Biology at UMB

A Handbook for Undergraduates
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University of Massachusetts Boston

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I. INTRODUCTION

Biology is an enormously diverse discipline. A few of the many fields it encompasses are anatomy, animal behavior, botany, cell biology, developmental biology, ecology, microbiology, molecular biology, ornithology, physiology and zoology. Each of those (and others) is the title of a separate department in some educational institutions, but there is an increasing tendency nowadays for unification. The Biology Department of UMB reflects some of this diversity, not only in its faculty, but also in the students and in the curriculum.

In recent years about 6.8% of the undergraduates at UMB have been Biology majors and have had a wide range of interests and aims. Some have decided to major in Biology because they are curious about the world around them, or are concerned with environmental problems; others are looking to medical school or other career training, notably Biotechnology. There are considerable numbers of older students who have returned to college after other degrees or other careers.

The purpose of this booklet is to help you to get more out of your time at UMB and to help you make wise choices during your college career. We expect most of the readers will be Biology majors, although non-majors and graduate students also will find useful material here. The information provided is certainly not all inclusive; the intention is to indicate regulations and also to suggest courses of action and direct you to further useful sources. In some cases you will need to get important details and current information from the University Catalog (copies available in the Admissions Office), from the Chairman of the Department, the Biology Office, or from other offices in the University, as indicated. The University web site address www.umb.edu as well as our department web site www.bio.umb.edu can be very helpful. [Also see Advising, page 8].

All Biology majors are expected to be conversant with all appropriate parts of the current handbook. New features in this edition reflect recent changes since the previous version was published in September 2008. Most notably, the changes reflect the newly installed pre-requisites now required for all upper-level Biology and Biochemistry courses as well as the addition of a required freshman seminar course for both Biology and Biochemistry majors. Additionally, a more in-depth explanation of the Biology Minor requirements is also explained in this latest edition of the handbook. The new General Education requirements are included, some new courses are listed, and there are numerous alterations to the text. If you are unclear about any of the policies, etc., described here, please consult your advisor. If you have suggestions for future editions of this handbook, please send them to the Chairman of the Department, currently Michael Shiaris (michael.shiaris@umb.edu).

The Biology Major List Server
Subscribing to the list server will allow you to automatically receive information about registering for courses, changes to courses and schedules, department activities, job and research opportunities, scholarships, and much more. To subscribe: send an e-mail from your account to bio-majors-subscribe@mail.bio.umb.edu. If at any time you no longer wish to receive these informative email notifications from the departmental list server, please unsubscribe anytime via bio-majors-unsubscribe@mail.bio.umb.edu.

II. THE BIOLOGY CURRICULUM

New General Education Guidelines
The undergraduate curriculum in the College of Sciences and Mathematics (CSM) is divided into three parts: preparation in general education; a major field of study; and electives that complement the major and provide the breadth and depth of a liberal education. To earn a degree, students must meet the general education requirements (in addition to fulfilling major, total credits, and grade point average requirements
Levels and Sequence of Courses
The array of courses is intended to meet the needs of a variety of students, both those who will go on to graduate and professional schools, and those who adopt Biology as a terminal science major. The Biology core requirements are described elsewhere in this booklet. For complete information about these requirements, please see the Undergraduate Catalog, or visit [http://www.umb.edu/academics/undergraduate/office/gened/index.html](http://www.umb.edu/academics/undergraduate/office/gened/index.html).

Because the study of biology is by necessity more structured than some subjects, a definite sequence of courses is recommended. Majors are encouraged to take Biology 111-112, Chemistry 115-116, and Math 135, 140, or 145 during their first year. In the second year, aim for Genetics (Biology 252), Cell Biology (Biology 210), Population Biology (Biology 290), and Physics with lab. (Note that Biology 252 is a prerequisite for Biology 290). If your schedule is too crowded, you can defer a course that is not a prerequisite for the first 300-level courses you plan to take (see pages 22-23). If you plan to take 300-level courses in evolutionary biology, take Genetics and Population Biology as soon as possible. The prerequisites for advanced courses are important. In general, it is appropriate to take all the 100-level and 200-level courses specifically required for the major before taking courses numbered 300 or higher. An average of "C-" or better in Biology 111-112 (or equivalent), or written permission of the course instructor, is required for registration in biology courses numbered 200 or above.

Frequency of Course Offerings
In general, all required courses are offered each semester, i.e., General Biology (Biology 111 and 112), Genetics with lab (Biology 252), Cell Biology with lab (Biology 210), and Population Biology (Biology 290). Advanced courses are offered once per year or in alternate years. At present, the Extended Day (Saturday and evening) program and summer school are limited to a few introductory courses (101, 102, 108, 111, & 112). A provisional schedule of biology courses for the next two years may be available in the Biology Office. If you are interested in a course that is listed in the Undergraduate Catalog but not in the course listing, inquire at the Biology Office as to when it may be offered again. Some advanced courses are offered only when there is sufficient demand.

Laboratories
Many biology courses include laboratory or field work, and there are extensive lab requirements for the major. In some cases it is possible to take only the lecture part of the course, but generally not the lab alone. Two systems exist for taking only the lecture: (1) for some courses, the lecture and lab have separate numbers, i.e., are different courses, usually with lecture a co-requisite for the lab, (2) in others, the course is listed with the lab and there is an alternate number listed for "lecture-only" option. Generally, students taking the lab portion perform substantially better on the lecture part of the course than those who are not taking lab, perhaps because they experience the material from another angle and also have more opportunities to discuss the work. Because you receive credit for the same material only once, you can not receive credit for both “lecture only” and “lecture & lab” versions of the same course. Working in laboratories requires precautions that are addressed on page 8.
**Majoring in Biology**
The undergraduate degree in Biology is the Bachelor of Science. In addition to the standard biology major, there is one specialization which is described below: the Biotechnology Track. The Biotechnology Track requires the same number of credit hours as the standard Biology major, but more courses are specified. An additional major in Biochemistry has been developed. The following describes the requirements of the Biology Department; those of the College and University can be found in the University’s Undergraduate Catalog and in the Graduate Studies Bulletin and Application.

**Declaration of Major**
To declare or change your major, file a form with the Registrar’s Office within the One Stop Shop, located on the UL of the Campus Center. The "Declaration of Major/Change of Major" form is available in the Biology Department Office, Wheatley Building, 3rd floor, Room 021, in the Academic Support Office on the first floor or in the Campus Center, in the “One Stop Shop” on the upper level in the Campus Center, and in the Registrar’s Office, 4th floor Campus Center. You are required to declare a major no later than the semester immediately following the accumulation of 60 credits. Transfer students who enter the University with 60 or more credits must declare a major during their first semester. If you are interested in a double major or a concentration (program of studies), complete and file the same declaration form. You must tell the Registrar in this way if you want these to be identified on your transcript. A student pursuing a double major may in some cases be able to use the same course(s) to satisfy the requirements of two departments.

**Courses from Other Departments**
The following paragraphs about Chemistry, Math and Physics courses apply to the Biology major and the Biotechnology track. Some knowledge of chemistry is essential for the study of biology. Chemistry 115/117 and 116/118 are required of all Biology majors. If possible you should take these in your freshman year because Chemistry 115/116 is a prerequisite for Biology 210 and 252 (Chemistry 107-108 does not meet this requirement). Organic Chemistry (Chemistry 251, 252, 255, 256) is a pre- or co-requisite for some advanced biology courses and is often required by graduate and professional schools. This course can be counted towards the biology major (but is not required), and it also counts toward the lab requirement. Courses in physical chemistry and biochemistry are sometimes advisable.

Mathematics is also necessary. Look for particular sections and/or courses intended for Biology majors. The Math Department offers a placement test which you must take. This test is offered frequently, especially before classes begin in the Fall semester and during the Registration period. Details are available from the Admissions Office. A new student must achieve placement by this test into Math 115 or higher as a pre-requisite for Biology 210, 252 and 290. In addition, each of the Biology majors requires mathematics through at least one semester of Calculus (Math 135 or 140). You should complete this requirement as soon as possible, and before you take Ecology (Biology 342) or Comparative Physiology (Biology 337). It is often advisable to take additional Calculus, Statistics or Computer Programming courses in preparation for jobs or further training. One year of Introductory Physics (either 107-108 or 113-114), plus lab (Physics 181-182) is also required, and it is advisable not to leave this requirement until the last moment!

**Biology Major Requirements**
The requirements for the standard Biology major were changed slightly in 1995; the current version is summarized below and presented fully in Appendix C. Other options for completing the major (described below) differ only in small ways from this. If you matriculated before Fall 1988, please consult with Dr. Robert Guimond about the appropriate requirements. Please see Appendices A, B, C, D and E for more detailed information related to the Biology major requirements.
1. A Biology "core" of 19 credits in Biology (General Biology 111 & 112 plus three specified 200-level courses: 210, 252, 290), and 24 credits in Math, Physics and Chemistry.

2. At least 20 credits of appropriate courses at 300-level or above in Biology. These must include at least 4 credits (or 12 class hours) in the laboratory. In two cases, up to 8 of these credits may be taken in departments other than Biology: (a) Organic Chemistry, or (b) courses taken to complete the requirements of the Biobehavioral Studies Program (see page 9 or Appendix C).

3. Final GPA of 2.0 in biology courses above Biology 111-112 which are used to meet the major requirements.

4. Not more than one course used to satisfy requirements 1 or 2 listed above shall be taken Pass/Fail.

**Biotechnology Track**
The Biotechnology Track in Biology is designed primarily for students who wish to work in research and development at Biotechnology companies. However, this track also provides training for work as a laboratory technician in university or medical research labs, or for graduate school in Biochemistry, molecular and cellular Biology. Like other Biology majors, those in the Biotechnology track complete a rigorous core of basic science courses in Biology, chemistry, physics and math. Intermediate level work includes Cell Biology, Genetics, and Population Biology. Advanced work focuses on techniques and areas of Biology that are important in the Biotechnology industry including Biochemistry I, Microbiology, Immunology, Molecular Biology, and Biotechnology. Elective courses may be chosen from Animal Physiology, Developmental Biology, Endocrinology, Histology, Biochemistry II, Neurobiology, and Plant Physiology. All intermediate and advanced courses should include lab work. Biotechnology companies strongly encourage undergraduates to acquire research experience and the Biology Department offers a variety of such opportunities (see page 11). The current Director of the Biotechnology track is Dr. Kleene, email: kenneth.kleene@umb.edu. For more information see Appendix F.

**Biochemistry Joint Major**
The Biochemistry Joint Major provides an integrated and rigorous curriculum to those students who wish to concentrate their studies on the interface between Biology and chemistry. This major was established in 1995 and has specified courses that include 18 credits in Math and Physics, 30 in Chemistry, 17 in Biology and 12 in Biochemistry. The major amalgamates and integrates Biochemistry expertise from the Biology and Chemistry faculty, to present students with a comprehensive study in Biochemistry that coalesces the information into a congruous perspective of biological processes and chemical mechanisms in the cell and organism. The Biochemistry Joint Major curriculum follows the American Society of Biochemistry and Molecular Biology (ASBMB) guidelines. ASBMB guidelines signify that the student has completed a rigorous course of study that emphasizes critical thinking and a proficiency in the discipline of Biochemistry, including an emphasis on laboratory techniques. For additional information, consult Dr. Steven Ackerman, W-3-031, 617-287-6682, steven.ackerman@umb.edu. See Appendix I.

**Biochemistry Certificate**
The Biochemistry Certificate requires a minimum of 15 credits (5 courses, 21 credit hours). By allowing students who have completed Introductory Biology, General Chemistry, Cell Biology, Genetics, and Organic Chemistry to just complete the 300-level requirements, it is possible to complete the Biochemistry Certificate in one year. Students needing to complete the 100- and 200-level prerequisites could complete the program in two to three years. To receive the Biochemistry Certificate, a student must complete, at UMB, the following courses: Biochemistry 383 Lecture, Biochemistry 385 Lab, Biochemistry 384 Lecture, Biochemistry 386 Lab, and Biology 372 Molecular Biology. Successful completion of a course requires a minimum grade of C; the GPA for all completed required courses must be 2.5 or higher. See Appendix J.

**Biology Major with Secondary Education Certification**
Students who seek certification in Massachusetts for teaching Biology in Secondary Schools need to complete the requirements for the Biology or Biochemistry major as well as the requirements for the Teaching Certificate mandated
through the Graduate College of Education (GCE). The program requires additional courses in Psychology and Secondary Education. Students must pass both the Communication & Literacy Test as well as the Biology Subject Test on the MTEL in order to participate in their Practicum course. Students in this program will also be required to have a Biology or Biochemistry adviser as well as an adviser in the GCE to oversee all of their coursework. The Teaching Coordinator for the Biology Department is Dr. Brian White. He can be reached through email at brian.white@umb.edu. Please see Appendix K for more detailed information.

**Biology Minor Requirements**

Requirements for the Biology minor include Biology 111 and 112, and four additional Biology courses (at least 12 credits), with or without associated labs. Of these courses, two must be at the 200 level and two at the 300 level. At least three of the six required courses (including one course at the 300 level) must be taken at UMass Boston. The GPA for all courses taken to meet the Biology minor requirement must be at least a 2.0. Only one course for the minor can be taken pass/fail, provided all six courses are taken at UMASS Boston. See Appendix H.

**Laboratory Safety**

Working in laboratories requires certain precautions. You have a responsibility for your own safety, and for that of others. You are expected to comply with all safety rules laid down by the University, the Department or your instructor. Before you first start to work in a lab, familiarize yourself with the location and operation of the emergency shower, first-aid kit, eye-wash station, fire extinguisher, and the nearest telephone. Before using any equipment, apparatus, or chemicals read and heed the relevant instructions. Do not leave apparatus unattended without taking precautions to ensure that it is safe. In case of accident, inform your instructor immediately. Working alone in laboratories, darkrooms, etc. can cause extra hazards (for example, if you have a lab job that requires you to be in at unusual hours). For your own protection, take the following extra precautions: inform someone else where you are and what you are doing, and make sure you can contact them if necessary. Emergency telephone numbers are listed beside telephones in the labs.

**III. ACADEMIC ADVISING**

All Biology majors are assigned an academic advisor. You are encouraged to establish a continuing advising relationship with a member of the Biology Department. This will not only facilitate the planning of your academic career at UMB to meet your needs, but also will help you with career counseling, references, etc. as your work at UMB draws to a close. Simply go to someone in the Biology Department to choose (or to be assigned) an Advisor. If possible, choose one with interests related to your own, or you may wish to have a teacher of one of your courses as your advisor. If, at a later date, you wish to change advisors, you may do so at your discretion.

Early in your undergraduate career, in conjunction with your advisor, you should complete a plan of work (see Tally Sheet, Appendix D). The purpose of this plan is to help you develop a coherent and useful selection of courses consistent with your plans and prospects. The study of Biology differs from other non-science disciplines because it requires a theoretical foundation in the natural sciences combined with laboratory work. Both of these take time and demand forethought in the selection and scheduling of courses. The work plan is flexible and can be changed with the approval of your advisor.

If you are having problems with a Biology course, you can seek help for course-related matters from the lecturer or lab instructors in the course. For more general academic difficulties, you may wish to talk to your Advisor or with the Academic Support staff. Free individual or group tutoring is offered through Academic Support Programs to UMass Boston students enrolled in one or more College of Liberal Arts and/or College of Science and Mathematics 100-200 level courses for which tutoring is offered. Students must be enrolled in the course for which they are requesting tutoring. For additional information and to register for tutoring, please go to Academic Support Programs,
CC-1-1300, (617-287-6550). It is usually more effective to take action early, yourself, than to rely on advice from your classmates and/or trying to "muddle-through."

Additionally, the Biology department offers Facilitated Study Groups (FSGs) for many lower level (100 & 200 level) courses Biology, Chemistry, and Math courses. Please contact Jessica Thomas (jessica.thomas@umb.edu), Program Coordinator of the Initiatives for Maximizing Student Diversity (IMSD) for more information. Students whose performance in Biology courses has been outstanding may be recommended to the student tutoring office for jobs as tutors or to the IMSD Office for a job as an FSG Leader.

The College of Science and Mathematics Student Success Center was established in September 2008 and aims to enhance advising in the academic home of CSM students, and to increase the number of places that students can find guidance and support as to improve student retention, reduce time to graduation and to provide academic enhancement opportunities for the young scientist. The CSM Student Success Center will ultimately provide comprehensive services for students in every phase of their academic career ranging from students struggling to adjust to university study, to outstanding young scientists seeking an opportunity to enhance their participation in first rate scientific research. The CSM Student Success Center is located in the Science building, second floor, room 60. For additional information, please contact Michelle Foster, Director of the Student Success Center, at studentsuccesscenter@umb.edu or 617-287-3974.

IV. ACADEMIC DISHONESTY

The University defines violations of academic honesty to include, but not be limited to, the following: A. Submitting an author's published or unpublished work, in whole, in part, or in paraphrase, as one's own without fully and properly crediting the author. This includes, but is not limited to, submitting un-attributed, published work, e.g., material from a journal, newspaper, encyclopedia, website etc. without proper acknowledgment. B. Submitting as one's original work materials obtained from an individual or agency. C. Submitting as one's own original work material that has been produced through unacknowledged collaboration with others. D. Using any unauthorized material during an examination, such as notes, tests, calculators, etc. E. Obtaining answers to examination questions from another person with or without that person's knowledge; furnishing answers to examination questions to another student; using or distributing unauthorized copies of, or notes from, an examination. F. Submitting as one's own an examination taken by another person; or taking an examination in another person's place. G. Gaining or seeking to gain unauthorized access to the computer files of a fellow student, faculty member, or staff member, or altering or destroying those files. For further details on academic dishonesty and other University Policies & Regulation, visit the following website: http://www.umb.edu/students/student_rights/grad_academic_regulations.html.

V. SPECIAL PROGRAMS AND OPPORTUNITIES

Diverse Ways to Complete the Major
Of the many considerations involved in choosing courses to complete the major, an important one is how to achieve a well-rounded Biological training. The major requirements attempt to provide for both breadth and depth. In the past, Biology was easily divided into segments based on the organisms studied (Botany, Entomology, Ichthyology, etc.). Recently, other kinds of divisions have become more significant. One of these suggests that the study of Biology has two major poles: one which seeks mechanistic explanations, eventually of cellular mechanisms, sometimes at the molecular level. On the other end are the evolutionary Biologists whose aim is to understand how natural selection produces the patterns we see. These two approaches are distinct, but they certainly do not account for all of Biology and many people find this division inadequate. An alternative is to consider the levels of organization studied -- "cells," "organisms," and "populations," which is how the Biology courses are listed in Appendix A. (Of course, these boundaries are arbitrary). No good Biologist can afford to be ignorant of the different approaches and levels, but at the same time a realistic program cannot cover everything.
The Department has informally recognized internal concentrations in (1) Evolutionary and Population Biology, (2) Cell and Molecular Biology, (3) Organismal Biology, and (4) the Biochemistry Program. If you are interested in pursuing any of the disciplines listed above, we urge you to get further information from your advisor or other faculty members after looking at Appendix A. In general, students interested in Evolutionary and Population Biology should take 290 in their sophomore year, followed by 342, 352, etc. Students of Cell Biology are encouraged to complete Organic Chemistry before or during their junior year, and may benefit from extra courses in chemistry and math.

**Independent Study**

Biology 478/479 offers a chance for qualified, advanced students to work on a specialized topic or research project in Biology with individual guidance from a faculty advisor. Juniors with a cumulative average of 3.0 who have completed at least two semesters of advanced Biology courses at UMB are eligible. If you are interested, talk it over with a prospective sponsor. The schedule number for registration is assigned in the Biology Office. The course is normally taken for 3 credits per semester, and it is recommended that you enroll for the full year. A research report or honors thesis is required. Because this work is specialized, these credits do not count towards the Biology major requirement, but up to 6 of the credits earned do count towards graduation. Independent study students also should attend the weekly departmental seminar held each Friday at 2:30pm in the Small Science Auditorium during the regular Fall and Spring academic semesters.

**Honors**

Students who have taken 3 or more credits of Independent Study (478, 479) may be eligible for Departmental Honors. You do not need to be in the CLA/CSM Honors Program to be eligible for Departmental Honors. Application materials are available from Dr. Alexia Pollack (617-287-6618, W-3-005, email: alexia.pollack@umb.edu). Honors theses presented in the past years are available in the Biology Office. To be awarded Honors, the student must have (1) an overall GPA of 3.0 or better, (2) have obtained satisfactory grades in advanced Biology courses (generally interpreted as no pass/fail enrollments, and a 3.0 average in all Biology courses numbered 200 or above), and (3) have written a thesis and made an oral presentation of this project to the faculty before graduating, usually in the last week of classes in the Spring semester, less frequently in December.

**Nantucket Field Station**

The University owns a small field station on the Coast of Nantucket Island; its primary purpose is teaching and research in Biology. In addition to housing, there are laboratory facilities, field equipment and an excellent range of diverse marine, estuarine, and terrestrial habitats suitable for field work. In recent years the field station has been used by Biologists for field trips throughout the year, for individual research, and for two summer courses. These courses are Biology 100 Coastal Ecology (a non-science majors course), and Biology 306 Marine and Coastal Ecological Research. Specific information about the field station and the courses taught there (including topics of student projects) are available from Dr. Greg Beck (617-287-6619, W-3-004, email: greg.beck@umb.edu).

**Bio-behavioral Studies Program**

This interdisciplinary program of study is intended to provide a coordinated set of courses for majors in any of the three departments of Anthropology, Biology or Psychology who are interested in the subject of animal behavior. You will need to satisfy the Biology major requirements and take additional requirements to complete the program. The combined requirements are rather complex and need some advance planning. The additional requirements are a minimum of five Anthropology and/or Psychology courses chosen from an approved list, with certain distribution requirements. Eight of these appropriate credits can be applied towards your Biology major if you get prior approval from the Biology Department Chairman. The program requirements and the list of approved courses are available in the Biology Office. For advice and further information, please consult Dr. Alexia Pollack (617-287-6618, W-3-005, Biology) or Dr. Susan Zup, (617-287-6319, M-4-271, Psychology). See Appendix G.
Environmental Studies Program
This interdisciplinary program of study provides students with opportunities to understand the underlying causes of environmental problems and to formulate solutions. In recognition of the complexity of environmental problems the Program is broadly based in the humanities, the social sciences, and the sciences. If completing a degree, it is taken in addition to a major. Biology majors can complete some of the requirements for the Environmental Studies Program with Biology and Chemistry courses. Other courses in environmental studies, economics, and social sciences, and an environmental internship are also required. **PLEASE NOTE:** This program is transitioning from a Program of Study to a series of Minors; please see ESP webpage at [http://www.envsty.umb.edu/](http://www.envsty.umb.edu/) for the most up-to-date information regarding this changeover. For more information, please consult the Biology Department Director, Dr. Alan Christian (617-287-6639; email: alan.christian@umb.edu).

Summer School
Summer courses on the Harbor Campus are offered through Continuing Education and usually are confined to a few lower-level courses such as Biology 101-102, 108, 111, 112, and some courses for related programs including Biology 207, 208 and 209. A similar selection of courses is offered at several off-campus sites in the evenings during the academic year. Field courses are offered at the University Field Station on Nantucket; currently, an introductory course on coastal ecology and an advanced course involving individual research have been offered.

For all students considering careers in Biology, it is recommended that during their undergraduate years, one summer be spent at work on a different kind of academic activity such as research, or exploring a course at a marine lab or field station. Courses at marine labs or field stations are often field-oriented, but are not confined to ecology or natural history topics. Many of the students taking such classes will be seniors or beginning graduate students. Announcements posted near the Biology Office indicate the diversity of courses available at various locations around the world. Not surprisingly, some of these courses are likely to be expensive, but scholarships are available. The courses at our Nantucket Field Station are an unusually good value for the money.

Research Experience
If you are considering a career in Biology, you will find directed research to be of great value. Hands-on experience, paid or unpaid, is one of the best choices an undergraduate scientist can make, not only from a personal standpoint, but also as an asset when applying for graduate school or prospective employment. Opportunities include the federal Work-Study Program which provides paid employment, some of which may involve field or laboratory work. Alexa MacPherson of the Biology staff (W-3-021, 617-287-6600) can provide further information. Generally, jobs for the academic year are filled early in September, and summer jobs in late spring. However, applications to establish eligibility and support must be made to the Financial Aid Office much earlier. A variety of part-time jobs supported by faculty research grants are available throughout the year, and volunteers are always welcome. In addition, there are federally funded programs on campus that provide year-round research experiences and mentoring for under-represented minorities. For more information, consult the Initiatives for Maximizing Student Diversity (IMSD) Program and the McNair Program. One of the courses offered each summer at the UMass Nantucket Field Station is based on individual projects (Bio 306). In the summer these jobs are more numerous, and full-time fellowships or other kinds of financial support may be available (see below). For more information, consult the bulletin boards near the Biology Office, or speak with Alexa MacPherson in the Biology Department Office.

Several programs provide summer support (including salary) for research by undergraduates. For the past fifteen years, The National Science Foundation (NSF) has supported a program of **Research Experiences for Undergraduates** (REU) in Biology at UMB, and similar opportunities are available elsewhere, funded by various organizations. These may be programs involving numbers of students or for single research labs. The announcements are posted in the late Fall near the Biology Office. (Individual faculty members also receive
information and announcements about summer jobs in newsletters, etc.; please feel free to ask them if they know of any appropriate opportunities; most of these are unlikely to reach the bulletin boards, so ask in good time!) December is an appropriate month to start looking for this sort of summer experience. All student researchers are strongly encouraged to report their findings at scientific meetings (some funding may be available). There is also an Annual Science Meeting for undergraduates each spring at varying sites within the UMASS System; the information will be posted outside the Biology Office as it becomes available. Information regarding our REU Program is available on our web site at www.reu.umb.edu, and about other REU programs at the NSF website, www.nsf.org.

The Initiative for Maximizing Student Diversity (IMSD) at UMass Boston is a year-round, research-intensive, skill-building, mentoring program for undergraduates interested in the biomedical sciences. Sponsored by the National Institutes of Health, the program aims to increase diversity among PhD-level researchers in biomedical fields. Students can apply to the program as either an IMSD Affiliate or Fellow. Affiliates are students who have received less than 60 credits towards graduation; they receive enrichment opportunities and an introductory research experience. Fellows have demonstrated mastery of their coursework and are within 60 credits of graduation; they receive more advanced training and participate in intensive research experiences. All students receive tuition waivers and a competitive hourly wage for their participation; Fellows also receive research supply funds and a loaner laptop. The IMSD program provides numerous professional development opportunities, including year-round research experiences in laboratories at UMass Boston or Dana-Farber/Harvard Cancer Center, research skills training, biomedical career development workshops, facilitated study groups in science and math courses, journal club, intensive mentoring and advising, travel to scientific conferences, and the benefits of being part of a community of scientists.

To be eligible for the program, you must be enrolled as a full-time undergraduate student at UMass Boston, be a U.S. Citizen or permanent resident, and aspire to pursue a PhD in the biomedical field. Individuals belonging to racial, ethnic, or other under-represented groups in the sciences, as well as persons with disabilities, are strongly encouraged to apply. For more information, please contact the Program Coordinator, Jessica Thomas, at jessica.thomas@umb.edu or in the IMSD Program Office, Wheatley Hall, 3rd floor, Room 011.

The Graduate Program in Biology
The graduate program in Biology consists of diverse areas of study and research involving approximately 100 Master's and Ph.D. students. The Biology Department grants a Ph.D. in Environmental Sciences under three tracks: Environmental Biology, Molecular, Cellular and Organismal Biology, and Biomedical Engineering and Biotechnology. The departmental Master's programs include (1) the M.S. in Biology in which students may elect to study in any of the major sub disciplines of Biology (30 credit hours), and (2) the M.S. in Biotechnology and Biomedical Science which focuses on cell and molecular Biology and laboratory techniques relevant to Biotechnology (32 credit hours). The Biology Department also shares three tracks with the Master's Program in Environmental Coastal and Ocean Sciences (ECOS): Environmental Microbiology and Aquatic Toxicology. Information on the Ph.D. and the Master's Programs, as well as the research interests of the Biology Faculty is available on our web site at http://www.Bio.umb.edu/Programs/GraduatePrograms/index.html. The graduate teaching assistants from these programs and from the Ph.D. Program in Environmental Science are an invaluable asset to undergraduate Biology majors -- they assist in teaching labs, tutor in certain courses, and give undergraduates the opportunity to interact with people at a more advanced stage in their professional training in Biology.

VI. SPECIAL CREDITS AND GRADES

AP and CLEP Exams
If your background, either in school or work-related experience, is strong you may qualify for exemption from Biology 111-112, or for an accelerated program. The Advanced Placement (AP) examination is offered by certain high schools. On the basis of interviews and their score on this exam, students may be exempted from taking
Introductory Biology (score 3), or both exempted and granted 4 elective credits towards graduation (score 4 or more). Certain work-related experiences can be translated into credits on the basis of a nationwide examination administered by the College Level Equivalency Program (CLEP). Students who score 50 or higher on the CLEP exam will be exempted from taking Introductory Biology and will be granted 6 elective credits towards graduation. For more information, ask the Admissions Office.

Minimum Grades
An average grade of "C-" or better in Biology 111-112 (or equivalent), or written permission of the student's advisor, is advised for registration in Biology courses numbered 200 or above. In order to graduate as a biology major, a final GPA of 2.0 is required in Biology courses above Biology 111-112 which are used to meet Biology major requirements.

Pass-Fail Option
Of the science courses required for the Biology major, a maximum of one course may be taken Pass-Fail. This option should be approved by your advisor. The same is true for the Biology minor —one course may be taken Pass-Fail.

Incompletes, Withdrawals and/or Failure
University policy on these matters is summarized in the catalog. An instructor may give a grade of Incomplete only when a portion of the assigned or required class work, or the final examination, has not been completed because of a student's serious illness or extreme personal circumstances. If the student's record is such that he/she would fail the course regardless of the missing work, he/she fails; an Incomplete is not appropriate. It is your responsibility to meet with the instructor to make a written agreement on the work to be done and the timetable for completion. Incompletes automatically change to "F" after one year. The appropriate Form for Grade Incomplete must be completed and signed by both the instructor and student. Incompletes will not be granted to students who remain in courses beyond the end of the withdrawal period and choose not to complete work because of concern for the anticipated grade.

Repeating a Course
A student may repeat any course, but only once, and may do this for a maximum of four courses during his/her undergraduate career at UMB. For all repeated courses both grades will appear on the transcript, the first will be bracketed, and only the second grade will contribute to the GPA. Waivers of these restrictions are handled by the Committee on Standards and Credits (see Academic Support). The preceding restrictions do not apply to Biology 381, 444, 478 or 479, but note that these courses do not meet the Biology major requirements.

The preceding sentences do not refer to withdrawals. Approval by course instructor and the Department Chair are required to repeat a Biology course in which the student has twice received a grade of W (withdrawal).

Transfer Credits
The transfer of credit for courses completed at other institutions prior to registration at UMB involves two stages: (1) Review by the Admissions Office will determine how many and which of these credits will be accepted towards UMB’s graduation requirements; this information will be placed on your official UMB transcripts; (2) Review by the Chairman of the Department Advising Committee (Dr. Robert Guimond) or by the Chairman of the Biology Department to determine which courses satisfy the major requirement. This review should be initiated by the student early in his/her career at UMB. Courses at State, Community, and Junior Colleges in Massachusetts have been evaluated for transfer and UMB equivalence. This information is available in the Admissions Office and the Biology Office. After review, the form summarizing the evaluation is stored in the Biology Department, and will be needed to confirm that you have satisfied the major requirements when you file for graduation. The acceptable minimum grade for transferring a course for major credit is "C-." A grade of "P" (Pass) is not transferable.
A transfer student must include at least 12 credit hours (including a minimum of 2 hours [6 class hours] in laboratory work) taken within the Biology Department at UMASS/Boston. These courses must be at the 300 level or above unless the Chair's approval is obtained for lower level courses. Biology 381, 444, 478-479, 483 and 672-673 do not fulfill this requirement. The University also requires that at least 30 of the 120 semester credits required for graduation must be completed at the University of Massachusetts/Boston.

To take courses for transfer credits at other institutions while registered at UMB requires prior approval of the department(s) concerned, and the completion of a form which can be acquired from Dr. Guimond or from the Registrar’s Office. At present, courses offered through the Mass Bay Marine Studies Consortium do not count for major credit.

**VII. CAREERS IN BIOLOGY**

The main resources for help with career planning and job placement are located in the University Advising Center on the 1st floor of the Campus Center, Room 1100. Counselors in the Career Services Office and the Coop/Internship Office (Campus Center, 1st floor, Room 1100, telephone 617-287-5519) can help with individual career and job searches. In the Career Library, you will find pamphlets which have been prepared by several agencies of the U.S. Government, as well as various professional societies, describing opportunities for careers in the life sciences. These pamphlets explain the kind of work in the different areas, employment opportunities, salaries to be expected, and more importantly, the kinds of academic preparation needed at various professional levels. One such pamphlet, with reference to many other publications, is the *Occupational Outlook Handbook*, published by the U.S. Department of Labor (http://www.bls.gov). Two books, *Careers in Science and Engineering; A Student Planning Guide to Grad School and Beyond* (National Academy Press 1996), and *Rethinking Science as a Career* (Research Corporation 1996), are excellent resources. (More recent editions may be available). Many Biological organizations have their own excellent career advice and information on their web sites, e.g., www.asmusa.org, if you are interested in a career in Microbiology.

Two areas of biology clearly are growing in terms of the number of people employed. One of these involves private and governmental groups that detect, monitor, and ameliorate environmental problems, including impacts on biodiversity. Second, the field of biotechnology is rapidly expanding in medical, agricultural, and industrial applications of modern technology and offers many entry-level positions for students with particular skills. Appropriate courses taken as a biology major may be sufficient, but you are encouraged to consult the description of the undergraduate Biotechnology Track, as well as the M.S. program in Biotechnology and Biomedical Sciences for more information about both undergraduate and graduate courses.

**Graduate School**

Some kind of advanced degree is necessary for many careers in Biology, particularly if one wishes to advance beyond the laboratory technician ranks. There are many different kinds of programs and many different kinds of graduate schools. In contrast to expensive professional schools such as Law or Medicine, most graduate students in Biology are paid (but not much!) in the form of fellowships or assistantships. Depending upon the scope of the program selected, a Master's degree may require anywhere from one to three years and a PhD four to seven years from the start of graduate study. The PhD is generally required for teaching and research positions at universities, and for leadership positions in other scientific laboratories.

If you are thinking about graduate school, talk to faculty members in your field of interest and to those who have studied or taught at the graduate schools that attract you. The web is a particularly rich source of information on graduate programs. The graduate program in the Biology Department is briefly described on page 12. Further information can be found at www.Bio.umb.edu. The criteria for admissions vary widely from school to school, and
the following generalizations are not precise: the Graduate Record Exam is usually required, and the three general tests may be more important than the Biology test. Good letters of recommendation from persons who know you are very important, the overall GPA is less so, although grades in particular courses are likely to be significant. Research and/or other relevant experience are always a strong point: naturally, such experience is very helpful for deciding on career directions as well as for admission. As a general rule, maintain a broad perspective and, if possible, take more science courses than the minimum required to complete a major. Some graduate courses may also be appropriate, although not essential.

The courses you take to complete the Biology major are likely to satisfy the requirements of most graduate schools, but bear in mind that if you have to make up deficiencies after arrival, you will not get graduate school credit for undergraduate courses. Thus, it is important to check graduate school catalogs to ensure that you are well-prepared. Many catalogs are available in the Career Services Library, and there are individual counselors who can help you. Every applicant to graduate school should be computer-literate: at the very least competent in spreadsheets, information retrieval, and word-processing. In addition, depending on your interests, you may benefit from additional courses to provide extra dimensions: for instance in chemistry, statistics, geographical information systems, programming, electronics, or the history and philosophy of science.

Health-Related Professions
For the student who is seriously considering medicine, dentistry, veterinary medicine or one of the allied health professions, it is important to plan one's academic program in advance and with attention to timing and scheduling. If you are interested in these fields, you should consult with Grace McSorley or Jeanette Welch in the University Advising Center (617-287-5500) as early as possible in your college career. You will then be identified as a student with pre-med/pre-dental/pre-vet interests, properly advised as to what courses to take, when to apply, and in general what to do to further your application for admission. It is equally important to look into and plan for alternative careers in the health fields as competition for admission to medical school results in the rejection of many highly qualified individuals -- the number of applicants exceeds the number of available places by almost three to one. The admissions situation is even more limited in relation to veterinary school, but more encouraging in relation to dental school. There are increasing numbers of opportunities in other health professions, and students would do well to consider these as alternative career possibilities. The pre-medical requirements can serve as a strong academic background for both allied health and primary care fields. For more info, log onto http://www.uac.umb.edu/premed/.

There is no formal pre-medical or pre-dental major here, or at many other universities. Pre-medical preparation involves completion of basic science courses, usually Biology 111-112, Chemistry 115-118, Organic Chemistry, Elementary Physics (with Lab) and a year of Calculus. Some medical schools might prefer more course work, or expect that specific courses be completed. One can major in any field and be a pre-med student simply by taking the above courses, although non-Biology majors are well advised to take a second year of Biology for the specific purpose of preparing for the admission test. Biology majors satisfy pre-med requirements as a normal part of the Biology major if they include Organic Chemistry as part of their course load. Pre-medical students often are urged to gain experience in a job (volunteer or paid, clinical or research) which is related to health care. See Appendix L for more information.

Criteria for acceptance to the various health professions differ, as does the degree of difficulty in gaining admission. Information on admissions criteria is available from catalogs and from various reference materials in the Office of Career Services.

The Biology Department offers courses in Anatomy and Physiology, Medical Microbiology (Biology 209), and Nutrition, which are required courses of students enrolled in the College of Nursing (i.e. Nursing Program and Exercise Science majors) and are NOT open to Biology majors.
**Biotechnology Careers**

A career in the Biotechnology industry deserves consideration as an attractive alternative to medicine or academia. Biotechnology is a dynamic new industry that applies techniques of genetics, molecular and cellular biology and microbiology to the production of commercial products. Biotechnology is revolutionizing a broad range of commercial fields including pharmaceuticals, organic chemistry, agriculture, and environmental remediation. The Greater Boston area is the second largest Biotechnology center in the world, with approximately 215 companies that provide many employment opportunities for students with undergraduate and post-graduate degrees in Biology.

Hard working individuals with aptitudes for leadership and learning new skills will find careers in Biotechnology to be financially rewarding and intellectually challenging. Employees in the research and development divisions perform experiments to evaluate the commercial potential of new products. Employees in the process/quality assurance divisions devise reproducible, cost-effective techniques to make large amounts of commercial products, while those in the manufacturing and production divisions are responsible for making a safe and effective product. Technical support and marketing representatives have great opportunities for personal and professional interactions. Most salary packages include health and dental benefits, retirement plans, stock options, and educational reimbursement.

The Biology Department offers three programs of study to train students for careers in Biotechnology. The Masters Program in Biotechnology and Biomedical Sciences prepares students for careers in research and development divisions of Biotechnology companies, and virtually all of the graduates of this program have been able to find good positions in Biotechnology companies or Biomedical research laboratories. The Graduate Certificate in Biotechnology is designed to provide a sound theoretical background for individuals already working in the research and development divisions of Biotechnology companies or Biomedical research laboratories. At the undergraduate level, the Biotechnology track leads to a BS in Biology and emphasizes disciplines such as Molecular Biology, Biochemistry, Cell Biology, Genetics, Immunology, and Microbiology.

Graduate and undergraduate students who wish to work in a Biotechnology company should obtain independent research experience. The Masters Program in Biotechnology and Biomedical Sciences includes a thesis research project that most graduates find to be the single most important factor in obtaining satisfactory postgraduate employment. Undergraduates can acquire research experience by independent study in faculty laboratories. Financially qualified students can be supported through the Work-Study Program or research grants to individual faculty members. In addition, some Biotechnology companies offer internships or co-op positions that provide invaluable experience and contacts. For additional information, contact Dr. Kenneth Kleene, Biotechnology Program Director (617-287-6679, or email: kenneth.kleene@umb.edu). See Appendix F.

**Environmental Careers**

Employment opportunities in the ecological and environmental fields are expected to grow enormously. Students completing a Biology major in the Environmental Studies Program have opportunities to enter a broad range of environmental fields, although further training is usually required if the goal is technically oriented job or a research career. The range of jobs include: environmental specialist with a municipal, regional, state or federal department of environmental quality or wildlife management; environmental enforcement officer in a governmental regulatory agency; environmental educator in a school system, a government environmental department, or non-government environmental/conservation organizations; health and safety specialist; or as a science journalist.
The Biology Department Office at UMass Boston is located in the Wheatley Building on the 3rd Floor in Room 021 (telephone 617-287-6600, Fax 617-287-6650, email for the two office assistants are: alexa.macpherson@umb.edu or anshika.verma@umb.edu). Here you can obtain useful information and/or leave notes and lab reports in faculty or graduate students’ mailboxes. The faculty has individual offices and labs in Wheatley and McCormack, and the teaching labs are also in these buildings. The **Greenhouse** is in the Science Building. To arrange a visit to the Greenhouse, please call Jim Allen, Greenhouse Manager at 617-287-6580.

The bulletin boards outside the Biology Office are used for: (1) announcements of seminars and colloquia at nearby colleges and universities, (2) brochures about summer schools, graduate schools and special courses, etc., (3) current course listings, faculty, a few jobs, etc.

**Biology Seminar Series**

Students are warmly invited to attend the weekly seminar series, held on Fridays at 2:30 p.m. in the Small Science Auditorium. These talks, usually by outside speakers, generally describe recent or ongoing research. Information about them is posted each week outside the Biology Office and elsewhere. The semester schedule is posted on the door of the Biology Office. Students enrolled in Biology 478 and 479 (Independent Study) as Grad Students are expected to attend these seminars. To find the most up-to-date seminar information please use the following link: [http://www.bio.umb.edu/events/Seminar_Series.html](http://www.bio.umb.edu/events/Seminar_Series.html).

**Department Prizes and Awards**

Departmental prizes are awarded each year to a few graduating Biology majors who have demonstrated superior abilities in their course work, have high over-all averages (at least Cum Laude level), and have made special contributions to the Department. The Prize winners, along with Biology Honors students, are invited to the CSM Honors Convocation. This special occasion, held shortly before graduation, recognizes and applauds the best students in the college along with their families and friends. Outstanding teaching by undergraduates or graduate students is recognized by the Harrison Prize, an award established by Dr. Bettina Hall Harrison when she retired.

**Student Organizations**

The liveliness of these clubs varies greatly from year to year (and their names may change). If a club is not listed by the current Student Activities SAC, this may signal your chance to revive it! The Biology Club (student run), telephone 617-287-6640, has organized in recent years outside speakers, films, field-trips and the like, sometimes in a very convivial atmosphere. As a Registered Student Organization the club is eligible for funds from the Student Activities Committee. The Biology Club is located in the Campus Center, 2nd Floor, Room 2100 inside the Student Life Office. In the Club's room, (Campus) there are not only various academic resource materials such as reference books, texts, course outlines and old exams, but also cooking facilities, a refrigerator, and some comfortable chairs. Students can join at any time by paying the $5.00/semester membership fee.

Two clubs, inactive at the time of this writing, cater to the interests of birders and scuba divers: the UMASS Bird Club has organized talks and field trips. The Scuba Club (Norlantic Reef Combers) has been run by students interested in understanding and preserving marine systems. The club may offer scuba courses, make dive trips, and maintain aquaria (see Dr. John Ebersole if interested; john.ebersole@umb.edu).

**Biology Alumni**

Since our first Commencement in 1969, the Biology Department has graduated thousands of majors. Many of our former students have built careers in Biology and in the allied professions; many have gone into other fields. The Department is constantly renewing its contacts with all former students and has an active alumni organization. We
hope that those who are students in the department at the present time will begin to think of themselves as future alumni and will drop off an up-to-date mailing and email address in the Department Office.

**Beta Beta Beta (TriBeta) Biological Honors Society** (www.tri-beta.org) Theta Omicron Chapter at UMass-Boston. Tri-Beta is a national Biological Honors Society founded in 1922, with over 430 chapters and more than 175,000 members. The goals of Tri-Beta are to promote interest in the biological sciences and to support and promote student research. Tri-Beta holds national and regional conventions and publishes a journal, BIOLS, in which students can publish their work. Chapters have regular meetings and organize activities in the spirit of the goals of Tri-Beta. For applications and more information please contact Dr. Alexia Pollack, 617-287-6618; email: alexia.pollack@umb.edu.

### IX. LIBRARY AND COMPUTER RESOURCES

We urge Biology majors to take advantage of the resources of the Joseph Healey Library. The library has good holdings in Biology. A student with a valid I.D. may borrow circulating materials. Most of the books (monographs) and bound periodicals (journals, serials, etc.) will be found on Floors 6 and 7. Current unbound periodicals are on Floor 5. Reference materials are in the Main Reference Room on the 4th floor. The Reserve Desk is on the 3rd floor. You can access many of these from home if you have a current UMB Library bar code. However, there are some databases that are only accessible in the library, including one that is often useful for Biologists: the Science Citation Index. Often, searches of specialized databases are much more effective than diffuse web-based searches. Knowing how to find information from printed and electronic sources is an important skill to develop. The electronic availability is changing too fast for a brief summary. The Library’s website is a very useful starting point: home page www.lib.umb.edu. To see a list of electronic sources, visit the databases and indices page.

The Library staff encourages you to join one of their tours of the facilities. For information about these tours, or other services offered, inquire at the Circulation Desk, or call 617-287-5900. The Library holdings are substantial; however, for special projects you may need to visit other nearby libraries, or obtain materials through Interlibrary Loan. The Library staff will help you with such tasks but bear in mind that this takes some time. If you have any suggestions for new books, it may be possible to request them if you provide publication data (or a review) to an interested faculty member. Library hours: Monday - Thursday 8:00 a.m. -10:00 p.m., Friday 8:00 a.m.-6:00 p.m., Saturday 9:00 a.m. - 5:00 p.m., and Sunday 1:00 p.m.-8:00 p.m., during the semester. On most holidays the hours are 9:00 a.m.-5:00 p.m. To confirm the hours for any particular holiday, please call 617-287-5940. Between semesters, the library closes at 7:00 p.m. Monday-Thursday and is not open on Sundays.

Word processing and other computer software application workshops are offered by UMASS Computing Center. Consult their bulletin board for times and dates. If you already have microcomputer skills, you may use manuals and word-processing instruction disks at any UMASS computing room. If you do not yet have a user account, go to Lower level of the Healey Library to obtain one. At each location Academic Computing Services provides an attendant who will assist you. Additional information about services, and the hardware and software available, can be obtained from the Consulting Office at Healey Library Lower Level.
X. THE BIOLOGY FACULTY

The information provided below will help you to identify individual faculty members and discover their major interests. Telephone numbers (617-287-xxxx) are listed along with locations of offices and/or labs in McCormack or Wheatley. Faculty with temporary appointments are not listed. Additional information about research interests is available in the Biology Office and on our web site at http://www.bio.umb.edu.

Steven M. Ackerman (Associate Professor & Biochemistry Program Director) 617-287-6682, W-3-031, steven.ackerman@umb.edu. Gene regulation in plants and animals, specifically transcription initiation mechanisms. We investigate the function of the general transcription proteins for basal transcription, and the mechanism of action of activator transcription from plants in animal systems, both in vitro and in vivo.

Kamaljit S. Bawa (Professor) 617-287-6657, M-2-310, kamal.bawa@umb.edu. Conservation genetics; conservation and management of Biodiversity; ecology and economics of non-timber forest products; tropical Biology. Website: http://www.atree.org/

Gregory Beck (Associate Professor) 617-287-6619, W-3-004, greg.beck@umb.edu. Evolutionary immunology; evolution of host defense mechanisms, phagocyte-bacteria interaction, acute-phase response, and molecular immunology. Website: http://asterias.bio.umb.edu/

Solange Brault (Associate Professor) 617-287-6683, W-3-032, solange.brault@umb.edu. Population and conservation ecology, population dynamics models, marine mammal and bird demography.

Kenneth L. Campbell (Professor) 617-287-6676, M-3-322, kenneth.campbell@umb.edu. Reproductive endocrinology - the mechanism of action of the gonadotropic protein hormones on their target cells and the metabolism of these hormones in culture; biological determinants of human reproduction. Website: http://kcampbell.bio.umb.edu/

Alan Christian (Associate Professor) 617-287-6639, W-3-010, alan.christian@umb.edu. Aquatic and fresh water mussel ecology and conservation; ecosystem ecology: structure, function, and nutrient cycling; landscape ecology: watershed land use, land cover and spatial patterns of organisms and abiotic factors; food web and community ecology: age and growth, fecundity, life history analysis; and molecular ecology: population genetics and phylogenetics. Website: http://faculty.www.umb.edu/alan.christian/index.php

Adán Colón-Carmona (Associate Professor) 617-287-6680, W-3-029, adan.colon-carmona@umb.edu. Cell Biology, genetics, and molecular biology of plants: environmental and developmental control of cell division in Arabidopsis thaliana, and phytoremediation. Website: http://www.acc.umb.edu/

John P. Ebersole (Associate Professor) 617-287-6681, W-3-030, john.ebersole@umb.edu. Community structure of coral reef fishes as influenced by natural events (hurricanes) and by human activities involving mechanical damage (ship groundings), and toxic releases.

Ron J. Etter (Professor) 617-287-6613, W-3-025, ron.etter@umb.edu. Evolution and ecology of marine invertebrates, geographic variation in mitochondrial DNA; life history evolution; the effects of spatial and temporal variation in biotic interactions on population dynamics and community structure. Website: http://www.etterlab.umb.edu/

Katherine Gibson (Assistant Professor) 617-287-6614; W-3-012; katherine.gibson@umb.edu. Molecular genetics of bacterial-plant symbiosis; signal transduction; regulation of bacterial cell cycle progression.

Robert W. Guimond (Professor and Director of Undergraduate Advising) 617-287-6654, M-2-127, robert.guimond@umb.edu. Vertebrate physiology, Bio-medical Law; comparative respiratory physiology and gas exchange patterns in amphibious vertebrates.
William Hagar (Associate Professor and Associate Dean of the College of Mathematics and Science) 617-287-6669, M-3-312, william.hagar@umb.edu. Environmental monitoring and photonbiology: monitoring anthropogenic inputs into water systems and factors influencing the photosynthetic rates.

Linda Huang (Associate Professor) 617-287-6674, W-3-006, linda.huang@umb.edu. Cell biology, signal transduction, and regulation of cell morphology.

Rick Kesseli (Professor and Director of Graduate Program) 617-287-6627, W-3-024, rick.kesseli@umb.edu. Population genetics; molecular evolution; evolution and genetic bases of host-pathogen interactions; evolution and genetic bases of sex determination; conservation genetics. Website: http://www.genetics.umb.edu/

Kenneth C. Kleene (Professor and Director of the Biotechnology Track Program) 617-287-6679, W-3-028, kenneth.kleene@umb.edu. Molecular and developmental Biology; use of recombinant DNA technology to study gene regulation during spermatogenesis in the mouse.

Alexia Pollack (Associate Professor) 617-287-6618, W-3-005, alexia.pollack@umb.edu. Neurobiology; research focuses on the role of dopamine in regulating motor behavior and neuronal activity in the rat basal ganglia.

Michael A. Rex (Professor) 617-287-6678, W-3-027, michael.rex@umb.edu. Systematics, zoogeography and ecology of deep-sea gastropod mollusks in the Atlantic Ocean: theoretical, comparative and experimental aspects of island biogeography.

Michael P. Shiaris (Professor and Chairman) 617-287-6675, M-3-321, michael.shiaris@umb.edu. Microbial ecology, especially the biodegradation of organic pollutants in aquatic ecosystems and the population dynamics and diversity of pollutant-degraders and public health bacteria in aquatic sediments. Website: http://microbe.bio.umb.edu/

Rachel C. Skvirsky (Associate Professor) 617-287-6617, W-3-007, rachel.skvirsky@umb.edu. Molecular genetics; microbiology; extracellular secretion in bacteria.

Robert Stevenson (Associate Professor) 617-287-6572, M-1-523, robert.stevenson@umb.edu. Animal physiology, physiological ecology, conservation Biology, conservation physiology, conservation education, micrometeorology, energetics, locomotion, temperature regulation, muscle physiology, scaling, insect flight. Website: http://efg.cs.umb.edu/

Manickam Sugumaran (Professor) 617-287-6598, W-4-075, manickam.sugumaran@umb.edu. Protein chemistry and enzymology pertaining to insect cuticle, insect immunity, melanogenesis, Bioprospecting, oxidative browning of plant products, metabolism of xenobiotic compounds and biodegradation of organic pollutants (especially aromatic compounds). Website: http://www.faculty.umb.edu/yvonne_vaillancourt/Biology/Biochem.htm

Alexey Veraksa (Assistant Professor) 617-287-6665, M-3-116, alexey.veraksa@umb.edu. Cell and molecular biology of Drosophila development; cell signaling; proteomics and mass spectrometry; developing new methods to analyze protein-protein interactions; network biology.

Brian T. White (Associate Professor) 617-287-6630, W-3-003, brian.white@umb.edu. Science education; investigation of students changing conceptions of science (especially Biology); development and evaluation of teaching materials including computer software. Website: http://intro.bio.umb.edu/BW/research.html

H. Garrison Wilkes (Professor) 617-287-6662, M-2-330. Evolution under domestication, the origin and evolution and maize and its New World relatives, the origin and development of Meso-American habitat disturbance and manipulation in the quest of food; stability models in indigenous agricultural systems both New and Old; plant germplasm resources; general economic botany.
Appendix A
Biology Courses

Course descriptions can be found in Appendix B, and current offerings in the Course Listings Catalog for each semester. A course appears only once on the list below although some courses could fit into more than one category. To find out when a course will be offered see the course listing for the appropriate semester and more information.

★ Lecture Only
† Rarely offered
♦ Not acceptable for major

Note: Because you may receive credit for the same material only once, you may not receive credit for both “lecture only” and “lecture & lab” versions of the same course.

Required Biology Courses for Majors
111 & 112  General Biology (prerequisite for Biology courses 200 and above)
210 (212★♦) Cell Biology (with Lab) (prerequisites: Chemistry 115, 117)
252 (254★♦) Genetics (with Lab)
290   Population Biology

Advanced Courses (Prerequisites as indicated)

Cell Biology and Related Fields
334   Microbiology (prerequisites: 210, 252; Chemistry 115-118)
360   Bioinformatics (prerequisites: 210, 252 and 290)
370 (372★) Molecular Biology (prerequisites: 383 & 385 [*383 only])
378 (380★) Introduction to Immunology (prerequisites: 210, 252; Chemistry 115, 117)
383   Biochemistry I (lecture) (prerequisites: 210 or 212; Chemistry 252, 256)
384   Biochemistry II (lecture) (prerequisite: 383)
385   Biochemistry I (lab) (co-req. 383)
386   Biochemistry II (lab) (prerequisite: 385, co-req. 384)
602   Plant Molecular Biology & Physiology (prerequisites: 320, 321, 322 or 323, 675 or 676)
612   Advanced Cell Biology (permission)
614†   Advanced Cell Chemistry (permission)
615   Immunology (prerequisites: 378 or 380)
622†   Concepts and Methods in Cytology (permission)
626   Molecular Genetics of Bacteria (prerequisites: 252)
627   Bacterial Physiology (prerequisites: 334 & 383)
662   Photobiology (permission)
668   Cellular and Molecular Endocrinology (prerequisites: 317; or Biochem 383, Chemistry 251, 255)
670   Tissue Culture (prerequisites: 313 or 383)
675 (676★) Molecular Biology (prerequisites: 385, 670, & permission)
677   Advanced Eukaryotic Genetics (prerequisites: 252)
678 (679★) Protein Chemistry and Enzymology (prerequisites: Biochem 383 & 384 & permission)
685   Biomedical Tracers (prerequisites: 317 or 319; or Biochem 383; Chemistry 251, 255)
690   Concepts in Modern Biology (permission)
697   Special Topics in Biology (permission)

Organismal Biology and Related Fields
312 (or 313)  Developmental Biology (prerequisites: 210 & 252; Chemistry 115-118)
316 (318★)   Neurobiology (prerequisites: 210, 252)
317 (319★)   Endocrinology (prerequisites: 210, 252)
320 (322★)   Vascular Plants (prerequisites: 210, 252)
321 (323★)   Plant Physiology (prerequisites: 210; Chemistry 115-118; Math 130)
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>328</td>
<td>Plant Life</td>
<td>(prerequisites: 210, 252 and 290)</td>
</tr>
<tr>
<td>337</td>
<td>Comparative Animal Physiology</td>
<td>(prerequisites: 210; Chemistry 115-118; Math 130)</td>
</tr>
<tr>
<td>331</td>
<td>Biology of Marine Invertebrates</td>
<td>(prerequisites: 252, 290)</td>
</tr>
<tr>
<td>338†</td>
<td>Insect Life</td>
<td>(prerequisites: 252, 290)</td>
</tr>
<tr>
<td>344</td>
<td>Ornithology</td>
<td>(prerequisites: 252, 290)</td>
</tr>
<tr>
<td>345</td>
<td>Ornithology Lab</td>
<td>(co-requisite: Bio 344)</td>
</tr>
<tr>
<td>627</td>
<td>Bacterial Physiology</td>
<td>(prerequisites: 334; Biochem 383)</td>
</tr>
<tr>
<td>658</td>
<td>Environmental Physiology</td>
<td>(prerequisites: Biochem 383)</td>
</tr>
<tr>
<td>670</td>
<td>Tissue and Organ Culture</td>
<td>(prerequisites: 313; or Biochem 383)</td>
</tr>
<tr>
<td>692</td>
<td>Advanced Physiology</td>
<td>(prerequisites: 316; Biochem 383; Chemistry 251, 255; Physics 107)</td>
</tr>
</tbody>
</table>

**Evolutionary Biology and Related Fields**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>330</td>
<td>Biology of Fishes</td>
<td>(prerequisites: 252, 290)</td>
</tr>
<tr>
<td>342</td>
<td>Ecology</td>
<td>(prerequisite: 252, 290)</td>
</tr>
<tr>
<td>343</td>
<td>Ecology Lab</td>
<td>(co-requisite: Bio 342)</td>
</tr>
<tr>
<td>348</td>
<td>Animal Behavior</td>
<td>(prerequisites: 252, 290)</td>
</tr>
<tr>
<td>349</td>
<td>Methods in Ethology</td>
<td>(co-requisite: Bio 348)</td>
</tr>
<tr>
<td>352</td>
<td>Evolution</td>
<td>(prerequisite: 252, 290)</td>
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<tr>
<td>353</td>
<td>Evolution Lab</td>
<td>(co-requisite Bio 352)</td>
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<tr>
<td>601</td>
<td>Marine Ecosystems</td>
<td>(permission)</td>
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<tr>
<td>603</td>
<td>Theories of Community Structure</td>
<td>(prerequisites: 342)</td>
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<tr>
<td>605</td>
<td>Field Methods</td>
<td>(prerequisites: 342 &amp; 343)</td>
</tr>
<tr>
<td>613</td>
<td>Archeological Botany</td>
<td>(permission)</td>
</tr>
<tr>
<td>628</td>
<td>Microbial Ecology</td>
<td>(prerequisites: 334 or 342 &amp; 384)</td>
</tr>
<tr>
<td>632</td>
<td>Advanced Evolution</td>
<td>(permission)</td>
</tr>
<tr>
<td>635</td>
<td>Advanced Genetics and Diversity</td>
<td>(prerequisite: 352)</td>
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<tr>
<td>638</td>
<td>Advanced Ecology</td>
<td>(prerequisites: 342)</td>
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<tr>
<td>640</td>
<td>Modeling in Biology</td>
<td>(permission)</td>
</tr>
<tr>
<td>642</td>
<td>Biogeography</td>
<td>(prerequisites: 342 and 352)</td>
</tr>
<tr>
<td>643</td>
<td>Behavior and Ecology of Seabirds</td>
<td>(permission)</td>
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<tr>
<td>645</td>
<td>Plant and Animal Co-evolution</td>
<td>(prerequisites: 290, 342 or 352)</td>
</tr>
<tr>
<td>691</td>
<td>Advanced Ethology</td>
<td>(prerequisites: 290 and 348)</td>
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**General**

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<th>Course</th>
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<td>381♦</td>
<td>Special Topics</td>
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<tr>
<td>444♦</td>
<td>Cooperative Education</td>
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<tr>
<td>478-479♦</td>
<td>Independent Study I and II</td>
<td>(This also serves as the route to Honors in Biology, see page 10).</td>
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<tr>
<td>672-673♦</td>
<td>Directed Readings I and II</td>
<td>(permission)</td>
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<td>650♦</td>
<td>Scientific Communication</td>
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<tr>
<td>697♦</td>
<td>Special Topics in Biology</td>
<td>(permission)</td>
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**Courses for Non-Majors** (may be taken as electives but do not satisfy Biology major requirements)

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<tr>
<th>Course</th>
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<td>100♦</td>
<td>Coastal Ecology</td>
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<td>101♦</td>
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<td>102♦</td>
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<td>103♦</td>
<td>Biology of Human Disease</td>
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<td>104♦</td>
<td>Human Biology</td>
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<td>107♦†</td>
<td>Extinction</td>
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<td>108♦</td>
<td>Introduction to Nutrition</td>
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<td>207♦</td>
<td>Anatomy and Physiology I</td>
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<td>208♦</td>
<td>Anatomy and Physiology II</td>
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<tr>
<td>209♦</td>
<td>Medical Microbiology</td>
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</tbody>
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Appendix B
UNDERGRADUATE COURSE DESCRIPTIONS

Biol 100
Coastal Ecology
Investigations of the natural history and community dynamics of salt marshes, sea grass beds, mudflats, and beaches. Field and laboratory exercises on the adaptations and interactions of marine organisms are emphasized. Meets every weekday during five weeks of the summer at the University's field station on Nantucket.
Distribution Area: NS
40 hrs wk, 5 Credits
Mr Beck

Biol 101
The Basis of Life
The uniqueness of life within the physical universe. The matter and energy of life, the genetic code, molecular Biology, and the origin and evolution of life. An overview for students in the humanities and social sciences of those features which distinguish living organisms from non-living things. No background in the natural sciences is required.
Distribution Area: NS
3 Lect Hrs, 1 Disc Hr, 3 Credits
Staff

Biol 102
Evolutionary Biology
Designed for students in the social sciences and humanities. Those areas of genetics, ecology, and evolution that form a unified approach to the study of organisms and populations. No background in the natural sciences is required.
Distribution Area: NS
3 Lect Hrs, 3 Credits
Staff

Biol 103
Biology of Human Disease
This course uses human disease as a vehicle to study Biology in a context that is relevant to students' lives. We will focus specifically on cancer, AIDS, and sickle cell anemia. These diseases will be used to illustrate concepts in genetics and cell and molecular biology. The course will provide experience in scientific problem solving and in evaluation of scientific evidence, so that students develop an appreciation of how science works. Students will also examine ethical and social policy issues associated with these diseases.
Distribution Area: NS
3 Lect Hrs, 3 Credits
Ms Skvirsky

Biol 104
Human Biology
A one-semester course designed for those who do not intend to major in Biology. Topics are drawn from among the following: reproduction and development, human evolution and diversity, disease, and genetics. No background in the natural sciences is required.
Distribution Area: NS
3 Lect Hrs, 3 Credits
Ms Skvirsky

Biol 107
Extinction
An introductory survey for non-majors of the causes and implications of extinction in biological systems, at the level of the allele, the population, and the ecosystem. One field trip may be required.
Distribution Area: NS
3 Lect Hrs, 3 Credits
Mr Wilkes

Biol 108
Introduction to Nutrition
Introduction to the elements of nutrition with emphasis on nutrition for humans, examination of food stuffs and nutritional quality, physiology of food utilization, food quality regulations, and the global ecology of food production. No background in natural science required.
Distribution Area: NS
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr White
Biol 207
Anatomy and Physiology I
A study of the human organism, correlating structure and physiological mechanisms. Emphasis on skin, the special senses, and the skeletal, articular, muscular, nervous, and endocrine systems. Required of nursing and human performance and fitness majors.
Prerequisite: Bio 111 or equivalent.
Distribution Area: NS
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr Guimond

Biol 208
Anatomy and Physiology II
(Continuation of Biol 207)
Emphasis on the digestive, circulatory, respiratory, excretory, and reproductive systems. Required of nursing and human performance and fitness majors.
Prerequisite: Bio 111 and 207.
Distribution Area: NS
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr Guimond

Biol 209
Medical Microbiology
An introduction to viruses, bacteria, fungi, and protozoa which may be pathogenic to humans and animals; and to immunology, epidemiology, and clinical microbiology. The laboratory introduces sterile techniques, maintenance of pure cultures, isolation, identification, and immunological methods. For nursing majors. Biology majors should take Biol 334 for microbiology.
Prerequisites: Bio 111; Chem 115-118; or Chem 130
Distribution Area: NS
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Staff

Biol 210
Cell Biology
A study of structure and function of cells including physiological and biochemical processes of cells, membranes, subcellular organelles, and of specialized cells. Specific topics include synthesis and mode of action of biological macromolecules, flow of information and energy, mode of enzyme action, cell-to-cell communication, and membrane functions such as transport. Note: Students (non-Biology majors) who do not wish to take the laboratory portion of this course should register for Biol 212.
Prerequisites: Bio 111 and 112; Chem 115,117; Co-req: Math 130 or higher using the UMB Math Placement Test.
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Ms Huang

Biol 212
Cell Biology (Lecture)
The description of this course is the same as Bio 210; this course consists of lecture sections only; there is no laboratory. Biology majors should take Bio 210.
Prerequisites: Same as Bio 210.
3 Lect Hrs, 3 Credits
Ms Huang

Biol 252
Genetics
The basic principles of heredity, studied through an integrated presentation of molecular and classical (Mendelian) genetics. Topics include the nature of the hereditary material, structure of chromosomes, and patterns of inheritance.
Note: Students (non-Biology majors) who do not wish to take the laboratory portion of this course should register for Bio 254.
Prerequisites: Bio 111 and 112; Chem 115, 117; Co-req: Math 130 or higher using the UMB Math Placement Test.
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr Kesseli, Ms Skvirsky

Biol 290
Population Biology
This course examines evolution and the growth of populations, developing principles and applying them to such issues as interaction among species, social behavior, preservation of genetic variation in domestic species, ecology of human pathogens, control of insect pests, and the organization of ecosystems. The course includes two field trips.
Prerequisites: Bio 252 or 254 and Math 130.
3 Lect Hrs, 3 Credits
Ms Brault, Mr Christian

Biol 302
Histology
A survey of the structure and organization of tissues and organ systems, primarily of mammals. Cellular physiology is considered as it relates to structure, ultrastructure, and staining characteristics.
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Staff

Biol 306
Marine and Coastal Ecological Research
Supervised research on the adaptations and interactions of organisms of the beaches, salt marshes, sand dunes, and embayments of Nantucket. Meets every weekday during five weeks of the summer at the University's field station on Nantucket.
Prerequisites: Bio 210, 252 and 290; Math 130
40 hrs wk, 3 Credits
Staff

Biol 312
Developmental Biology and Embryology
This course analyzes the development of multi-cellular animals and plants by examining major developmental processes: growth, gene expression, cell interaction, morphogenesis, and pattern regulation. Lectures use experimental evidence to explore the commonality of mechanisms in differing organisms. Basic labs provide experience with materials
and methods, and help clarify changing three-dimensional relationships. Additional labs investigate vertebrate embryology in greater detail. Please note: Students wishing to take this course with fewer lab hours for fewer credits should enroll in Bio 313.

**Biol 313**
**Developmental Biology & Embryology (Lecture)**
The description of this course is the same as Bio 312; Bio 313 has fewer lab hours. Students wishing to take this course with additional lab hours for more credits should enroll in Bio 312.

*Prerequisites: Bio 210 and 252; Chem 115, 117
3 Lect Hrs, 6 Lab Hrs, 5 Credits*

**Staff**

**Biol 314**
**Development Biology**
The description of this course is the same as Bio 312; Bio 313 has fewer lab hours. Students wishing to take this course with additional lab hours for more credits should enroll in Bio 312.

*Prerequisites: Bio 210 and 252; Chem 115, 117
3 Lect Hrs, 3 Lab Hrs, 4 Credits*

**Staff**

**Biol 316**
**Neurobiology**
Examination of the nervous system beginning at the membrane and cellular level, and then moving on to the organization of sensory and motor systems. Special topics include the Biological bases of various neurological and psychiatric diseases. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 318.

*Prerequisite: Bio 210 and 252
3 Lect Hrs, 3 Lab Hrs, 4 Credits*

**Ms Pollack**

**Biol 317**
**Endocrinology**
The study of hormone physiology and Biochemistry in the context of organismal regulation and coordination. Includes hormone chemistry, control and regulation of hormone production, and the cellular and Biochemical nature of hormone action. Emphasis on mammalian systems and on laboratory and clinical investigations of the endocrine system. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 319.

*Prerequisite: Bio 210 and 252
3 Lect Hrs, 3 Lab Hrs, 4 Credits*

**Mr Campbell**

**Biol 318**
**Neurobiology (Lecture)**
The description of this course is the same as Bio 316; this course consists of lecture sections only; there is no laboratory.

*Prerequisite: Bio 210 and 252
3 Lect Hrs, 3 Credits*

**Ms Pollack**

**Biol 319**
**Endocrinology (Lecture)**
The description of this course is the same as Bio 317; this course consists of lecture sections only; there is no laboratory.

*Prerequisite: Bio 210 and 252
3 Lect Hrs, 3 Credits*

**Mr Campbell**

**Biol 320**
**Vascular Plants**
The anatomy, morphology, and evolution of the major groups of vascular plants. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 322.

*Prerequisite: Bio 210 and 252
3 Lect Hrs, 3 Lab Hrs, 4 Credits*

**Staff**

**Biol 321**
**Plant Physiology**
A study of plant function with emphasis on nutrition, translocation, metabolism, signal transduction and gene expression, photosynthesis and respiration, hormonal controls during vegetative and reproductive growth, and responses to environmental signals and stresses. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 323.

*Prerequisites: Bio 210 and 252; Chem 115-118; Math 130
3 Lect Hrs, 3 Lab Hrs, 4 Credits*

**Mr. Colón-Carmona**

**Biol 322**
**Vascular Plants (Lecture)**
The description of this course is the same as Bio 320; this course consists of lecture sections only; there is no laboratory.

*Prerequisite: Bio 210 and 252
3 Lect Hrs, 3 Credits*

**Staff**

**Biol 323**
**Plant Physiology (Lecture)**
The description of this course is the same as Bio 321; this course consists of lecture sections only; there is no laboratory.

*Prerequisites: same as for Bio 321
3 Lect Hrs, 3 Credits*

**Mr. Colón-Carmona**

**Biol 328**
**Plant Life**
An advanced survey of plant diversity, the major groups, their organization and reproduction, the elements of taxonomy and economic botany of vascular plants, and the major issues of conservation Biology. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 329.

*Prerequisites: Bio 210, 252, & 290
3 Lect Hrs, 3 Lab Hrs, 4 Credits*

**2-3 Field Trips**

**Mr Wilkes**

**Biol 329**
**Plant Life (Lecture)**
The description of this course is the same as Bio 328; this course consists of lecture sections only; there is no laboratory.

*Prerequisites: Bio 210,252, & 290
3 Lect Hrs, 3 Credits*
Mr Wilkes
Biol 330
Biology of Fishes
The evolution, ecology, genetics, taxonomy, and structure of fish. Biological problems of general interest are emphasized, such as breeding systems, genetics of sex determination, evolution by means of chromosome duplication, environmental physiology, and migration.
Prerequisites: Bio 252 and 290
3 Lect Hrs, 3 Credits
Ms Gibson

Biol 331
Biology of Marine Invertebrates
Essential background for those planning to concentrate in organismic Biology, evolution, ecology, or applied environmental science. The course covers life histories, ecological roles, adaptations, morphologies, evolution, and classification of marine invertebrate animals. Laboratory includes field trips to local marine communities. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 339.
Prerequisites: Bio 252 and 290; Chem 115-118
3 Lect Hrs, 6 Lab Hrs, 5 Credits
Mr Stevenson

Biol 332
Comparative Animal Physiology
Considers physiological principles and problems in a phylogenetic perspective. An integrated view of physiological solutions from the cellular to organismal level will be used to discuss adaptations to environments and constraints on life history. Major topics to be considered include: temperature responses, biological clocks, allometry, respiration, circulation, energetics, locomotion, and salt and water balance. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 339.
Prerequisites: Bio 210 and 252; Chem 115-118; Math 130
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Ms Brault

Biol 333
Insect Life
Physiological and other adaptations that account for the survival and success of insect life are considered. The laboratory will deal primarily with the diversity of insects. Brief consideration is also given to the relationship of insects to humankind.
Prerequisites: Bio 252 and 290
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr Stevenson

Biol 334
Microbiology
Study of viruses, bacteria, algae, fungi, and protozoa, to include their characterization, classification, and relationship to humans and the environment. Lectures cover microbial Biochemistry, cell Biology, genetics, taxonomy, pathogenic bacteriology, food and industrial microbiology, and ecology. The laboratory emphasizes aseptic techniques to isolate, culture, observe, and identify bacteria.
Prerequisites: Bio 210 and 252; Chem 115-118
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Ms Gibson

Biol 337
Comparative Animal Physiology
Considers physiological principles and problems in a phylogenetic perspective. An integrated view of physiological solutions from the cellular to organismal level will be used to discuss adaptations to environments and constraints on life history. Major topics to be considered include: temperature responses, biological clocks, allometry, respiration, circulation, energetics, locomotion, and salt and water balance. Note: Students who do not wish to take the laboratory portion of this course should register for Bio 339.
Prerequisites: Bio 210 and 252; Chem 115-118; Math 130
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Ms Brault

Biol 338
Ecology
A course in population and community ecology. Topics include theory and case studies of population dynamics, competition, predation, niche concepts, life history strategies, behavioral interactions, energetics and productivity, community structure and organization, and Biogeography.
Prerequisite: Bio 252 and 290
3 Lect Hrs, 3 Credits
Mr Ebersole

Biol 339
Ecology Laboratory
Field trips to local terrestrial and marine communities, laboratory studies of population dynamics and interactions between species, and analytical approaches to ecological data. Some field trips may be scheduled on Saturdays. Offered in even-numbered years, fall term.
Co-requisite: Bio 342
1 Lect Hr, 3 Lab Hrs, 2 Credits
Mr Ebersole

Biol 340
Ornithology
The Biology of birds, with emphasis on problems of wider biological interest in ecology and behavior.
Prerequisite: Bio 252 and 290
3 Lect Hrs, 3 Credits
Staff

Biol 345
Ornithology Laboratory
Laboratory and field work in ornithology.
Biol 348
Animal Behavior
The course deals with some topics in the physiology and development of behavior and more extensively with social organization, communication, and ecological aspects of behavior. Emphasis on the function and evolution of behavior.
Prerequisite: Bio 252 and 290
3 Lect Hrs, 3 Credits
Staff

Biol 349
Methods in Ethology
Observational and experimental analyses of the behavior of a variety of species. Laboratory studies, films, and field trips.
Co-requisite: Bio 348
5 Lab Hrs, 1 Disc Hr, 3 Credits
Staff

Biol 352
Evolution
Evolution as the unifying concept of Biology. Topics include population genetics, adaptive strategies, sex and breeding systems, speciation and population differentiation, fossil histories, evolution of man.
Prerequisites: Bio 252 and 290
3 Lect Hrs, 3 Credits
Mr Etter

Biol 353
Evolution Laboratory
Laboratory investigations of evolutionary processes, including simulations of population genetics, biometric analyses of adaptive morphological features in natural populations, experiments on mimicry, field trips to systematic museum collections and local natural habitats, and phylogenetic analysis of land snails. Concepts of experimental design and statistical analysis are emphasized. (Course offered in the spring semester of even-numbered years.)
Co-requisite: Bio 352
3 Lab Hrs, 1 Disc Hr, 2 Credits

Biol 360
Bioinformatics
This course will provide a fundamental overview of Bioinformatics, which is the collection, organization, and analysis of biological information. Topics include data searches and sequence alignments, substitution patterns, phylogenetics, genomics, protein and RNA structure prediction, and proteomics. Designed as a required course for biotechnology track students and other students interested in biotechnology careers or graduate study in Biological sciences.
Prerequisites: Bio 210, 252 & 290
3 Hrs Lec, 3 Credits
Staff

Biol 370
Molecular Biology
The molecular biology and biochemistry of gene expression in prokaryotes and eukaryotes. Topics include DNA structure/physical biochemistry, recombinant DNA technology, techniques in research, DNA synthesis, RNA synthesis, protein synthesis, operons, chromatin structure and gene regulation, oncogenes, hormones and growth factors and signal transduction, transposons, mutagenesis and repair, boogies, flowering, photosynthesis, development, circadian rhythms, etc. Laboratories emphasize basic research techniques.
Prerequisites: Bio 210/212, 252/254; Biochem 383 and 385 or permission of instructor
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr Ackerman

Biol 372
Molecular Biology Lecture
The description of this course is the same as Bio 370; this course consists of lecture sections only; there is no laboratory.
Prerequisites: Biochem 383.
3 Lect Hrs, 3 Credits

Biol 378
Introduction to Immunology
An introduction to the principles of immunology including definition of antigens and antibodies, specificity of the immune response, immunoglobin structure, the genetics of immunoglobin synthesis, cellular cooperation in the immune response, and mechanism of inflammation, transplantation, and diseases associated with responsiveness of the immune system.
Prerequisites: Bio 210, 252; Chem 115-118
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr Beck

Biol 380
Introduction to Immunology (Lecture)
The description of this course is the same as Bio 378; this course consists of lecture sections only; there is no laboratory.
Prerequisites: same as Bio 378
3 Lect Hrs, 3 Credits
Mr Beck

Biol 381
Special Topics
Detailed study of a specialized field of biology. Several topics may be offered each semester. Prerequisite: Permission of instructor.
Hrs by arrangement, 1-4 Credits
Staff

Biochem 383
Biochemistry I
In the first of a two semester sequence, the chemistry of life processes is discussed in terms of structure and biological function of proteins, nucleic acids, carbohydrates, lipids, and other cellular components. Special emphasis is given to protein structure and function, enzymology, carbohydrate metabolism, transport mechanisms, energy
transformations, and photosynthesis.  
**Prerequisites:** Bio 111; Chem 252, 256; Co-req: Biochem 385

3 Lecture Hrs, 3 Credits

Mr Hagar, Ms Torok, Mr Sugumaran

**Biochem 384**

**Biochemistry II**

In the second of a two semester sequence, discussion of cellular function is continued. The topics are biochemistry and synthesis of nucleic acids and proteins, structural motifs in protein folding, metabolism of lipids and amino acids, nitrogen fixation, molecular immunology, hormones, ion channels, neurochemistry, biological applications of nuclear resonance and biochemical evolution.  
**Prerequisites:** Biochem 383 or permission of instructor.

3 Lecture Hrs, 3 Credits

Mr Hagar, Ms Torok, Mr Sugumaran

**Biochem 385**

**Biochemistry Lab I**

Laboratory course to complement Biochem 383. Experiments involving titration, purification and analysis of biological molecules. Provides training in such techniques as chromatography, electrophoresis, and enzyme kinetics.  
**Prerequisites:** Chem 252, 256 Co-requisites: Biochem 383 or permission of instructor.

1 Lecture Hr, 5 Lab Hrs, 3 Credits

Mr Hagar, Mr Sugumaran

**Biochem 386**

**Biochemistry Lab II**

Laboratory course to complement Biochem 384. Experiments involving high performance liquid chromatography, circular dichroism, optical rotary dispersion, nuclear magnetic resonance, photosynthesis and analysis of proteins, lipids, and carbohydrates.  
**Prerequisites:** Biochem 385. Co-requisites: Biochem 384 or permission of the instructor.

1 Lecture Hrs, 5 Lab Hrs, 3 Credits

Mr Hagar, Ms Torok, Mr Sugumaran

**Biochem 398**

**Special Topics in Biochemistry**

A course designed to examine a specialized topic of Biochemical sciences that is not part of the curriculum of Biochemistry, Biology, or chemistry, or to examine in detail a topic that constitutes only a minor portion of the curriculum in a Biochemistry, Biology, or chemistry course.  
**Prerequisite:** Permission of the instructor

Hrs by arrangement, 1-3 credits

Mr Ackerman, Mr Hagar, Ms Torok, Mr Sugumaran

**Biol 444**

**Cooperative Education Field Placement in Biology**

A work placement in an off-campus biological laboratory or field setting where a student carries out an approved project comparable in depth and scope to an advanced undergraduate biology course. The department appoints one or more faculty to serve as co-sponsors. All placements are for six months. Full-time: six credits. Half-time: three credits.

**Prerequisites:** Junior standing, Bio 210 and 252, cumulative grade point average of 2.5 or higher in all courses, and grade point average of 2.5 or higher in science and mathematics courses.

Hrs by arrangement, 3-6 Credits

**Biochem 471-472**

**Readings in Biochemistry I**

Topics vary depending on the instructor; consult faculty member

Hrs by arrangement, 1-3 Credits

**Biol 479**

**Independent Study II**

See Bio 478

**Biochem 491-492**

**Directed Research in Biochemistry**

An opportunity for qualified, advanced students to work on a specialized research project under the guidance of a faculty advisor.  
**Prerequisite:** Second semester junior standing and permission of the instructor.

Hrs by arrangement, 1-6 Credits

**GRADUATE COURSES**

All 600 level courses with the exception of Bio 698 and 699 are open to advanced undergraduates who meet prerequisites and have permission of the instructor.

**PERMISSION OF THE INSTRUCTOR IS REQUIRED FOR ALL GRADUATE LEVEL COURSES.**

**Biol 601**

**Marine Ecosystems**

The structure and function of coastal marine habitats including rocky intertidal areas, sandy beaches, tidal and mud flats, estuaries, salt marshes, soft bottom areas and plankton. The course will review the physical regime, flora and fauna of these environments and case histories of community organization.  
**Prerequisites:** Undergraduate course in ecology

3 Lecture-Disc Hrs, 3 Credits

Staff

479 do not count toward Biology major requirements. Laboratory and field work.  
**Prerequisites:** Second semester junior standing and permission of a research director.

Hrs by arrangement, 1-3 Credits

**Biol 602**

**Plant Molecular Biology and Physiology**

This course focuses on molecular mechanisms of gene regulation, gene expression patterns during development and differentiation,
molecular responses to light, plant genetics, evolution of genomes, plant biotechnology, and the molecular biology of the regulation of physiological processes in plants. Lecture topics integrate molecular Biology, plant genetics, plant physiology, and plant evolution. The syllabus includes a core of basic lectures introducing students to the field of plant molecular Biology.

Prerequisites: Bio 320, 321, 322, or 323; and 675 or 676.

3 Lect Hrs, 3 Credits

Biol 603
Theories of Community Structure
Theoretical aspects of community development and organization including demography, competition, predation, life history strategies, trophic structure, community stability, and equilibrium and non-equilibrium models of species diversity. The course emphasizes rigorous mathematical and graphical approaches. Prerequisite: Bio 342

3 Lect Hrs, 3 Credits

Biol 605
Field Sampling Methods and Data Analysis
Statistical principles of research design, integrated with field techniques, to measure parameters of community structure. Field exercises involve application of the principles learned in lectures and the use of typical sampling equipment to solve environmental questions. Laboratory and field work. Prerequisites: Bio 342 & 343

3 Lect Hrs, 6 Lab Hrs, 5 Credits

Biol 608 (Physics 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. Prerequisites: Senior or graduate status, advanced laboratory work in major, familiarity with a programming language.

2 Lect Hrs, 4 Lab Hrs, 4 Credits

Mr Stevenson

Biol 610
Ethnobotany
Review of studies on plant use by primitive societies in historic and prehistoric times. Ordinarily offered in conjunction with Biol 613. 2 Seminar/ Tutorial Hrs, 2 Credits

Staff

Biol 612
Advanced Cell Biology
Lecture/discussion course studying eukaryotic subcellular organization. Primary literature is used to explore Biochemical, genetic and molecular approaches toward understanding organelle function, the cytoskeleton and intracellular transport. Hrs by arrangement, 3-5 Credits

Ms Huang

Biol 613
Topics in Archaeological Botany
Laboratory tutorial: Recovery, identification, and analysis of macroscopic plant remains, pollen, and spores from archaeological and geological deposits; interpretation of the data derived and their botanical, archaeological, and paleoecological applications. Since course content varies from semester to semester, the course may be taken more than once for credit. Prerequisite: Bio 610 or equivalent. The number of credit hours will be determined by prior consultation with instructor.

3 Lab-Disc Hrs per Credit

2-5 Credits

Biol 614

Advanced Cell Chemistry
The methodology of cell analysis with emphasis on macromolecules and intermediary metabolites. Hrs by arrangement, 3-5 Credits

Staff

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: Bio 378 or 380

3 Lect Hrs, 3 Credits

Mr Beck

Biol 619
Theory and Techniques of Electron Microscopy
This intensive course in scanning and transmission electron microscopy will provide practical experience in tissue preparation, darkroom procedures, microtomy, and the use of microscopes. The theory of the techniques and the basic physics of the microscopes will be presented in lectures. Each student will compile a portfolio of micrographs. Prerequisite: Biochem 383 and 385 or comparable training.

Hrs by arrangement, 4 Credits

Staff

Biol 622
Concepts and Methods in Cytology
The structural basis of cellular and subcellular functions, with practical experience in methods of visualizing cellular structure. Hrs by arrangement, 1-5 Credits

Staff

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. 

Prerequisite: Bio 252
3 Lect Hrs, 3 Credits
Ms Skvirsky

Biol 627
Bacterial Physiology
A rigorous biochemical examination of the bacterial cell. Lectures focus on bacterial cytology, physiology, and genetics. Areas of current research are emphasized. Students are expected to read primary literature and prepare an in-depth review paper on a special topic.

Prerequisites: Bio 334 and Biochem 383, or equivalent.
3 Lect Hrs, 3 Credits
Mr Shiaris

Biol 628
Microbial Ecology
The functions, roles, and ecology of microorganisms in the environment, emphasizing biogeochemical cycling of elements. Topics for special concentration are chosen from the following: microbial diversity, evolution, interactions, aquatic or soil microbiology, and sewage microbiology. The course focuses on relating molecular and biochemical mechanisms to ecological principles. Readings are assigned from classical and current scientific literature for class discussion. An in-depth review paper on a special topic is required.

Prerequisites: Bio 334 or 342
3 Lect Hrs, 3 Credits
Mr Shiaris

Biol 632
Advanced Evolution
An inquiry into the modern synthetic theory of evolution with emphasis on population genetics, ecological genetics, evolution of dominance, genetic homeostasis, canalization and genetic theory of polymorphism.
Hrs by arrangement, 3 Credits
Staff

Biol 635
Population Genetics and Diversity
A quantitative approach to the concept of populations and the evolutionary forces affecting them. The course analyzes the interactions among forces and the resulting dynamics of population structure. Toward the end of the semester, the course shifts is primary emphasis from lecture to discussion in order to cover current topics in population genetics. Topics include, among others, the theory and application of tools necessary for assaying genetic variation in natural populations, DNA fingerprinting in forensics, the evolution of sex, and the genetics of rare and endangered species.

Prerequisites: Bio 252 and 352 or equivalent.
3 Lect Hrs, 3 Credits
Staff

Biol 638
Advanced Ecology
Concepts of population and community ecology. Topics covered may include population dynamics, life history strategies, theory of r- and K-selection, competition, predation, community organization, and species diversity. Particular emphasis is placed on the relationship between theoretical and empirical ecology. A weekly tutorial provides the opportunity for greater discussion of material covered in lecture. Emphasis changes from year to year.

Prerequisite: Bio 342
2 Lect Hrs, 1 Disc Hr, 3 Credits
Staff

Biol 639
Conservation Biology
The principles of conservation Biology are drawn from such various subdisciplines of Biology as ecology, genetics, evolution, and biogeography. The course begins with an analysis of the distribution of biodiversity, proceeds to examine the patterns of biodiversity loss at all levels, from genes to ecosystems and finishes with a discussion of the causes, consequences and solutions of the crisis. Topics include assessment and monitoring of species diversity, conservation genetics, the theory of island biogeography, habitat loss and forest fragmentation, human impacts on biodiversity, the design of nature reserves, economic valuation of biodiversity, and sustainable use of biodiversity.

Prerequisites: Bio 342 and 352.
3 Lect-disc Hrs, 3 Credits
Mr Bawa

Biol 640
Principles of Qualitative Modeling in Biology
A mathematical analysis of biological systems, with emphasis on qualitative rather than quantitative approaches. Signed digraphs (Loop Analysis), matrices, and computer programming will be used. In addition, notions of feedback, stability and other global properties of systems will be presented. During the work sessions, students will be grouped to solve problems. At the completion of the course students will be competent to distinguish the various methods, assess their strengths and limitations, and apply them to biological systems of interest.
3 Lect-Disc Hrs, 3 Credits
Staff

Biol 641
Introduction to Population Models
Fundamentals of mathematical models of population dynamics. The course examines single-species models, including stability analysis, life tables, and analysis of matrix models, as well as competition and predation model forms. More advanced topics include spatial structure, stochasticity, harvesting models, individual-based models, and population viability analysis. The course combines lectures,
discussions, and hands-on model development.  

**Biol 642**  
**Biogeography**  
A study of geographical distribution patterns in plants and animals. Includes historical and descriptive aspects of the distributions of organisms, experimental and comparative tests of island biogeography theory, the population genetics and evolutionary strategies of colonizing species. Independent research by students is presented to the class in seminar form.  
**Prerequisites:** Bio 342 and 352 or equivalents. Some knowledge of statistics and calculus highly recommended.  
Hrs by arrangement, 3 Credits  
Mr Rex

**Biol 643**  
**Behavior and ecology of Seabirds**  
Adaptations of seabirds to the marine environment with particular reference to breeding biology and feeding strategies; other topics of current interest in behavioral ecology. Lectures or lecture and field work.  
Hrs by arrangement, 2-5 Credits  
Staff

**Biol 644**  
**Marine Mammal Biology**  
The biology and ecology of marine mammals (*Pinnipeds, Cetaceans, Sireniats*), with emphasis on applied population ecology and conservation issues. Topics include phylogeny, adaptation to marine environments, effects of human exploitation, case studies of population recovery, and multispecies interactions.  
**Prerequisite:** Bio 342  
3 Lect Hrs, 1 Disc Hr, 3 Credits  
Ms Brault

**Biol 645**  
**Ecological and Evolutionary Aspects of Plant-Animal Interactions**  

**Biol 646**  
**Scientific Communication**  
Required of all biology and environmental sciences Biology graduate 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 or the doctoral level.  
3 Credits  
Staff

**Biol 647**  
**Environ. Biol.**  
A series of one credit seminar courses focusing on subfields of environmental biology to help students develop the habit of keeping up with recent developments through reading scientific journals. The seminars also provide a forum for oral presentations where students can get comment and critique of their scientific progress.  
1 Seminar Hr, 1 Credit

**Biol 648 (Env Sci 658)**  
**Environmental Physiology**  
A discussion course exploring in detail the mechanisms by which organisms adapt to their environment and highlighting the interplay among cellular function, physiological function, and the ecology of the organism.  
**Prerequisites:** Bio 210 or 212, and Bio 337  
3 Lect Hrs, 3 Credits  
Mr Stevenson, Mr Robinson

**Biol 650**  
**Coevolution of plants and animals**  
Coevolution of plants and animals is examined in an ecological context. Interactions to be examined include pollination, seed predation, herbivory, and grazing. Topics of discussion include the role of these interactions in the regulation of community structure. Although the main emphasis is on tropical communities, there is also some discussion of alpine, temperate, and desert communities.  
**Prerequisites:** Bio 290, and 342 or 352.  
3 Lect Hrs, 3 Credits  
Mr Bawa

**Biol 651**  
**Ecological and Evolutionary Genetics**  
Population genetic theory, the population genetics of island biogeography, tests of island biogeography experimental and comparative distributions of organisms, descriptive aspects of the populations of species. Includes historical and evolutionary strategies of colonizing species. Independent research by students is presented to the class in seminar form.  
**Prerequisites:** Bio 342 and 352 or equivalents. Some knowledge of statistics and calculus highly recommended.  
Hrs by arrangement, 2-5 Credits  
Mr Rex

**Biol 652**  
**Biological Diversity and Evolution**  
This course is an inquiry into the origin and evolution of patterns of biological diversity. It presents an overview of the Earth’s biogeochemical history and discusses theories of life’s origin, the diversification of metazoans during the Phanerozoic, and the nature and causes of periodic mass extinction events. Biological diversity is considered at the molecular, population, and community levels.  
**Prerequisites:** Enrollment in Environmental Biology Track of Environmental Sciences Graduate Program  
3 Lect Hrs, 3 Credits  
Mr Etter, Mr Rex

**Biol 653**  
**Current Literature in Environmental Biology**  
A series of one credit seminar courses focusing on subfields of environmental biology to help students develop the habit of keeping up with recent developments through reading scientific journals. The seminars also provide a forum for oral presentations where students can get comment and critique of their scientific progress.  
1 Seminar Hr, 1 Credit

**Biol 658 (Env Sci 658)**  
**Environmental Physiology**  
A discussion course exploring in detail the mechanisms by which organisms adapt to their environment and highlighting the interplay among cellular function, physiological function, and the ecology of the organism.  
**Prerequisites:** Bio 210 or 212, and Bio 337  
3 Lect Hrs, 3 Credits  
Mr Stevenson, Mr Robinson

**Biol 662**  
**Photobiology**  
The photochemical reactions that occur in Biological systems. Major topic areas are properties of light energy, utilization of light energy by photosynthetic organisms, mechanism of visual transduction, photochemical triggering mechanisms for developmental processes.  
3 Lect Hrs, 3 Credits  
Mr Hagar

**Biol 664**  
**Computer Analysis of DNA and Protein Sequences**  
This course focuses on using computers to predict structure of RNA and protein, search DNA and protein sequence data bases, align protein and DNA sequences, find restriction enzyme sites to design cloning strategies, and choose oligonucleotide primers.
for DNA sequencing and PCR. The biological significance, limitations, and interpretation of computer analyses are strongly emphasized.

1 Lect Hr, 3 Lab Hrs, 3 Credits
Mr Kleene

Biol 666
Mammalian Toxicology
This course provides a background of toxicology as they are applied to mammalian systems. Coverage will include: basic concepts in evaluation of poisons and their commonalities with evaluations of 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; exploration of the role of diet, lifestyle, and concurrent exposures; methods of toxicant evaluation with emphasis on multigeneration and high throughout testing; and environmental and medical implications of toxicant or toxin exposures on individual and ecological health.

Prerequisites: Chem 251, 255; Bio 111, at least one course in Cell Biology or physiology;
3 Lect Hrs, 3 Credits
Mr Campbell

Biol 668
Cellular and Molecular Endocrinology
A laboratory and seminar course on selected aspects of endocrinology, emphasizing laboratory investigations of such topics of current interest in endocrinology as molecular control of the synthesis of hormones, complete elucidations of the mechanisms of hormone action, and methods of modulating fertility and development.

Prerequisites: Chem 251, 255; Bio 317 or Biochem 383
2 Lee-Seminar Hrs, 6 Lab Hrs, 4 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.

Prerequisites: Bio 313
2 Sem Hrs, 6 Lab Hrs, 4 Credits
Staff

Biol 672-673
Directed Readings in Biology
Selected readings in advanced areas of Biology with guidance and regular discussion.
Hrs by arrangement, 1-3 Credits

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: Bio 370 or 372
3 Lect Hrs, 3 Lab Hrs, 4 Credits
Mr Ackerman, Mr Kleene

Biol 676
Advanced Molecular Biology Lecture
A lecture only course covering the same material as Bio 675; no lab work is required.

Prerequisites: Same as Bio 675.
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.

Prerequisites: Bio 252
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 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: Biochem 383 and Bio 372
3 Lect Hrs, 7 Lab Hrs, 5 Credits
Mr Sugumaran

Biol 679
Protein Chemistry and Enzymology Lecture
A lecture only course covering the same material as Bio 678; no lab work is required.

Prerequisites: Same as Bio 678.
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 251, 255; Bio 317 or 319; or Biochem 383
2 Lect-Seminar Hrs, 6 Lab Hrs, 4 Credits

Mr Campbell

**Biol 690**

**Advanced Ethology**
Examination in depth of topics in the biological study of behavior with particular reference to communication and the evolution of social behavior. Lecture-discussions, occasional lab exercises and field trips. Emphasis changes year to year.

**Prerequisites:** Graduate student or senior standing, Bio 348
Hrs by arrangement, 3 Credits

Staff

**Biol 691**

**Seminar in Developmental Biology**
Current problems in developmental Biology. Topics include molecular and cellular differentiation, and pattern determination.

**Prerequisites:** Bio 312 or 313
3 Sem-Disc Hrs, 3 Credits

Ms Huang

**Biol 692**

**Advanced Physiology**
In-depth experimental studies of two or three selected areas of organismal and cellular physiology, focusing on sensory and nervous systems and membrane transport. Provisions will be made for independent projects during the course. One weekly seminar plus one weekly lab meeting.

**Prerequisites:** Bio 337; Biochem 383; Phys 107 or equivalents;
1 Sem Hr; 3-4 Lab Hrs, 3-4 credits

Staff

**Biol 693**

**Seminar in Neurobiology**
This seminar will examine the contribution of specific genes to governing such complex traits/disorders as learning and memory, addiction, anxiety and depression. Reading will be taken from the current scientific literature. Students will be responsible for presenting papers and leading class discussions.

**Prerequisites:** Bio 316 or 318
3 Lect Hrs, 3 Credits

Ms Pollack

**Biol 697**

**Special Topics in Biology**
A field of current interest in biology is examined in detail.

**Prerequisite:** Permission of instructor.
Hrs by arrangement, 2-5 Credits

**Biol 698**

**Projects in Biology**
A substantial written report based on library research or an original project such as curriculum design, design of teaching aids and exercises or critique of a book or theory. No more than 6 credits of this course may be applied to the master's degree. The credit may be applied over more than one semester. Bio 698 and Bio 699 are mutually exclusive.
Hrs by arrangement, 6 Credits

**Biol 699**

**Thesis Research**
Substantial laboratory or field research resulting in a master's thesis. This course may not substitute for Biol 698 (these two courses are mutually exclusive). No more than 10 credits of this course may be applied to the master's degree. The credit may be applied over more than one semester.
Hrs by arrangement, 10 Credits

Staff

**Biol 720**

**Cell Ultrastructure**
Concepts of cell ultrastructure and methods of electron microscopy.

**Prerequisites:** Graduate standing
Hrs by arrangement

Staff

**Biol 899**

**Thesis Research**
Research conducted under biology department faculty supervision which leads to the presentation of a doctoral dissertation in environmental sciences for students in the environmental biology track of that program.
Hrs by arrangement

Staff
Appendix C
Departmental Requirements for the Bachelors Degree in Biology

COURSES AND COURSE CREDITS

1. **Biology "Core"** (19 credits in Biology, 24 credits in Math, Physics and Chemistry) as follows:
   - General Biology 111 and 112 (lab required)
   - Genetics 252 (lab required)
   - Cell Biology 210 (lab required)
   - Population Biology 290
   - Introductory Chemistry 115 and 116 (lab required 117-118)
   - Physics 107 and 108/ Labs 181-182
   - Mathematics through one semester of calculus (usually Math 135 or 140 or 145)

2. **20 credits at the 300 level or above in Biology**. These must include at least 4 credits (12 class hours) in the laboratory. (Biochem. 383, 384, 385 and 386 are acceptable)

   In two cases, up to 8 of these required 20 credits may be taken in departments other than the Biology Department: (a) Organic Chemistry (Chem. 251, 252, 255, 256) may be counted toward this 20 credit requirement (departmental approval is not required),

   **NOTE:** no more than 2 of those 4 lab credits can be taken from courses outside the Biology Department, such as Organic Chemistry. In other words, of the required 4 upper level lab credits, a minimum of two must be taken from within the Biology Department – see Residency Requirements.

   (b) courses taken to complete the requirements of the Bio-behavioral Concentration may be counted toward this requirement, but only with prior approval of the Biology Department Chair.

   The following Biology courses do NOT fulfill this requirement: 381, 444, 478-479, 672-673.

   Majors are advised to complete Biology 111-112, Chemistry 115-118 and Math through Algebra during their first year and Biology 252, Biology 210, and Introductory Physics during their second year.

**PASS/FAIL**

Students may take **ONLY ONE** course Pass/Fail that counts towards any of the Biology Major course requirements (including all required chemistry, math and physics courses – see 1 and 2 above).

**BIOLOGY TRANSFER COURSE POLICY (LIMITATIONS):**

Fully matriculated students no longer are permitted to take courses elsewhere and transfer them to UMB. Notwithstanding, students who have a particularly pressing reason to take courses at other institutions, may appeal this regulation. That is done through the use of a prior approval form, obtained from the Admissions Office and signed by the Department Chairman or the Departmental Director of Undergraduate Advising or the instructor of UMB’s equivalent course.

**BIOLOGY RESIDENCY REQUIREMENTS:**

All students, including transfer students, must take at least 12 credit hours, including a minimum of 2 credit hours (6 class hours) in laboratory work, within the Biology Department at UMASS/Boston. These courses will be at the 300 level or above unless Chair’s approval is obtained for lower level courses. Biology 381, 444, 478-479, and 672-673 do not fulfill this requirement. Moreover, organic chemistry, (251, 252, 255 and 256) does **NOT count towards the residency requirement**, notwithstanding the fact that 8 of those credits can count towards the fulfillment of the overall minimum of 20 credits upper level bio courses. The Biology residency requirement, therefore, can only be satisfied by upper level (300+ level) biology courses (**including a minimum of 2 upper level credits**).
EXEMPTION FROM GENERAL BIOLOGY:

(a) **CLEP:** The Biology Department accepts the CLEP exam with a score of 50 or above. Students who meet this requirement will be exempt from General Biology 111 and 112 and will receive six (6) credits towards graduation.

(b) **ADVANCED PLACEMENT (AP):** Students with a score of 3 on Advanced Placement Biology are exempt from Biology 111 and 112; those with an AP score of 4 or higher are exempt from Biology 111 and 112 and receive 4 elective credits.

**BIOLOGY GPA 2.0**

In order to graduate as a Biology major, a **final grade point average of 2.0** is required in Biology courses above Biology 111-112 which are used to meet Biology major requirements.

**HONORS IN BIOLOGY:**

The Biology Faculty may award departmental honors to students who have completed at least 3 credits of Independent Study (Biology 478-479) and who also meet the following requirements:

1. Overall GPA of 3.0 or better
2. Satisfactory grades in advanced Biology courses (usually interpreted as no pass/fail enrollment and GPA of at least 3.0 for all Biology courses 200 level and above)
3. Written thesis and oral presentation of the Independent semester. The thesis is due one week before the presentation.

**ADVISERS**

Every Biology major must have a faculty advisor from the **Biology Department**. Students should see the Biology departmental assistants to be assigned an advisor.

**FURTHER INFORMATION**

Additional information can be obtained in the department’s Student Handbook for undergraduates available online [http://www.bio.umb.edu/documents/Undergrad_Handbook_Fall_2010.pdf](http://www.bio.umb.edu/documents/Undergrad_Handbook_Fall_2010.pdf) and in the University catalog.
Appendix D
BIOLOGY DEGREE REQUIREMENTS TALLY SHEET
(To be used for planning and/or approvals)

Rev. Spring 10

EMAIL ________________________________

STUDENT NAME ___________________________    ID/SS # ___________________

ADDRESS ________________________________    TEL # ___________________

DATE OF MATRICULATION _____________    ADVISER ______________________

Check if Completed

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<th>UMB credits</th>
<th>APPROVED transfer credits</th>
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I. CORE: ALL BIO MAJORS

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<th>Course</th>
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<td>General Biology 111-112</td>
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<td>*Chemistry 115-116; &amp; labs (117-118)</td>
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<td>Physics 107-108 &amp; Labs (181-182)</td>
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<td>Math through one semester of calculus (135 or 140 or 145)</td>
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<td>*Cell Biology 210</td>
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<td>Genetics 252</td>
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<td>Population Biology 290</td>
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II. UPPER LEVEL BIO/BIOCHEM ELECTIVES (MINIMUM 20 CREDITS):

These upper level Biology offerings are at the **300 or above level**, Organic Chemistry (251, 252, 255, 256) or (with prior approval) courses taken to complete Bio-behavioral Concentration, **including 4 lab credits**. **NOTE**: no more than 2 of those 4 lab credits can be taken from courses outside the Biology Department, such as Organic Chemistry. In other words, of the required 4 upper level lab credits, a minimum of two must be taken from **within** the Biology Department – see Residency Requirements on next page:

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<th>Course</th>
<th>UMB credits</th>
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**Requirements to be completed:**

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Course

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This form **must** be signed by the Department Chairman or the Departmental Director of Undergraduate Advising if it involves transfer credits, substituted courses, or course waivers.

Signature __________________________  Date ______________________

*Physiology 211 **substitutes** for Cell Biology 210

# Formerly Chem. 103-104 (prior to fall 2006)
PASS/FAIL

Students may take ONLY ONE course Pass/Fail that counts towards any of the Biology Major course requirements (including chem., math and physics courses).

BIOLOGY TRANSFER COURSE POLICY (LIMITATIONS):

Fully matriculated students no longer are permitted to take courses elsewhere and transfer them to UMB. Notwithstanding, students who have a particularly pressing reason to take courses at other institutions, may appeal this regulation. That is done through the use of a prior approval form, obtained from the Admissions Office and signed by the Department Chairman or the Departmental Director of Undergraduate Advising or the instructor of UMB’s equivalent course.

BIOLOGY RESIDENCY REQUIREMENTS:

All students, including transfer students, must take at least 12 credit hours, including a minimum of 2 credit hours (6 class hours) in laboratory work, within the Biology Department at UMASS/Boston. These courses will be at the 300 level or above unless Chair’s approval is obtained for lower level courses. Biology 381, 444, 478-479, and 672-673 do not fulfill this requirement. Moreover, organic chemistry, (Chem. 251, 252, 255, and 256) does NOT count towards the residency requirement, notwithstanding that it can count towards the fulfillment of the overall minimum of 20 credits upper level bio courses. The Bio major residency requirement, therefore, can only be satisfied by taking upper level (300+) biology courses (including a minimum of 2 upper level lab credits).

EXEMPTION FROM GENERAL BIOLOGY

The Biology Department accepts the CLEP exam with a score of 50 or above. Students meeting these this requirement will be exempt from General Biology 111 and 112 and will receive six (6) credits towards graduation.

Students with a score of 3 on Advanced Placement Biology are exempt from Biology 111 and 112; those with an AP score of 4 or higher are exempt from Biology 111 and 112 and receive 4 credits.

BIOLOGY GPA 2.0

In order to graduate with a Biology Major, students must have a cumulative GPA in all biology courses taken to satisfy the major above the 100 level.

ADVISERS

Biology majors must have a faculty adviser from the Biology Department. Students should see the departmental assistants to be assigned an adviser.

FURTHER INFORMATION

Additional information can be obtained in the department’s Student Handbook for undergraduates available online http://www.bio.umb.edu/documents/Undergrad_Handbook_Fall_2010.pdf and in the University catalog.
Appendix E  
Sample Four-Year Plan for a B.S. in Biology

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<thead>
<tr>
<th>Semester</th>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tr>
<td>Freshman Year</td>
<td>Biology 111 – 4 cr</td>
<td>Biology 112 – 4 cr</td>
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<td>Chemistry 115 &amp; 117 – 5 cr</td>
<td>Chemistry 116 &amp; 118 – 5 cr</td>
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<td>Math 130 – 3 cr</td>
<td>Math 135 or 140 – 3 to 4 cr</td>
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<td></td>
<td>First-Year Seminar – 4 cr</td>
<td>English 101 – 3 cr</td>
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<td>(16 credits)</td>
<td>(15 to 16 credits)</td>
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<td>Sophomore Year</td>
<td>Biology 252 – 4 cr</td>
<td>Biology 210 – 4 cr</td>
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<td>English 102 – 3 cr</td>
<td>Chemistry 251 &amp; 255 – 5 cr</td>
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<td></td>
<td>Chemistry 251 &amp; 255 – 5 cr</td>
<td>Intermediate Seminar – 3 cr</td>
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<td>General Education – 3 cr</td>
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<td>Junior Year</td>
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<td>Physics 108 &amp; 182 – 5 cr</td>
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<td>Physics 107 &amp; 181 - 5 cr</td>
<td>Biology 300+ Elective -3 cr</td>
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<td>(15 credits)</td>
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<td>Senior Year</td>
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<td>Biology 300+ Elective -3 cr</td>
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<td></td>
<td>Science Elective – 3 to 4 cr</td>
<td>Science Elective – 3 to 4 cr</td>
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<tr>
<td></td>
<td>Science Elective – 3 cr</td>
<td>Science Elective – 3 cr</td>
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<tr>
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<td>General Education – 3 cr</td>
<td>General Education – 3 cr</td>
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<tr>
<td></td>
<td>General Education – 3 cr</td>
<td>General Education – 3 cr</td>
</tr>
<tr>
<td></td>
<td>(15 to 16 credits)</td>
<td>(15 to 16 credits)</td>
</tr>
</tbody>
</table>

All students must take a minimum of 120 credits (approximately 40 courses). Thirty credits must be taken at UMass Boston. Also, some departments require that a minimum number of courses in the major be taken at UMB.

A minimum cumulative grade point average (GPA) of 2.0, calculated only from UMB courses, is required by the university. Some majors require a specific average in courses taken toward the major; see the major department for more information.

You can select courses that fulfill more than one requirement.
Biotechnology at the University of Massachusetts Boston

The past decade has seen enormous growth in the biotechnology industry. Biotechnology utilizes molecular and cellular biological processes to make commercial products in a wide range of fields, from agriculture, health care, and organic chemistry, to environmental remediation. The Greater Boston area is one of the largest biotechnology centers in the world, with over 150 companies that are predicted to create 20,000 new jobs by the end of the decade.

The Biology Department at the University of Massachusetts Boston is at the forefront of biotechnology education. Since the implementation of the Master’s Program in Biotechnology and Biomedical Science in 1983, virtually all of the graduates of this program have gone on to careers in biotechnology research and development, or to advanced study. Our graduates are employed at Amgen, Amicon, Biogen, Ciba-Corning, Costar, Damon, Genetics Institute, Gene Trak, Genzyme, ImmuLogic, CytoMed, ProCept, T-Cell Sciences, and many other companies. Others work at medical research labs at hospitals and universities, while others have entered Ph.D. and M.D. programs. Undergraduate training has recently been focused as a Biotechnology Track within the biology Major.

Bachelor of Science Biotechnology Track in Biology

The Biotechnology Track in Biology is designed primarily for students who wish to work in research and development at biotechnology companies. However, this track also provides training for work as a laboratory technician in university or medical research labs, or for graduate school in biochemistry, molecular biology or cellular biology.

Students in the biotechnology track must complete the biology major core of basic science courses at the introductory and intermediate levels. In addition, students in the biotechnology track must complete Organic Chemistry I and II. Advanced work focuses on technique and areas of biology that are important in the biotechnology industry. All required biology, chemistry and physics courses must be taken with a laboratory. Elective courses (not required) that would be useful in the biotechnology industry include Animal Physiology, Developmental Biology, Endocrinology, Biopharmaceutical GMP and Licensing, Histology, Biochemistry II, Neurobiology, and Plant Physiology.

Biotechnology companies strongly encourage undergraduates to acquire research experience. The Biology Department offers a variety of opportunities for undergraduate research. Financially qualified students can gain basic research experience through the Work-Study program. Off-campus work experience can be incorporated into a research project for credit as Cooperative Study in Biology. Other students are supported by the National Science Foundation’s Research Experiences for Undergraduates program. Qualified advanced students may undertake Independent Study in a Biology Department or off-campus laboratory, which may lead to graduation with honors.

Required Courses in the Bachelor of Science Biotechnology Track in Biology

<table>
<thead>
<tr>
<th>Basic Science Core Courses</th>
<th>Required Advanced Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Introductory and Intermediate Courses</td>
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</tr>
<tr>
<td>Bio 111 and 112 (General Biology I and II with lab)</td>
<td>Bio 334 (Microbiology with lab)</td>
</tr>
<tr>
<td>Chem 115 – 118 (Chem Principles I and II with lab)</td>
<td>Bio 360 (Bioinformatics)</td>
</tr>
<tr>
<td>Mathematics through at least one semester of calculus</td>
<td>Bio 370/372 (Molecular Biology with or without lab)</td>
</tr>
<tr>
<td>(Math 135 or 140 or 145)</td>
<td>Bio 378/380 (Introduction to Immunology with or without lab)</td>
</tr>
<tr>
<td>Physics 107 and 108 (College Physics I and II) or</td>
<td></td>
</tr>
<tr>
<td>Physics 113 and 114 (Fund. of Physics I and II)</td>
<td>Biochem 383 (Biochemistry I)</td>
</tr>
<tr>
<td>Physics 181 &amp; 182 (Introductory Physics Lab I and II)</td>
<td>Biochem 385 (Biochemistry Lab I)</td>
</tr>
<tr>
<td>Bio 210 (Cell Biology with lab)</td>
<td></td>
</tr>
<tr>
<td>Bio 252 (Genetics with lab)</td>
<td></td>
</tr>
<tr>
<td>Bio 290 (Population Biology)</td>
<td></td>
</tr>
<tr>
<td>Chem 251, 252, 253, and 256 (Organic Chemistry I and II with lab)</td>
<td></td>
</tr>
</tbody>
</table>
Advanced Courses

Bio 334 Microbiology
Study of viruses, bacteria, algae, fungi, and protozoa, to include their characterization, classification, and relationship to humans and the environment. Lectures cover microbial biochemistry, cell biology, genetics, taxonomy, pathogenic bacteriology, food and industrial microbiology, and ecology. The laboratory emphasizes aseptic techniques to isolate, culture, observe, and identify bacteria.

Prerequisites: Bio 210, 252 and Chem 115-118
3 Lect. Hrs., 3 Lab Hrs, 4 Credits
Ms. Gibson

Bio 360 Bioinformatics
This course will provide a fundamental overview of bioinformatics, which is the collection, organization, and analysis of biological information. Topics include data searches and sequence alignments, substitution patterns, phylogenetics, genomics, protein and RNA structure prediction, and proteomics. Designed as a required course for Biotechnology track students and other students interested in biotechnology careers or graduate study in biological sciences.

Prerequisites: Bio 210, 252 and 290
3 Lect. Hrs., 3 Credits

Bio 372 Molecular Biology
The molecular biology and biochemistry of gene expression in procaryotes and eucaryotes. Topics include DNA structure/physical biochemistry, recombinant DNA technology, techniques in research, DNA synthesis, RNA synthesis, protein synthesis, operons, chromatin structure, gene regulation, oncogenes, hormones, growth factors, signal transduction, transposons, mutagenesis, flowering, DNA repair, photosynthesis, development, circadian rhythms, etc.

Prerequisites: Biochem 383 and 385
3 Lect. Hrs., 3 Credits
Mr. Ackerman

Bio 378 Introduction to Immunology
An introduction to the principles of immunology including definition of antigens and antibodies, specificity of the immune response, immunoglobulin structure, the genetics of immunoglobulin synthesis, cellular cooperation in the immune response, mechanisms of inflammation, transplantation, and diseases associated with responsiveness of the immune system.

Prerequisites: Bio 210 and 252 and Chem 115-118
3 Lect. Hrs., 3 Lab Hrs., 4 Credits
Mr. Beck

Biochem 383 Biochemistry I
In the first of a two semester sequence, the chemistry of life processes is discussed in terms of structure and biological function of proteins, nucleic acids, carbohydrate, lipids, and other cellular components. Special emphasis is given to protein structure and function, enzymology, carbohydrate metabolism, transport mechanisms, energy transformations, and photosynthesis. It is recommended that Biochem 385 be taken concurrently.

Prerequisites: Bio 210 or 212 and Chem 255, 256
3 Lect. Hrs., 3 Credits
Mr. Hagar, Mr. Sugumaran

Biochem 385 Biochemistry Lab I
Laboratory course to complement Biochem 383. Experiments involving titration, purification, and analysis of biological molecules. Provides training in such techniques as chromatography, electrophoresis, and enzyme kinetics.

Prerequisites: Chem 255, 256; Corequisite: Biochem 383
1 Lect. Hr., 5 Lab Hrs, 3 Credits
Mr. Sugumaran, Mr. Hagar

The Biology Department would like to alert students to the course described below, which would be a valuable qualification for an entry level position in the biotechnology industry.

Biopharmaceutical GMP (Good Manufacturing Practice) and Licensing 10.555

Biopharmaceutical GMP examines the regulatory framework in which “drugs,” “biologics,” and “cellular therapies” are evaluated in the United States, including laws, regulations and the state of industrial practice. Students learn about licensing biotechnology products, clinical trials, and license applications and requirements.

3 Credits, 3 Contact Hrs., Senior standing required

The course was listed in the Spring 1996 schedule as follows:

Biol 555L PHARMACUT/PRACT/LIC 3CR #057714 WED 18:00-21:00 LOWELL

Biopharmaceutical GMP is taught by Professor Randall Swartz of the University of Massachusetts Lowell Chemical Engineering Department, who has more than 20 years experience working in the biotechnology industry. Biopharmaceutical GMP provides invaluable preparation for entry level positions in quality assurance and quality control in the biotechnology industry. Biol 555L will not count toward the Biology Major.

The course is offered spring semester by two-way, interactive video telecommunication with UMass Lowell. Please note that the course will almost certainly be offered in the evening, probably 6 pm to 9 pm, and will probably begin sometime in the middle of January (while UMass Boston is in inter-session). In addition, because the video link with UMass Lowell is expensive to operate, at least 10 UMass Boston students must enroll in the course; if fewer than 10 students enroll, the course will be canceled. If you wish to take the course, notify Kenneth Kleene, Director of the UMass Boston Biotechnology program, so he can advise UMass Lowell of the expected enrollment.

For additional information, contact Kenneth Kleene, Director of Biotechnology and Biomedical Science Program. Phone 617 287-6679 or email: kenneth.kleene@umb.edu
Appendix G

BIO-BEHAVIORAL STUDIES PROGRAM

Directors:
Associate Professor Alexia Pollack (Biology) and Assistant Professor Susan Zup (Psychology)

Program Details:
Students that are interested in animal behavior and are majoring in psychology, biology or anthropology may choose to participate in the Bio-behavioral Studies Program (BSP) as a specialized addition to their regular major.

The goal of the BSP is to provide students with a broad understanding of the various approaches to the naturalistic study of the behavior of all animals, including humans. Students in the program complete a major in one of the three departments associated with the program and in addition, take a group of appropriate courses in each of the other two departments. Interested students are urged to consult with one of the program’s directors.

Requirements and Recommendations:
Students entering the program are advised to take introductory courses in all three departments. In order to ensure that the program is recorded on their transcripts, students should complete the appropriate form, available from either of the program directors, and file a card with the Registrar’s Office.

The program’s requirements are intended to introduce students to the study of animal behavior and to provide both breadth and depth, through courses in both the major field as well as related field.

Students in the program must complete a major in Biology, Psychology or Anthropology. Each of these three departments offers courses which are simultaneously applicable to the department major requirements and to those of the BSP. For matriculated students, successful completion of the program is recorded on official university transcripts when students have met all of the graduation requirements. Non-matriculated students will receive a certificate of completion.

Approved Courses:

A. First Courses in Animal Behavior
   a. Anthro 210 – Biosocial Bases of Human Behavior
   b. Psych 467 – Evolution and Behavior

B. Associated Fields
   a. Biology 290 – Population Biology
   b. Biology 316/318 – Neurobiology
   c. Biology 317/319 – Endocrinology
   d. Biology 342 – Ecology
   e. Biology 344 – Ornithology
   f. Biology 352 – Evolution
   g. Psych 350 – Learning and Memory
   h. Psych 360 – Behavioral Neuroscience
   i. Psych 460 - The Neuropsychology of Higher Cognitive Processes

C. Advanced Courses in Animal Behavior
   a. Anthro 310 – Primate Behavior
   b. Biology 348 – Animal Behavior
   c. Biology 349 – Ethology
   d. Biology 690 – Advanced Ethology
   e. Psych 465 – Psychobiology of Development

Transfer Credit Policy:
At least three of the five program-approved courses from the departments outside the major department must be taken at U-Mass Boston. Transfer courses must be approved in writing by one of the program’s directors.

Co-Directors Information:
Alexia Pollack: Office: W-3-005; phone: 617-287-6618; email: alexia.pollack@umb.edu
Susan Zup: Office: M-4-273; 617-287-6319; email: susan.zup@umb.edu
Appendix H

The Biology Minor Requirements Fact Sheet:

a) **General Biology BIOL 111 and 112;**

b) Four additional biology courses (at least 12 credits), with or without associated lab. Of these courses, two must be at the **200 level** and two at the **300 level**. (Or you may take three 300 level and one 200 level, or four 300 level courses).

c) At least three of the six required courses (including one course at the 300 level) must be taken at UMass Boston.

d) Only one course for the minor can be taken pass/fail, provided all 6 classes are taken at UMass Boston.

e) The overall **GPA** for all courses taken to meet the biology minor requirement must be at least **2.0**.

f) Students who take a biology minor in a field of study that is closely related to their major may apply or overlap (double count) all courses at the 100 & 200 levels, but only one course at the 300 level may be counted for both the minor and the major.
### Appendi I
### REQUIREMENTS FOR THE B.S. DEGREE IN THE JOINT MAJOR IN BIOCHEMISTRY

Note: Biochemistry majors may not double-major with Biology or Chemistry or minor with Biology or Chemistry.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemistry 383(^\circ)</td>
<td>Biochemistry Lecture I &amp; II</td>
<td>6</td>
</tr>
<tr>
<td>Biochemistry 385(^\circ)</td>
<td>Biochemistry Laboratory I &amp; II</td>
<td>6</td>
</tr>
<tr>
<td>Biology 111-112(^*)</td>
<td>General Biology I &amp; II</td>
<td>8</td>
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<tr>
<td>Biology 212 (or 210)*</td>
<td>Cell Biology (lecture) (or lecture &amp; laboratory)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Biology 254 (or 252)*</td>
<td>Genetics (lecture) (or lecture &amp; laboratory)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Biology 372 (or 370)*</td>
<td>Molecular Biology (lecture) (or lecture &amp; laboratory)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Chemistry 115 &amp; 117 + 116 &amp; 118 **</td>
<td>Chemical Principles lecture I &amp; II + lab I &amp; II</td>
<td>10</td>
</tr>
<tr>
<td>Chemistry 251 &amp; 252 + 255 &amp; 256**</td>
<td>Organic Chemistry lecture I &amp; II + lab I &amp; II</td>
<td>10</td>
</tr>
<tr>
<td>Chemistry 311(^\circ)</td>
<td>Analytical Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Chemistry 313(^\circ)</td>
<td>Analytical Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 312(^\circ)</td>
<td>Physical Chemistry (lecture)</td>
<td>4</td>
</tr>
<tr>
<td>Math (140^<em>) or (145^</em>) + (141^<em>) or (146^</em>)</td>
<td>Calculus I &amp; II</td>
<td>8</td>
</tr>
<tr>
<td>Physics 113-114*</td>
<td>Fundamentals of Physics I &amp; II</td>
<td>6</td>
</tr>
<tr>
<td>Physics 181-182*</td>
<td>Physics Laboratory I &amp; II</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total:** 77-80

* Biochemistry 383-386 and a minimum of 15 additional credit hours of non-400 level Biochemistry/Biology/Chemistry courses must be completed at UMB. A final GPA of 2.0 or better in select Biochemistry+Biology+Chemistry courses is required for the Biochemistry degree.

* Students may substitute Bio 210 for 212, Bio 252 for 254 and Bio 370 for 372 if they so desire.

\(^\circ\) These courses were formerly numbered Chemistry 103 and 104. \(^*\) These courses were formerly numbered Chemistry 253 and 254.

\(^\uparrow\) Students must pass a placement exam to enroll in these courses.

\(^\downarrow\) Math 140 + 141 are traditional calculus courses; Math 145 + 146 are designed for the life sciences. These courses may be mixed: 140+141, 145+146, 140+146, 145+141.

\(^*\) Offered every semester and during the summer sessions. \(^\circ\) Offered in the Fall semester. \(^\uparrow\) Offered in the Spring semester.

### Honors

A minimal cumulative GPA of 3.0 and a minimal GPA of 3.3 in allowed Biochemistry, Biology, and Chemistry courses and completion of Biochemistry 491 and/or 492 (an independent research project with a written thesis, and a presentation before an audience).

Biochem 491/492 Directed Research I/II 1-6 credits, repeatable, but only for a lifetime maximum of 6 credits each

### Students may alternatively/also enroll for research experience in:

Bio 478-479 Independent Study I & II 1-3 credits, for a maximum of 6 credits total

Chem 481-482 Advanced Laboratory I & II 1-4 credits each semester, repeatable

Chem 491 Senior Thesis 4 credits

### Possible electives for qualified students (many other Biology and Chemistry courses are also pertinent):

Biochem 471-472 Readings in Biochemistry I & II 1-3 credits each semester, repeatable

Biochem 480 Special Topics in Biochemistry 3 credits

Bio L680/Chem L680 Physical Biochemistry 3 credits

Bio 360 Bioinformatics 3 credits

Bio 664 Computer Analysis of DNA & Protein Structure 3 credits

Chem 361 Analytical Instrumentation 4 credits

### Pass/Fail Requirements:

One of the Mathematics or Physics courses required for the major may be taken on a pass/fail basis. No required Biochemistry, Biology, or Chemistry course for the major may be taken on a pass/fail basis.

### Example Course Sequence

**Year 1 Fall:**  
Biol 111, Chem 115+117, First Year Seminar, Eng 101 15 credits

**Spring:**  
Biol 112, Chem 116+118, Math 140 or 145 (or lower level Math course), Eng 102 16 credits

**Year 2 Fall:**  
Biol 212, Chem 251 + 255, Math 141 or 146, Physics 113, Physics 181 16 credits

**Spring:**  
Biol 254, Chem 252 + 256, Physics 114, Physics 182, Intermediate Seminar 15 credits

**Year 3 Fall:**  
Biochem 383, Biochem 385, Chem 311 & 313, Distribution course 15 credits

**Spring:**  
Biochem 384, Biochem 386, Chem 312, 2 Distribution courses 16 credits

**Year 4 Fall:**  
Biochem 491, Distribution courses, electives 15 credits

**Spring:**  
Biochem 492, Biol 372, Distribution courses, electives 15 credits
Appendix J

Biochemistry Certificate

The Biochemistry Certificate requires a minimum of **15 credits (5 courses, 21 credit hours)**. Students who have not completed the 100 level and 200 level pre-requisites for the required courses at the 300 level, will complete more course work.

By allowing students who have completed Introductory Biology, General Chemistry, Cell Biology, Genetics, and Organic Chemistry to just complete the 300-level requirements, it is possible to complete the Biochemistry Certificate in 1 year. Students needing to complete all the above listed courses could complete the program in two years, although a realistic plan would be three years.

To receive the Biochemistry Certificate a student must complete, at the University of Massachusetts-Boston, the following courses:

- **Biochemistry 383 - Biochemistry I**  lecture  3 credits / 3 hours
- **Biochemistry 385 - Biochemistry I**  lab  3 credits / 7 hours
- **Biochemistry 384 - Biochemistry II**  lecture  3 credits / 3 hours
- **Biochemistry 386 - Biochemistry II**  lab  3 credits / 5 hours
- **Biology 372 - Molecular Biology**  lecture  3 credits / 3 hours

Successful completion of a course requires a minimum grade of C. The Grade Point Average (GPA) for all completed required courses must be 2.5 or higher.

It is expected that students enrolling to complete this Biochemistry Certificate will have completed the pre-requisites for the above courses. The pre-requisites are listed in the University of Massachusetts Course Description catalog. Evidence of successful completion of these pre-requisites elsewhere should be presented, prior to enrolling in Biochemistry 383 and Biochemistry 385, to the Biochemistry Director, in the form of an official University transcript. A grade of C or better is required, and the decision on whether to accept a course from another institution resides with the Biochemistry Director, in consultation with appropriate colleagues in Biology and Chemistry.

For students lacking the appropriate pre-requisite courses, any or all of the following courses may be completed at the University of Massachusetts-Boston:

- **Biology 111 - General Biology I**  Chemistry 115 + 117 - Chemical Principles I lec + lab
- **Biology 112 - General Biology II**  Chemistry 116 + 118 - Chemical Principles II lec + lab
- **Biology 212 - Cell Biology (lecture)**  Chemistry 251 + 255 - Organic Chemistry I
- **Biology 254 - Genetics (lecture)**  Chemistry 252 + 256 - Organic Chemistry II

For further information contact the Biochemistry Director, Dr. Steven Ackerman (617-287-6682; steven.ackerman@umb.edu)
# Appendix K

## Sample Four-Year Plan for a B.S. in Biochemistry

<table>
<thead>
<tr>
<th></th>
<th><strong>Fall Semester</strong></th>
<th><strong>Spring Semester</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshman Year</strong></td>
<td>Chemistry 115 &amp; 117 – 5 cr</td>
<td>Chemistry 116 &amp; 118 – 5 cr</td>
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<tr>
<td></td>
<td>Biology 111 – 4 cr</td>
<td>Biology 112 – 4 cr</td>
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<td>Math 130 – 3 cr or</td>
<td>Math 140 or</td>
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<td>Math 140 or 145#</td>
<td>Math 141 or Math 146# – 4 cr</td>
</tr>
<tr>
<td></td>
<td>English 101 – 3 cr</td>
<td>First-Year Seminar – 4 cr</td>
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<td>(15 credits)</td>
<td>(17 credits)</td>
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<tr>
<td><strong>Sophomore Year</strong></td>
<td>Biology 212* (or 210) – 3 cr</td>
<td>Biology 254* (or 252) – 3 cr</td>
</tr>
<tr>
<td></td>
<td>Chemistry 251 &amp; 255 – 5 cr</td>
<td>Chemistry 252 &amp; 256 – 5 cr</td>
</tr>
<tr>
<td></td>
<td>Math 141 – 4 cr</td>
<td>Physics 113 &amp; 181 – 6 cr</td>
</tr>
<tr>
<td></td>
<td>English 102 – 3 cr</td>
<td>Intermediate Seminar – 3 cr</td>
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<tr>
<td></td>
<td>(15 credits)</td>
<td>(17 credits)</td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
<td>Biochemistry 383# &amp; 385# – 6 cr</td>
<td>Biochemistry 384# &amp; 386# – 6 cr</td>
</tr>
<tr>
<td></td>
<td>Physics 114 &amp; 182 – 6 cr</td>
<td>Science Elective – 3 cr</td>
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<tr>
<td></td>
<td>General Education – 3 cr</td>
<td>General Education – 3 cr</td>
</tr>
<tr>
<td></td>
<td>(15 credits)</td>
<td>(15 credits)</td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
<td>Biochemistry 491 – 4 cr</td>
<td>Biology 372# – 3 cr</td>
</tr>
<tr>
<td></td>
<td>Chemistry 311# &amp; 313# – 6 cr</td>
<td>Biochemistry 492 – 4 cr</td>
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<td>General Education – 3 cr</td>
<td>Chemistry 312# - 4 cr</td>
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<td></td>
<td>Science Elective – 3 cr</td>
<td>Science Elective - 3 cr</td>
</tr>
<tr>
<td></td>
<td>(16 credits)</td>
<td>General Education – 3 cr</td>
</tr>
<tr>
<td></td>
<td>(16 credits)</td>
<td>(17 credits)</td>
</tr>
</tbody>
</table>

*Fall only; #Spring only; #Fall and Spring; (All other courses are offered every semester including summer)

All students must take a minimum of 120 credits (approximately 40 courses). Thirty credits must be taken at UMass Boston. Also, some departments require that a minimum number of courses in the major be taken at UMB.

A minimum cumulative grade point average (GPA) of 2.0, calculated only from UMB courses, is required by the university. Some majors require a specific average in courses taken toward the major; see the major department for more information.

You can select courses that fulfill more than one requirement.
FACT SHEET- TEACHER CERTIFICATION (TC) OPTION: Biology Major

Students who seek certification for teaching Biology in Secondary Schools need to complete the following Biology major requirements.

COURSES REQUIRED FOR BIOLOGY MAJOR:

1. **Biology “core” (19 Biology credits; 24 in Math, Physics and Chemistry):**
   - General Biology 111 – 112 (Lab required)
   - Cell Biology 210 (Lab required)
   - Genetics 252 (Lab required)
   - Population Biology 290
   - Intro Chemistry 115, 116, 117, 118 (Lab required)
   - Intro Physics 107-108 or 113-114 and Labs 181-182
   - Mathematics through one semester of Calculus (Math 135 or 140 or 145)

2. **A minimum of 20 credits at the 300 level or above in Biology:**
   - In two cases, up to 8 of these required 20 credits may be taken in departments other than in the Biology Dept:
     - A. **Organic Chemistry** (Chem 251, 252, 255, 256) may be counted toward this requirement (but only 1 credit from each 2 credit lab (255 & 256) can be applied to this upper level option)
     - B. Course(s) taken to complete requirements of the Bio-Behavioral Program may be counted toward this requirement, but only with prior approval of the Biology Department Chair.
   - The following Biology and Biochemistry courses **do not** fulfill this requirement: **Bio** 381, 444, 478-479 and 672-673; **Biochem** 471-472, 480, and 491-492.

3. In order to graduate as a Biology major, a final grade point average of **2.0** is required in biology courses above 111-112 which are used to meet Biology major requirements.

4. Not more than one course used to satisfy requirements **1 & 2** above can be taken Pass/Fail.

REQUIREMENTS FOR BIOLOGY TEACHER CERTIFICATION (TC):

1. **Subject Matter Knowledge for Teacher Certification in Biology – Completion of the requirements for a major in Biology or Biochemistry.**

2. **In addition to the Biology major coursework, students must also complete two courses in the Psychology department (unless this coursework has been transferred in from another school). Students must take PSYCH 100 or 101 “Introduction to Psychology” and PSYCH 342, “Adolescence”**

3. **Secondary Education (9-12 in subject area)**
   - Semester 1: EDC G 441 Contemporary Issues in Education 3 credits
   - Semester 2: EDC G 424 Cultures of the High School 3 credits
EDC G 410  Computers – Technology and Education  3 credits  
EDC G 422  Middle & Secondary Pre-Practicum I  1 credit 

Semester 3: EDC G 460  Designing Secondary Curriculum and Learning Strategies  3 credits  
EDC G 465  Teaching and Learning in Science  3 credits 
EDC G 423  Middle and Secondary Pre-Practicum II  1 credit 

Semester 4: EDC G 499  Practicum & Seminar: Secondary Education  12 credits  
(29 Credits)

4. All students MUST pass both the Communication & Literacy Test as well as the Biology Subject Test on the MTEL prior to taking EDC G 499. Students who do not have passing scores on both exams will not be allowed to complete their Practicum. For information and objectives addressed on these exams, please visit the MTEL website at www.mtel.nesinc.com.

Advising:

Every Biology major in the TC Program must apply to the Graduate College of Education. Application and additional information are available in the Office of Student Services located in W-2-119. You can contact them via phone at 617-287-7625 or email: grad.teachered@umb.edu. The Office of Student Services will work with each student throughout the program.

Every Biology major must also have a faculty adviser from the Biology Dept. The Biology Teacher Coordinator (TC) is Dr. Brian White, phone 617-287-5776; email: brian.white@umb.edu.

Prior to the student teaching semester, the TC Coordinator and the Biology TC Committee will review and evaluate the candidate’s record.

Further information can be obtained from the Biology Department Administrative Assistants in Wheatley 3-021; phone: 617-287-6600.
Appendix M

Basic Courses Required by Medical, Dental and Veterinary Schools

These are the basic minimum requirement for admission to medical school. Dental schools and Veterinary schools often have additional required coursework.

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>COURSE NUMBER</th>
<th>COURSE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>101-102</td>
<td>Freshman English I and II (or equivalent)</td>
</tr>
<tr>
<td>Mathematics</td>
<td>130,140</td>
<td>Pre-calculus and Calculus I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Recommended as the combination accepted by the largest number of medical schools)</td>
</tr>
<tr>
<td></td>
<td>140, 141</td>
<td>Calculus I and II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Required by most highly competitive medical schools)</td>
</tr>
<tr>
<td></td>
<td>145, 146</td>
<td>Calculus I and II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For the Life and Environmental Sciences</td>
</tr>
<tr>
<td>Biology</td>
<td>111, 112</td>
<td>General Biology I and II</td>
</tr>
<tr>
<td>Chemistry</td>
<td>115,117</td>
<td>Chemical Principles I and Laboratory I</td>
</tr>
<tr>
<td></td>
<td>116,118</td>
<td>Chemical Principles II and Laboratory II</td>
</tr>
<tr>
<td></td>
<td>251,255</td>
<td>Organic Chemistry I and Laboratory I</td>
</tr>
<tr>
<td></td>
<td>252,256</td>
<td>Organic Chemistry II and Laboratory II</td>
</tr>
<tr>
<td>Physics</td>
<td>107,181</td>
<td>College Physics I (non-calculus based) Laboratory I</td>
</tr>
<tr>
<td></td>
<td>108,182</td>
<td>College Physics II (non-calculus based) Laboratory II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fundamentals of Physics I (calculus based) and Laboratory I</td>
</tr>
<tr>
<td></td>
<td>114,182</td>
<td>Fundamentals of Physics II (calculus based) and Laboratory II</td>
</tr>
</tbody>
</table>

Other recommended coursework:

In addition to the above courses, you are strongly advised to take more biology courses if you are not a Biology major. Biochemistry, cell biology, genetics, microbiology, neurobiology, molecular biology, and immunology are strongly recommended; they will prepare you for the MCAT and your first years in medical school (which is based largely on biology course work). They may also lead to additional recommendations from f

More information available online at: [www.uac.umb.edu/premed](http://www.uac.umb.edu/premed)
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