

# Master of Science in Biology

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## *Program Description*

The M.S. program in biology at USM is designed to meet diverse student interests and to provide additional preparation for careers in biology. The program is aimed at three groups: 1) students who wish to continue the scholarly pursuit of biology and possibly continue with a Ph.D. or M.D.; 2) students desiring laboratory or field experience to make them more competitive for employment; and 3) students who teach, or wish to teach, at the secondary, community college, or technical college levels.

To meet these needs, the M.S. program in biology offers a breadth of coursework, and a thesis requirement with an individualized approach. Coursework and research opportunities span the subdisciplines of cell and molecular biology, developmental biology, evolutionary genetics, physiology (animal, plant, and microbial), ecology (animal, plant, and microbial), and environmental science.

The student master's thesis, tailored to individual interests and falling within the research subdiscipline of a faculty mentor, is intended to provide experience in scientific investigation. Students are exposed to the current state of knowledge within the subdiscipline, and learn skills necessary for creative scientific inquiry. These include exploration and evaluation of the scientific literature, experimental design, implementation of original laboratory or field-based research, statistical analysis of data, and the writing of a publishable scientific paper.

## *Admission*

Admission to the M.S. program in biology is competitive and has two basic requirements. First, applicants should have earned a baccalaureate degree from an accredited institution, preferably in some area of biology, with a minimum GPA equivalent to 3.0. Second, admission is also dependent upon a faculty member agreeing to serve as the primary faculty advisor to the student. Therefore, before applying to the program, students must become acquainted with the research interests of individual faculty in or adjunct to the Department of Biological Sciences ([www.usm.maine.edu/bio](http://www.usm.maine.edu/bio)) and contact those faculty members to discuss the possibility of working with them in the M.S. program in biology and identify the faculty member(s) in their essay.

Students who do not meet the first criterion, but who demonstrate exceptional promise, may be granted conditional admission, during which time they must compensate for any specific deficiency as determined by the Biology Graduate Admissions Committee. Upon successful completion of the conditions, conditional students can be granted regular admission status.

## *Application Materials*

In addition to the materials described in the Admissions chapter of this catalog, applicants must submit the following information:

1. *Test scores* Official scores from the General Test of the Graduate Record Examination (GRE) are required. Official scores from the GRE Subject Test in Biology are recommended.
2. *Transcripts* Official undergraduate and graduate transcripts are required from any college or university attended.
3. *Essay* The essay should discuss your academic goals and anticipated research interests, and should include the name(s) of specific faculty members with whom you might like to work.
4. *Letters of recommendation* Three letters of recommendation are required from people who can evaluate your potential for success in a master's program in the biological sciences.

## *Application Deadlines*

Applications and supporting materials must be received by February 1 in order to receive priority status for fall admission and consideration of departmental financial support. The application deadline for spring admission is October 15. Students applying for spring admission are less likely to obtain graduate assistantships in their first semester, because most financial aid will be distributed during fall admissions.

## ***Program Policies***

In addition to the general policies described in the Academic Policies chapter, this program also includes the following policies.

*Transfer credits* Graduate students may transfer a maximum of 9 graduate credits, earned within the past 5 years, with a grade of B- or better. Approval of transfer credits must be requested at the time of admission.

*Time limit* All courses for the M.S. degree must be completed within 5 years from the time of first matriculation. Students may apply to the program graduate coordinator for an extension, which must be approved by the Department graduate faculty.

*Grade policy* Students must earn a grade of B- or better for courses to count toward the M.S. degree. If the cumulative GPA drops below 3.0, the student will be placed on probation. Terms and conditions of probation will be determined by the student's Advisory Committee in consultation with the Office of Graduate Studies.

## ***Eligibility for Financial Aid During Thesis Completion Stage***

To be eligible for federal financial aid (including deferment of student loans), a matriculated student must be enrolled in a minimum of 6 graduate credits in the master's degree program. However, a student who has completed coursework and is engaged in finishing his/her thesis will be considered eligible if he/she meets *one* of the following conditions:

- Is enrolled in at least 6 graduate credits
- or**
- Is enrolled in less than 6 graduate credits, has obtained certification of satisfactory progress from the chair of his/her thesis committee, indicating that the student is actively progressing in the work leading to completion of the master's degree, *and* is registered for GRS 602 (*see course description at the end of this chapter*).

## ***Program Requirements***

During the first semester, students are required to declare a research topic and to arrange an Advisory Committee, with guidance from their primary faculty advisor. The Advisory Committee consists of the student's primary faculty advisor and at least two other faculty members, of which at least one must be a member of the Department of Biological Sciences.

The degree provides two thesis options: research and literature review. Most students are expected to produce a research thesis, based on an original research project. However, with approval of the student's Advisory Committee, a student may undertake the literature review thesis option, which requires writing a comprehensive analysis of a specific topic. All master's candidates preparing a research thesis must complete a minimum of 24 credits of coursework and 6 credits of thesis research. Candidates completing the literature review thesis option must complete 32 credits of coursework, which must include at least one laboratory course, and 3 credits of literature review. Coursework is determined individually for each student in consultation with the student's Advisory Committee.

All students must take four required courses (15-18 credits):

AMS 545	Applied Biostatistical Analysis
<b>or</b>	
STA 588	Introduction to Biostatistics
BIO 601	Research Methods in Biology
BIO 621	Graduate Seminar (minimum of 2 required)
BIO 698	Thesis Research
<b>or</b>	
BIO 699	Literature Review

Students also choose electives. To maintain breadth, electives are required in at least two of three areas (selecting from Genetics and Molecular Biology, Physiology, and Ecology and Evolution). Upon approval of the Advisory Committee, students also may take graduate-level courses in other departments.

At the end of the program, the thesis or literature review must be written in a form satisfactory to the Advisory Committee and suitable for submission to a peer-reviewed scientific journal, and the results must be presented in a seminar open to faculty, students, and the public. After the presentation, the student and Advisory Committee will meet to discuss details of the project, paper, and seminar.

The following courses satisfy the three program areas. Also, courses from other departments, specifically the Chemistry Department and Applied Medical Sciences Department, may satisfy some of the program areas.

Genetics and Molecular Biology

- BIO 507 Molecular Mechanisms of Animal Development
- BIO 508 Experimental Genetics
- BIO 509 Cell and Molecular Biology
- BIO 510 Cell and Molecular Biology Laboratory

Physiology

- BIO 501 General Physiology
- BIO 502 General Physiology Laboratory
- BIO 503 Comparative Physiology
- BIO 504 Comparative Physiology Laboratory
- BIO 545 Advanced Pathophysiology
- BIO 611 Endocrinology
- BIO 615 Plant Metabolism

Ecology and Evolution

- BIO 505 Animal Behavior
- BIO 506 Animal Behavior Laboratory
- BIO 511 Estuarine Ecology
- BIO 515 Microbial Ecology
- BIO 516 Microbial Ecology Laboratory
- BIO 517 Issues in Evolution

***Laboratory Fees***

Laboratory fees are assessed in biology laboratory courses to cover the cost of supplies and materials.

**BIO 501 General Physiology**

A study of physiological processes and their regulation in animals. Cr 3.

**BIO 502 General Physiology Laboratory**

Laboratory examination of physiological mechanisms in animals. Cr 2.

**BIO 503 Comparative Physiology**

Physiological and biochemical basis of environmental adaptation. Cr 3.

**BIO 504 Comparative Physiology Laboratory**

Laboratory experiments on the physiological basis of environmental adaptation. Emphasis is on marine organisms. Cr 2.

**BIO 505 Animal Behavior**

This course is a study of the principles of behavioral organization in vertebrate and invertebrate animals, with emphasis on behavior under natural conditions. Cr 3.

**BIO 506 Animal Behavior Laboratory**

This course is a laboratory and field examination of behavioral principles in animals. Cr 2.

**BIO 507 Molecular Mechanisms of Animal Development**

A molecular genetic analysis of animal development focusing on an integrative approach toward understanding the evolution of developmental mechanisms. Cr 3.

**BIO 508 Experimental Genetics**

This course includes both lectures and laboratory exercises in human and fruit fly genetics. Cr 2.

**BIO 509 Cell and Molecular Biology**

A study of the eukaryotic cell at the level of organelles and molecules. The biochemical aspects of cell growth and reproduction are emphasized. Cr 3.

**BIO 510 Cell and Molecular Biology Laboratory**

A course in which the techniques of cell fractionation and biochemical analyses are applied to the eukaryotic cell. Cr 2.

**BIO 511 Estuarine Ecology**

Integrated lecture/field laboratory course focused on interactions determining the distribution and abundance of life in estuaries. Cr 3.

**BIO 515 Microbial Ecology**

This course is a continuation of the basic microbiology course (BIO 311). The course begins with an examination of microbial evolution and biodiversity, and explores the interactions of microorganisms in populations and communities, with other organisms, and with the environment, including an examination of physiological adaptations and biogeochemical cycles. Cr 3.

**BIO 516 Microbial Ecology Laboratory**

This companion lab course to BIO 515 Microbial Ecology is designed as a hands-on project lab to introduce students to a variety of methods used in microbial ecology. There are field, lab, and written components to the projects that will be carried out over the semester. Microscopic, cell culture, and molecular methods will be employed. Cr 2.

**BIO 517 Issues in Evolution**

This course surveys major issues that motivate current research in evolutionary biology, providing a historical analysis of active areas of controversy and alternative points of view. The course is based on selected readings in the theoretical and experimental literature of the field, from primary and classical sources. Cr 3.

**BIO 545 Advanced Pathophysiology**

This course is a study of physiological, genetic, biochemical, and environmental basis of diseases. Systems to be covered include reproductive, gastrointestinal, respiratory, cardiovascular, nervous, and skeletomuscular. Cr 3.

**BIO 601 Research Methods in Biology**

This course introduces students to faculty members' research. Students will study the philosophy of science, experimental design, data analysis and interpretation, and writing and assessment of scientific papers. Cr 3.

**BIO 602 Ethical Issues in Biology**

This course examines a variety of ethical issues arising in biology today, including those related to general scientific research, biotechnology, medicine, and the environment. Cr 2.

**BIO 611 Endocrinology**

This course examines hormone action in animals and plants at the molecular, cellular, organ, and organismal levels. Topics will include the endocrine control of development, behavior, and physiological processes. Cr 3.

**BIO 615 Plant Metabolism**

This is an advanced course on the regulation and integration of metabolism as viewed from a whole plant perspective. The course deals with primary metabolic pathways such as respiration, photosynthesis, nitrogen metabolism, and carbohydrate and lipid biosynthesis. Compartmentation of metabolic pathways and communication between cells, tissues, and organs via transport systems are discussed. Cr 3.

**BIO 621 Graduate Seminar**

This course reviews the literature pertinent to topics of biology. It may be repeated for credit as topics vary. Graduate students must complete at least two different seminars. Cr 1-3.

**BIO 650 Internship**

In this course, students apply their learning to a

practical context under supervision of a faculty member. Cr 1-3.

**BIO 660 Graduate Independent Study**

Independent work on a special topic as arranged by the student, advisor, and committee. Cr 1-6.

**BIO 698 Thesis Research**

This course involves thesis research and preparation. It may be repeated for credit, but no more than 6 cred-

its will apply to the degree. Enrollment is required each term in which the thesis is in progress. Cr 1-6.

**BIO 699 Literature Review**

This course involves preparation of a review paper based on current biological literature. Prerequisite: permission of the graduate advisor. Cr 1-6.

**GRS 602 Thesis Completion**

*See the complete course description in the "Continuous Enrollment and Residency" section of the Academic Policies chapter.* Cr 1.