must complete at least four of the following courses:

BIOL/PHYSIC 608 (Biophysical Instrumentation)
 BIOL 615 (Immunology)
 BIOL 626 (Molecular Genetics of Bacteria)
 BIOL 627 (Bacterial Physiology)
 BIOL 664 (Computer Analysis of DNA and Protein Sequences)
 BIOL 670 (Tissue Culture)
 BIOL 675 (Advanced Molecular Biology)
 BIOL 677 (Advanced Eukaryotic Genetics)
 BIOL 678 (Protein Chemistry and Enzymology)

Students must complete an additional nine credits by taking elective courses chosen from the following list, of which two must be biology courses.

BIOL 602 (Plant Molecular Biology and Physiology)
 BIOL 612 (Advanced Cell Biology)
 BIOL 614 (Advanced Cell Chemistry)
 BIOL 622 (Concepts and Methods in Cytology)
 BIOL 653 (Current Literature in Biology)
 BIOL 662 (Photobiology)
 BIOL 666 (Mammalian Toxicology)
 BIOL 668 (Cellular and Molecular Endocrinology)
 BIOL 672-673 (Directed Readings)
 BIOL 685 (Biomedical Tracers)
 BIOL 692 (Advanced Physiology)
 BIOL 693 (Seminar in Neurobiology)
 BIOL 699 (Thesis Research)*
 CHEM 653 (Polymer Chemistry)
 CHEM 658 (Medicinal Chemistry)
 ECOS 611 (Applied Statistics)
 PHYSIC 603 (Nuclear Radiation Physics and Biophysics Laboratory)
 PHYSIC 604 (Cryogenics and Vacuum Technology)
 PHYSIC 609 (Physics of Medical Imaging)
 PHYSIC 610 (Topics in Medical Imaging)

*Open as an elective only to those students choosing the thesis option. May be taken for a maximum of 4 credits.

Students wishing to substitute any other courses for those on this list of electives must have prior approval from their advising committee, the Biotechnology and Biomedical Science program advisor, and the graduate program director. Note that students have generally gained more benefit from Scientific Communication (BIOL 650) if it is taken after they have developed a thesis topic (generally later than the first year).

Students may choose either an internship option or a thesis option, which will enable them to pursue a thesis research project in the laboratory of a faculty member. Thesis students have the option of taking 4 additional research credits, as BIOL 699. This, in combination with two semesters of BIOL 696, will allow for a maximum of 10 credits toward research.

Each student must prepare a written report (internship option) or thesis on his or her research work and must also take an oral examination, which will not necessarily be limited to the topic of the report. The student must submit an outline of the report to his or her AAC before taking the oral examination.

Note: These course listings are subject to change as developments in the field affect the program's curriculum. Please contact the Biology Department for the most current information.

Admission Requirements

Please see the general statement of admission requirements for all graduate studies programs in the "Admissions" section of this publication, and the "Special Instructions for Applicants to Individual Programs" section at the back of this publication.

Each applicant to the MS Program in Biotechnology and Biomedical Science must submit Graduate Record Examination scores; a score for one advanced test is also suggested. An applicant is expected to have a grade point average of 3.0 in all undergraduate science and mathematics courses.

It is expected that entering students will have completed, or will complete, the following undergraduate courses or their equivalents (please consult UMass Boston's undergraduate catalog for complete information about these courses):

BIOL 252 (Genetics)
 CHEM 253 and 254 (Organic Chemistry I and II)
 BIOL 334 (Microbiology)
 BIOL L371 (Biochemistry) or
 BIOCHM 383 (Biochemistry I)
 BIOCHM 384 (Biochemistry II)
 BIOCHM 385 (Biochemistry Lab I)
 BIOCHM 386 (Biochemistry Lab II)
 CS [Computer Science] 110 (Introduction to Computing)
 PHYSIC 107 and 108 (College Physics I and II)
 PHYSIC 181 and 182 (Physics Laboratory I and II)

The stated interests of a prospective student must coincide to an acceptable degree with faculty specialties represented in the program. The Biology Graduate Committee, in conjunction with the director of the program, is responsible for reviewing applications and for recommending candidates to the Dean of Graduate Studies.

The Graduate Certificate

Students choosing to pursue the graduate certificate in biotechnology are given a sound theoretical background for working in the research and development divisions of biotechnology companies or biomedical research laboratories.

To earn the certificate, students must complete 15 credits, with a grade-point average of at least 3.0. Courses may be chosen from the list below:

BIOL/PHYSIC 608 (Biophysical Instrumentation) (4 credits)
 BIOL 612 (Advanced Cell Biology) (3 credits)
 BIOL 615 (Immunology) (3 credits)
 BIOL 626 (Molecular Genetics of Bacteria) (3 credits)
 BIOL 627 (Bacterial Physiology) (3 credits)
 BIOL 664 (Computer Analysis of DNA and Protein Sequences) (3 credits)
 BIOL 670 (Tissue Culture) (4 credits)
 BIOL 675 (Advanced Molecular Biology) (with Laboratory) (4 credits)
 BIOL 676 (Advanced Molecular Biology Lecture) (without Laboratory) (3 credits)
 BIOL 677 (Advanced Eukaryotic Genetics) (3 credits)
 BIOL 678 (Protein Chemistry and Enzymology) (with Laboratory) (5 credits)
 BIOL 679 (Protein Chemistry and Enzymology Lecture) (without Laboratory) (3 credits)
 BIOL 685 (Biomedical Tracers) (4 credits)
 BIOL 693 (Seminar in Neurobiology) (3 credits)

At least two of the student's courses must include laboratory work with biochemical or cellular techniques. BIOL 670, 675, or 678 all fulfill this laboratory requirement. Studies for the certificate must be completed within four years. Part-time students may be granted an additional year to complete their studies by petitioning the Biology Graduate Program Director and the Office of Graduate Studies.

Biotechnology and Biomedical Science

Admission Requirements

Please see the general statement of admission requirements for all graduate studies programs in the "Admissions" section of this publication.

Applicants must submit Graduate Record Examination scores, including the score for one advanced test. Applicants are expected to have a grade point average of 3.0 in all undergraduate science and mathematics courses.

Entering students must have a bachelor's degree, and must have completed the following UMass Boston undergraduate courses or their equivalents at another university (please consult UMass Boston's undergraduate catalog for information about these courses).

BIOL 252 (Genetics)

CHEM 253 and 254 (Organic Chemistry I and II)

BIOL 334 (Microbiology)

BIOCHM 383 (Biochemistry I)

BIOL 372 (Molecular Biology)

CS 110 (Introduction to Computing)

PHYSIC 107 and 108 (College Physics I and II), and

PHYSIC 181 and 182 (Introductory Physics Lab I and II)

Course Descriptions

Descriptions of courses required of all MS students appear below. Descriptions of elective courses may be found in the biology, chemistry, environmental sciences, and applied physics sections of this publication.

Courses

BIOL 608 (PHYSIC 608)

Biophysical Instrumentation

A lecture and laboratory course on the application of microcomputers and microprocessor-based electronics to laboratory experiments in the biological and physical sciences. Emphasis is on techniques for interfacing the microcomputer with laboratory experiments for automated data acquisition, data reduction and analysis, information display and real-time control of experiments.

Prerequisite: Graduate standing or permission of instructor.

2 Lect Hrs, 4 Lab Hrs, 4 Credits

BIOL 612

Advanced Cell Biology

The analysis of gene transfer and expression at the cellular level, including the nature of metabolic systems and the factors governing their regulation.

Prerequisite: Permission of instructor.

Hrs by arrangement, 3-5 Credits

BIOL 615

Immunology

Selected topics in immunology are studied in depth, using the current literature. Topics are chosen for relevance and current interest, or for their challenging, even controversial nature.

Prerequisite: BIOL 378 or 380 or permission of instructor.

3 Lect Hrs, 3 Credits

Mr Beck

BIOL 626

Molecular Genetics of Bacteria

In-depth examination of genetic and molecular processes in bacteria and their associated viruses. Coverage of classical bacterial genetics as well as modern molecular genetic analysis. Topics include genetic transfer processes, gene regulation, mutagenesis and repair, plasmids, transposons, gene fusion methodologies, and protein secretion. Emphasis is given to current experimental approaches and research design. (Course offered in the spring only.)

Prerequisite: BIOL 252 or equivalent.

3 Lect Hrs, 3 Credits

Ms Skvirsky

BIOL 627

Bacterial Physiology

A rigorous biochemical examination of the bacterial cell. Lectures focus on bacterial cytology, growth, and metabolism. Areas of current research are emphasized. Students are expected to read primary and secondary scientific literature and to discuss course material.

Prerequisite: BIOL 334 and BIOCHM 383, or equivalents.

3 Lect Hrs, 3 Credits

Mr Shiaris

BIOL 650

Scientific Communication

Required of all master's and doctoral students; usually taken in the second year. The course covers the storage and retrieval of scientific information (including searching of computerized data bases), the design of tables, figures, and other graphics, the writing of technical reports and papers, and the preparation of posters and publications. Writing, oral presentations and other assignments, and attendance at the weekly departmental seminar, are required.

Prerequisite: Admission to graduate study in biology at either the master's or the doctoral level.

3 Credits

BIOL 664

Computer Analysis of DNA and Protein Sequences

A lecture and laboratory course focusing on using computers to predict the structure of RNA and protein, to search DNA and protein sequence databases, to align protein and DNA sequences, to deduce the structure and mechanism of regulation of a gene from DNA sequences, to design cloning strategies, and to choose oligonucleotide primers for DNA sequencing and polymerase chain reactions. The course emphasizes the significance and limitations of computer analyses in biological research.

Prerequisites: An advanced undergraduate course or a graduate course in molecular genetics (BIOL 370 or equivalent, BIOL 675, or BIOL 626), and permission of instructor.

1 1/2 Lect Hrs, 3 Disc Hrs, 3 Credits

Mr Kleene

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BIOL 666

Mammalian Toxicology

This course provides a background in principles of toxicology in mammalian systems. It is an alternative to Environmental Toxicology, ECOS 635, as a core requirement for the Molecular, Cellular, and Organismal Biology doctoral track. Coverage includes: basic concepts of poisons and their commonalities with drugs and hormones; toxicant exposure routes, uptake, sites and mechanisms of action, storage, metabolism, activation, and clearance; toxicant roles in carcinogenesis, development, endocrine, and reproductive functions; roles of diet, lifestyle, and concurrent exposures; methods of toxicant evaluation emphasizing multigeneration and high-throughput testing; and environmental and medical implications of toxicant/toxin exposures on individual and ecological health.

Prerequisites: General chemistry and organic chemistry, general biology, and one advanced course in cell biology, biochemistry, or physiology.

3 Credits

Mr Campbell

BIOL 670

Tissue Culture

A seminar and laboratory course on the principles and methods of culturing cells, tissues, and organs of animals and plants. Topics include growth factors, differentiation and morphogenesis in vitro, cell cloning, protoplast fusion, and the production of hybridomas for monoclonal antibodies. Students also apply tissue culture methods to individual research projects.

Prerequisite: BIOL 313 or equivalent, or permission of instructor.

2 Sem Hrs, 6 Lab Hrs, 4 Credits

Ms Davis, Mr Kleene

BIOL 675

Advanced Molecular Biology

A lecture and laboratory course covering the biosynthesis and regulation of RNA, DNA, and proteins in eukaryotic organisms. The course examines the importance of gene regulation in oncogenesis, levels of gene expression, and development; as well as regulation by structure and function (chromosome structure and translational regulation); basic research techniques; and current recombinant DNA methodology. Please note: Labs meet every other week, for a total of seven hours every two weeks.

Prerequisites: BIOL 370 or 372 or equivalent, and permission of instructor.

Prerequisite or Corequisite: BIOL 670.

3 Lect Hrs, 3 1/2 Lab Hrs, 4 Credits

Mr Ackerman, Mr Kleene

BIOL 676

Advanced Molecular Biology

Lecture

A lecture-only course covering the same material as BIOL 675; no lab work is required.

Prerequisites: BIOL 370 or 372 or equivalent, and permission of instructor.

3 Lect Hrs, 3 Credits

Mr Ackerman, Mr Kleene

BIOL 677

Advanced Eukaryotic Genetics

A broad spectrum of readings in plant, animal, and fungal genetics on such topics as segregation distortion, the control of sex determination, modes of asexual reproduction, inheritance of cytoplasmic genomes, self-incompatibility systems, transposable elements, and genetic mapping.

Prerequisite: BIOL 252 or equivalent.

3 Lect Hrs, 3 Credits

Mr Kesseli

BIOL 678

Protein Chemistry and Enzymology

A lecture and laboratory course on various aspects of protein chemistry and enzymology. Emphasis is on purification, characterization, structure, function, mechanism of action, kinetics, and regulatory aspects of enzymes. Topics also include the practical and theoretical aspects of affinity chromatography and other separation techniques, immobilization of enzymes and other biomolecules, enzyme kinetics, and the analytical and industrial use of soluble and insoluble enzymes.

Prerequisites: BIOCHM 383 and BIOL 372, or equivalents, and permission of instructor.

3 Lect Hrs, 6 Lab Hrs, 5 Credits

Mr Sugumaran

BIOL 679

Protein Chemistry and Enzymology

Lecture

A lecture-only course covering the same material as BIOL 678; no lab work is required.

Prerequisites: BIOCHM 383 and BIOL 372, or equivalents, and permission of instructor.

3 Lect Hrs, 3 Credits

Mr Sugumaran

BIOL 685

Biomedical Tracers

A seminar and laboratory course describing the types and uses of physical tracers in the biomedical sciences. Covers theory and application of various tracers (immunoglobins, radioisotopes, lectins, enzymes, chromogen labels, spin labels, heavy isotopes, and particles), instrumentation for their detection, and general methods. The laboratory includes demonstrations and short projects chosen by the students and the instructor.

Prerequisites: CHEM 253, BIOCHM 383 (or BIOL 317 or 319), or equivalents, and permission of instructor.

2 Lect-Seminar Hrs, 6 Lab Hrs, 4 Credits

Mr Campbell

BIOL 693

Seminar in Neurobiology

Discussion of current literature in neuropharmacology and drug and behavior interactions. Combination of lectures and student presentations.

Prerequisites: BIOL 316 or 318, or equivalent, and permission of instructor.

3 Lect Hrs, 3 Credits

Ms Pollack

BIOL 696

Research Experimentation in Biology

This independent study provides students with sustained experience in a research laboratory. Each student pursues a specific research project, which may originate in a public or private sector laboratory or at the University. Each student's project should involve the student in ideas and laboratory skills and should permit the student to produce work of publishable quality.

Prerequisites: Admission to the Biotechnology and Biomedical Science Program; permission of instructor.

Hrs by arrangement, 3 Credits