

BIOLOGY AND MOLECULAR BIOLOGY

Telephone: (973) 655-4397

The graduate programs in the Biology and Molecular Biology Department are designed to enable a student to develop his or her preparation for a career in biological fields requiring advanced training or for the teaching profession.

MASTER OF SCIENCE DEGREE IN BIOLOGY

Research facilities of the Biology and Molecular Biology Department are maintained in Science Hall and include specialized equipment for molecular biology, electron microscopy, botany, microbiology, immunology, aquatic biology, tissue culture, animal behavior, and cell physiology. Additionally, the facilities at the New Jersey Marine Sciences Consortium, New Jersey School of Conservation, and other departments in the College of Science and Mathematics are available for cooperative graduate research. Faculty research interests include aquatic and terrestrial ecology, developmental biology, parasitology, microbiology, immunology, cell physiology, molecular biology, plant physiology, entomology and evolutionary mechanisms. The Biology and Molecular Biology Department has a state-of-the-art molecular biology laboratory for teaching both introductory and advanced courses in molecular biology and biotechnology.

The Biology and Molecular Biology Department offers thesis and non-thesis students opportunity for graduate research under faculty supervision in selected areas of biology. Original research should not exceed 7 semester hours for thesis students and 5 semester hours for non-thesis students. Students must complete a minimum of 26 semester hours in biology and a maximum of 6 semester hours in approved electives, completing 32 semester hours in coursework.

ADMISSION REQUIREMENTS

Prior to matriculation for the Master of Science degree in biology, the student should have completed a subject matter core of at least twenty-four semester hours in biology and have adequate preparation in college chemistry, mathematics and physics.

In cases where there has been a weak undergraduate program in the major and/or collateral fields, prerequisite courses, which will not count towards graduate credit, may be assigned.

The matriculation program for MS candidates is prepared in consultation with the biology graduate program coordinator. Changes in the program can be made only with the written approval of the graduate program coordinator. It is the responsibility of the student to keep the graduate program coordinator informed of progress in the program.

REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN BIOLOGY

	Semester Hours
I. Required Courses (9-10 semester hours):	
A. Organismic	
BIOL 520 Plant Physiology	4
<i>or</i>	
BIOL 540 Mammalian Physiology	3
B. Molecular	
BIOL 547 Molecular Biology I	3
C. Ecology	
BIOL 570 Ecology	3
II. Biology Areas of Emphasis (14-19 semester hours)	
A. Biology Courses at Montclair State University	
B. Biology Courses at NJ Marine Sciences Consortium	(Optional 0-4)
C. Non-departmental Approved Electives	(Optional 0-6)
(With approval of graduate program coordinator and Graduate Studies)	
III. Research, Laboratory, or Field Requirement	
A. Thesis Option (5 or 7 semester hours)	
BIOL 597 Research in Biological Literature	1
BIOL 698 Master's Thesis	4 or 6

Preliminary Examination: Students selecting this option will be required to take a Preliminary Examination. Preliminary Examination must be taken prior to submission of thesis proposal.

B. 1. Non-Thesis Research Option (5 semester hours)	
BIOL 597 Research in Biological Literature	1
BIOL 599 Introduction to Biological Research	4
(Open only to non-thesis students.)	

2. Non-Thesis Laboratory or Field Option (4-5 semester hours)	
BIOL 597 Research in Biological Literature	1
Approved Biology Laboratory or Field Course	3-4
(With approval of graduate program coordinator and Graduate Studies)	

The student will establish a 3 faculty member committee who will propose a semester long literature research paper. At the end of the semester, the student will submit the paper and orally defend it to the committee.

Minimum semester hours: 32

MASTER OF SCIENCE DEGREE IN BIOLOGY, BIOLOGY SCIENCE EDUCATION CONCENTRATION

The MS in Biology with a concentration in Biology Science Education is intended for certified Biology teachers interested in enhancing and updating their content expertise, exploring and conducting research on biology learning, and expanding their insights into pedagogy. Students will complete 32 semester hours of coursework in biology, biology education, and curriculum and teaching and/or educational foundations. Students must take a minimum of 20 credits in biology and 6 credits in College of Education and Human Services courses and can take a maximum of 6 credits outside the department including BIOL courses taken as a non-matriculated student, courses taken in other MSU departments, and courses transferred from other institutions. Students must receive a B or better in these courses and the credits can not have counted toward another degree.

This is a non-thesis program that can include graduate research under faculty supervision. Introduction to Biological Research (BIOL 599) as well as Research in Biological Literature (BIOL 597) within this concentration will focus on science education as it applies to Biology. Original research (BIOL 599) should not exceed 4 credits.

ADMISSION REQUIREMENTS

In addition to the admission requirements listed for the MS in Biology, candidates for admission to the Biology Science Education Concentration must have teaching certification in Biology.

REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN BIOLOGY, BIOLOGY SCIENCE EDUCATION CONCENTRATION

	Semester Hours
I. Required Courses (9-10 semester hours):	
A. Organismic	
BIOL 520 Plant Physiology	4
<i>or</i>	
BIOL 540 Mammalian Physiology	3
B. Molecular	
BIOL 547 Molecular Biology I	3
C. Ecology	
BIOL 570 Ecology	3
II. Required Biology Science Education Concentration (12 semester hours)	
A. BIOL 510 Biology Pedagogy for Secondary Teachers	3
B. BIOL 601 Advanced Biology Science Education Pedagogy	3
C. CURR 530 Principles of Curriculum Development	3
D. EDFD 550 Critical Thinking and Learning	
OR	
CURR 551 Problem Solving and Critical Inquiry in Curriculum Development	3

III. Electives in Biology (9-10 semester hours)

It is recommended that the student select appropriate electives from the following courses reflecting the students's professional interest. Only nine credits at the 400 level may be used in the Master's program.

BIOL 512	Topics in Modern Genetics	3
BIOL 520	Plant Physiology	4
BIOL 521	Field Studies of Flowering Plants	4
BIOL 523	Mycology	3
BIOL 531	Medical Parasitology	3
BIOL 532	Advanced Entomology	3
BIOL 540	Mammalian Physiology	3
BIOL 544	Comparative Animal Physiology	4
BIOL 546	Topics in Physiology	3
BIOL 548	Molecular Biology II	4
BIOL 549	Topics in Developmental Biology	3
BIOL 550	Topics in Microbiology	3
BIOL 551	Intermediary Metabolism I	3
BIOL 552	Biology of Lipids	3
BIOL 553	Microbial Ecology	4
BIOL 554	Microbial Physiology	3
BIOL 571	Physiological Plant Ecology	4
BIOL 572	Wetland Ecology	4
BIOL 573	Shoreline Ecology	4
BIOL 599	Introduction to Biological Research	4

With the approval of the graduate program coordinator and the Graduate School, other 500-level courses in Biology or in other departments may be acceptable.

IV. BIOL 597 Research in Biological Literature..... 1

V. Comprehensive Examination

Minimum semester hours: 32

MASTER OF SCIENCE DEGREE IN BIOLOGY, MOLECULAR BIOLOGY CONCENTRATION

The MS in Biology with a concentration in Molecular Biology is intended to provide appropriate training for biology students in the area of theoretical and applied molecular biology. This training can be used to prepare for research careers in biotechnology or further post-graduate study in molecular biology, to provide a mechanism for re-training biologists who wish to re-tool their skills for these new industries or to provide a well-defined, comprehensive knowledge of the discipline of molecular biology so that biology educators may convey these concepts to their students in the classroom and teaching laboratory. Students will complete 32 semester hours of coursework in biology and molecular biology.

ADMISSION REQUIREMENTS

Candidates for admission must meet the minimum requirements for the Biology department of Montclair State University. Specifically, prior to matriculation for the Master of Science degree in biology, the student should have completed a subject matter of at least twenty-four semester hours in biology and have adequate preparation in college chemistry, mathematics and physics.

REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN BIOLOGY, MOLECULAR BIOLOGY CONCENTRATION

	Semester Hours
I. Core Requirements (11 credits)	
BIOL 547 Molecular Biology I	3
BIOL 548 Molecular Biology II	4
BIOL 556 Molecular Biology of Proteins	3
BIOL 592 Graduate Colloquium	1
II. Electives (14-16 semester hours)	
BICL 405 Cell Culture	3
BIOL 512 Topics in Modern Genetics	3
BIOL 513 Instrumentation and Techniques for Biological Science	4
BIOL 520 Plant Physiology	4
BIOL 531 Medical Parasitology	3
BIOL 533 Advanced Cell Biology	3
BIOL 540 Mammalian Physiology	3
BIOL 549 Topics in Developmental Biology	3
BIOL 550 Topics in Microbiology	3
BIOL 551 Intermediary Metabolism I	3
BIOL 552 Biology of Lipids	3
BIOL 598 Selected Techniques in Molecular Biology	1.5
CHEM470 Biochemistry I	3
CHEM471 Biochemistry II	3
CHEM570 Selected Topics in Advanced Biochemistry	3
III. Non-thesis option (5 semester hours)/ Thesis option (7 semester hours)	
BIOL 597 Research in Biological Literature	1
BIOL 599 Introduction to Biological Research	4
OR	
BIOL 597 Research in Biological Literature	1
BIOL 698 Master's Thesis	6
Minimum semester hours: 32	

BIOLOGY

Course Descriptions

Semester Hours

BIOL 500 INTRODUCTORY MOLECULAR CELL BIOLOGY **1.5**

This course will focus on an introduction to the science and methods of cell and molecular biology.

Prerequisite: Permission of graduate advisor.

BIOL 510 BIOLOGY PEDAGOGY FOR SECONDARY TEACHERS **3**

Seminar and research course designed for study of methods and practices being used in teaching of secondary school biology.

Prerequisites: 24 semester hours in biology.

BIOL 512 TOPICS IN MODERN GENETICS **3**

Seminar course. Selected topics from current developments in genetic research, including chromosome and gene fine structure, extra chromosomal genetic elements, genetic engineering, and aspects of biomedical genetic research. May be repeated once for a maximum of six semester hours as long as the topic is different.

Prerequisites: Undergraduate course in genetics.

BIOL 513 INSTRUMENTATION AND TECHNIQUES
FOR BIOLOGICAL SCIENCE **4**

This course is designed to acquaint students with modern analytical and research techniques in biology, including manometry, spectrophotometry, electrophoresis, chromatography, microbial batch growth and assay techniques, immunotechniques and evaluation of experimental design and data.

Prerequisite: 24 semester hours in biology. Special fee.

BIOL 514 GRADUATE SEMINAR IN BIOLOGY **2**

Through a series of seminars delivered by faculty and guests, students will survey a broad range of topics in modern biology, and be introduced to the variety of specializations represented within the department. Emphasis shall be placed on recent advances in diverse areas of biology.

Prerequisites: Graduate biology majors only.

BIOL 518 STRATEGIES FOR TEACHING COLLEGE BIOLOGY **1**

Biology Teaching Assistants and upper-level undergraduates with interests in teaching will interact with experienced teachers, but more importantly will gain access to a forum for discussing their experiences and concerns with other prospective biology teachers. Students will discuss contemporary articles on science teaching at the college level.

Prerequisites: B.S. in Biology and departmental approval.

BIOL 520 PLANT PHYSIOLOGY **4**

Investigation of physiology of plants. Plant growth, development and reproduction as well as the new advances in plant physiology. Water relations of plants, mineral nutrition, physiological significance of soil and soil moisture, photosynthesis, respiration, plant biosynthesis and dynamics of growth.

Prerequisites: Organic chemistry, and botany. Special fee.

- BIOL 521 FIELD STUDIES OF FLOWERING PLANTS 4**
 The taxonomy, evolutionary trends and ecological adaptations of the gymnosperms and angiosperms. A variety of habitats will be visited and analyzed.
Prerequisites: Botany and field course in biology.
- BIOL 532 ADVANCED ENTOMOLOGY 3**
 Examination of insects as model systems for biological inquiry. Topics include an integrative treatment of insect molecular biology, genetics, physiology, behavior, evolution and ecology. Special fee.
Prerequisite: Matriculation in M.S. Biology program or permission of instructor.
- BIOL 533 ADVANCED CELL BIOLOGY 3**
 Detailed analysis of cellular structure and function. Topics to be covered include the role of subcellular organelles in maintaining cell viability, analysis of cytoskeletal components, structure and function of the plasma membrane and cellular defects that lead to cancer and other disease states.
Prerequisites: Matriculation in the M.S. Biology program or permission of instructor.
- BIOL 540 MAMMALIAN PHYSIOLOGY 3**
 A broad survey of the physiology of mammalian systems aimed at graduate students who lack an upper-level background in physiology at the undergraduate level. The principles of homeostasis mechanisms as they apply to various organ systems will be stressed.
Prerequisite: Graduate standing, but not open to students who have completed undergraduate upper division mammalian/human physiology classes.
- BIOL 542 ADVANCED ENDOCRINOLOGY 3**
 A study of the physiology of the mammalian endocrine system with emphasis on hormonal control of homeostasis.
Prerequisites: Endocrinology and cell biology.
- BIOL 543 ADVANCES IN IMMUNOLOGY 3**
 To study in detail selected topics in immunology.
Prerequisite: Immunology.
- BIOL 545 EXPERIMENTAL ENDOCRINOLOGY 4**
 A seminar and laboratory course in endocrinology in which the various endocrine glands will be surgically removed or chemically destroyed and the morphologic and physiologic effects measured and observed. May be repeated once for a maximum of six semester hours as long as the topic is different.
Prerequisites: Endocrinology. Special fee.
- BIOL 547 MOLECULAR BIOLOGY I 3**
 Central concepts at the cellular level will be emphasized. Contemporary viewpoints in the areas of biomolecules, energy yielding and energy requiring processes and transfer of genetic information.
Prerequisites: Cell Biology, and one year of organic chemistry.
- BIOL 548 MOLECULAR BIOLOGY II 4**
 Central concepts at the cellular level will be emphasized. Contemporary viewpoints in the areas of biomolecules, energy yielding and energy requiring processes and transfer of genetic information. The laboratory will deal with up-to-date investigative procedures via selected experiments.
Prerequisite: BIOL 547. Special fee.

- BIOL 549 TOPICS IN DEVELOPMENTAL BIOLOGY 3**
Seminar in the regulation of developmental events, including both classical morphogenesis and recent advances using techniques of cell and molecular biology. May be repeated once for a maximum of six semester hours as long as the topic is different.
Prerequisites: Genetics and developmental embryology.
- BIOL 550 TOPICS IN MICROBIOLOGY 3**
Coverage of selected topics such as the microbial genetics, antibiotic action, bacteriophage, virus, cancer and microbial metabolism. Emphasis will be placed on practical applications of modern research in specific areas. May be repeated once for a maximum of six semester hours as long as the topic is different.
Prerequisite: Microbiology.
- BIOL 552 BIOLOGY OF LIPIDS 3**
Biological cycles, unity and diversity in metabolic paths, metabolic evolution, metabolic control mechanisms and other special topics. Primary emphasis is placed on the metabolism of lipids.
Prerequisites: Cell biology and organic chemistry.
- BIOL 553 MICROBIAL ECOLOGY 4**
Exploration of the essential role of microorganisms in the ecosystem. Lecture, field trips and laboratory will demonstrate the ubiquitous and highly adaptive evolution of microorganisms, their interrelationships and their profound influence on the biosphere.
Prerequisites: Microbiology.
- BIOL 554 MICROBIAL PHYSIOLOGY 3**
A study of microorganisms in terms of their morphology and metabolism. The significance of metabolic diversity and secondary metabolic products of various microorganisms will be explored through lecture topics. The economic significance of microbial metabolism in relation to industry and pathogenic diseases will be emphasized.
Prerequisite: Microbiology.
- BIOL 555 MEDICAL GENETICS 3**
A detailed study and analysis of human genetics, inborn genetic diseases, genomics, gene therapy, and the Human Genome project.
Prerequisite: A genetics course or permission of instructor.
- BIOL 556 MOLECULAR BIOLOGY OF PROTEINS 3**
Study of the molecular biology of biomolecules, including proteins. The course will examine how changes in the three dimensional structure of biomolecules affect their biological function. Protein engineering, enzyme catalysis, and site-directed mutagenesis will be discussed.
Prerequisite: Admission into the graduate biology program or departmental approval.
- BIOL 557 VIROLOGY 3**
This course will develop the fundamental principles of modern virology and examine the connection between viruses and disease. It will examine the molecular biology of virus replication, infection, gene expression, the structure of virus particles and genomes, pathogenesis, classification of viruses, and contemporary viral research.
Prerequisite: Satisfactory completion of a cell and molecular biology course or permission of instructor.

- BIOL 558 MICROBIAL GENETICS 3**
 Microbial Genetics provides students with an understanding of the basis for genetic processes in microorganisms and the implication for higher organisms. The focus of the course will be on prokaryotes, particularly E.coli, and viruses, primarily bacteriophages. Current developments in microbial genetics, such as bioinformatics and genomics, will be presented.
Prerequisite BIOL 350, Microbiology.
- BIOL 560 MOLECULAR GENETICS 3**
 A course that will focus on biological research problems that are being addressed in eucaryotic systems from a molecular genetics viewpoint.
Prerequisite: BIOL 547 with a grade of "B" or better.
- BIOL 570 ECOLOGY 3**
 Basic ecological principles and concepts. Habitat approach to field exercises in fresh water and terrestrial ecology. Intra- and interspecific relationships with all living members of the ecosystem, problems in plant and animal biology.
Prerequisites: Botany and zoology.
- BIOL 571 PHYSIOLOGICAL PLANT ECOLOGY 4**
 The effects of soil, light, and water on plant growth, as well as, toxic effects of metals and salinity are measured using growth chamber and greenhouse facilities.
Prerequisite: Botany and one course in field biology. Special fee.
- BIOL 572 WETLAND ECOLOGY 4**
 Important biotic, chemical and physical parameters of New Jersey's estuaries. Evolution and successional trends of estuarine communities. Ecology of individual communities studies by field trips to Delaware Bay shore and to some Atlantic coast bays, marshes and offshore barrier islands. Also offered at the New Jersey Marine Sciences Consortium.
Prerequisites: Botany, and zoology, and field biology. Special fee.
- BIOL 573 SHORELINE ECOLOGY 4**
 Community structure, trophic dynamics, species diversity and distribution of bottom dwelling organisms in relationship to their environment; lectures, laboratory work and field investigations of marine benthos. Also offered at the New Jersey Marine Sciences Consortium.
Prerequisites: Botany, and zoology, and field biology. Special fee.
- BIOL 574 BEHAVIORAL ECOLOGY 3**
 This seminar course explains the ecological consequences of animal behavior, viewed within the context of how behavior evolves and how populations adapt to their environments.
Prerequisites: Field biology and zoology.
- BIOL 576 BIOLOGY OF EXTREME HABITATS 3**
 The course will describe the adaptations that allow the survival of plants and animals, as well as microorganisms, in a variety of extreme habitats. Some of these habitats include: deserts, arctic, grassland, estuaries.

- BIOL 579 PHYSIOLOGICAL ECOLOGY OF ANIMALS 3**
 A variety of different animals, ranging from protists to mammals, will be examined and compared to demonstrate the physiological adaptations they have evolved to successfully survive and reproduce.
Prerequisite: Graduate standing in Biology or departmental approval.
- BIOL 580 EVOLUTIONARY MECHANISMS 3**
 This course will provide students the opportunity to read primary resource material and interpret the findings of the data. This course will also teach students how to read, critique and present scientific data to a peer group. Students will analyze, discuss and present primary research articles with respect to scientific content, accuracy of the data and significance of the experiments.
Prerequisite: Matriculation in the M.S. Biology program or permission of instructor.
- BIOL 586 SELECTED ADVANCED TOPICS IN BIOLOGY 3-4**
 This course is designed to provide advanced biology graduate students with a literature intensive exploration of current developments and specialized content in the biological sciences. Topics will cover specific research areas in ecology, physiology, molecular biology, embryology and bioinformatics. This course is designed to fulfill elective requirements of the biology masters degree. May be repeated once for a maximum of eight semester hours.
Prerequisite: BIOL 520 or BIOL 540 or BIOL 547 or BIOL 570.
- BIOL 592 GRADUATE COLLOQUIUM 1**
 Students in this course will read primary resource material and interpret the data. This course will also teach students how to read, critique and present scientific data to a peer group. Students will analyze, discuss and present primary research articles with respect to scientific content, accuracy of the data and significance of the experiments.
Prerequisite: Matriculation in the M.S. Biology program or permission of instructor.
- BIOL 594 SIGNAL TRANSDUCTION 3**
 This course will cover various aspects of cellular signaling from the plasma membrane to the nucleus. Topics will include specific signal transduction systems, methods for studying these systems and the results of these signaling events on cell division, cell differentiation and cell function.
Prerequisite: BIOL 547 or permission of instructor.
- BIOL 595 CONSERVATION BIOLOGY: THE PRESERVATION OF BIOLOGICAL DIVERSITY 3**
 This course addresses concerns about the loss of biological diversity and genetic resources through species extinctions. Students will learn about the importance of maintaining biological diversity, the problems involved in monitoring and protecting sensitive and crucial habitat, the impact of human societies on biodiversity, the alternatives to the destruction of habitat/species, the prospects of restoration, and the policies needed to prevent the loss of biological diversity. Students will also learn about population processes that are directly related to species survival. This course is cross listed with CNFS 595.
Prerequisite: Botany, and zoology, and field biology. Special fee.

BIOL 596 SELECTED TECHNIQUES IN BIOLOGY SCIENCE EDUCATION 1.5

A laboratory course that trains teachers in manipulatives suitable for secondary biology education. Students will be introduced to a variety of physiological, ecological, molecular biological techniques applicable for implementation in secondary school classrooms. May be repeated three more times for a total of six semester hours.

Prerequisite: Biology teaching certification or departmental approval.

BIOL 597 RESEARCH IN BIOLOGICAL LITERATURE 1

To allow the student to investigate and evaluate a specific topic in biology under the supervision of a faculty member and to develop the student's skills in presenting current research in both the written and oral modes.

Prerequisites: Departmental approval.

BIOL 598 SELECTED TECHNIQUES IN MOLECULAR BIOLOGY 1.5

A laboratory course that trains students in advanced techniques in molecular biology. Students will learn how to perform a specific technique as well as learning the theory behind the technique. May be repeated three times for a total of six semester hours.

Prerequisites: Undergraduate or graduate molecular biology courses or equivalent and permission of instructor. Special fee.

BIOL 599 INTRODUCTION TO BIOLOGICAL RESEARCH 4

A research experience in which students will be exposed to current biologic techniques by working with scientific investigators in industry, or within the department. Students will work on projects involving research techniques, data collection and the analysis and interpretation of the data.

Prerequisites: Departmental approval Special fee.

BIOL 601 ADVANCED BIOLOGICAL SCIENCE EDUCATION PEDAGOGY 3

This course aims for the development of an understanding of the pedagogy of inquiry-based learning and of the processes of scientific investigation and reasoning, as well as other factors influencing effective teaching (e.g. equity issues, assessment methods, and communication skills). Modeling of the inquiry-based approach will be applied to a range of scientific concepts, focusing on biological concepts such as natural selection, meiosis and Mendelian genetics, and photosynthesis. As these concepts are explored, relevant science education literature will be examined in order to understand the nature of student conceptions as well as broader issues of constructivist and situated learning and implications of philosophy and sociology of science for science education.

BIOL 698 MASTER'S THESIS 4 or 6

Independent research project done under faculty advisement. Students must follow the MSU Thesis Guidelines, which may be obtained from the Graduate School. Students should take BIOL 699 if they don't complete BIOL 698 within the semester.

Prerequisite: Departmental approval.

BIOL 699 MASTER'S THESIS EXTENSION 1

Continuation of Master's Thesis Project. Thesis Extension will be graded as IP (In Progress) until thesis is completed, at which time a grade of Pass or Fail will be given.

Prerequisite: BIOL 698.