

Biology



C.A.A

Undergraduate Handbook

www.bio.umass.edu/biology

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The Field

Biology is the science of life. The vast scope of its subject matter makes biology an extremely diverse field of study. This diversity stems not only from the tremendous variety of life forms with which we share our planet, but also from the multiple levels of organization available for biological investigation. Given an organism, a biologist might choose to investigate how it behaves, how it fits into its ecosystem, the mechanisms by which its genes shape its appearance, what its ancestors were like, how its cells divide, how it grows and develops, or how it derives energy from nourishment. Biological inquiry encompasses perspectives from the planetary to the submicroscopic.

The wide array of biological perspectives is reflected in the many subdisciplines of the field. Genetics, anatomy, physiology, ecology, ethology, botany, neurobiology, systematics, molecular biology, developmental biology, paleontology, and cell biology are just a few of the multitude of specializations that, taken together, compose biology. Given the plethora of approaches that coexist under the biological umbrella, a casual observer might believe that biology is an intellectually fragmented and diffuse endeavor. Fortunately, biology, in all of its glorious diversity, is unified by a few grand ideas. In particular, the theory of evolution provides a conceptual framework that draws together the far-flung threads of biological thought.

Like other scientists, biologists use the scientific method to develop explanations for the patterns and processes that they observe in the natural world. The practice of biology thus involves both systematic observation, often aided by sophisticated instruments, and experimentation. Biologists may work in laboratories or in the field; some of the best biological research combines data gathered in both settings.

Career Opportunities

For many biology majors, undergraduate studies are preliminary to the pursuit of an advanced degree that will lead to a career as a medical doctor, veterinarian, academic, or scientist. A graduate degree is not, however, required to pursue a career related to biology. A bachelors degree in biology can lead to employment in the large and growing biotechnology, health care, or pharmaceutical industries. Many openings in these dynamic, high-tech fields require a degree in the life sciences. Biology majors are likewise well prepared for careers as secondary-school science teachers. Certain government agencies, including the National Park Service and the Environmental Protection Agency, also regularly hire biology graduates, as do private environmental and conservation organizations. Employers of all types recognize that a person with a science degree is likely to be comfortable with logical, quantitative thinking.

The Major

The Biology major is open to all students with an interest in biology. The course requirements for the major emphasize fundamental scientific concepts while allowing students to tailor a program to their own interests. All majors are required to complete a core sequence that includes basic math and science courses and a two-semester introduction to biology. The elective portion of the degree is more flexible and is intended to allow students to select a personalized array of courses while sampling the breadth of biology.

The Faculty

The Biology faculty includes more than thirty distinguished scientists, many of whom are very prominent in their fields. Most of these researchers regularly invite selected undergraduates to join their research teams. The faculty is proud of the many research opportunities that it is able to extend to undergraduates, but may take even more pride in its commitment to teaching. Many excellent teachers fill the ranks of the Biology faculty, including four winners of the prestigious UMass Distinguished Teacher Award.

Transfers

Courses completed elsewhere and accepted for transfer credit may substitute for some required courses. All post-introductory biology courses, however, must be completed in UMass Amherst.

The Minor

An undergraduate minor in Biology requires successful completion of at least 18 credits (all with grade of 'C' or better) from the Biological Sciences Core:

- 1) Biol 151, 152, and 153 (lab) Intro Biology I and II
- 2) Three additional Biology Department courses chosen from the list of approved courses* for the major (see page 4), subject to the following stipulations.
 - a) Each of the three courses must be from a different subject area (see page 4 for a list of courses in each area).
 - b) No more than one of the three courses may also be used to satisfy the requirements of another major.
 - c) Only 3-credit and 4-credit courses may be used.
 - d) Only Biology Department courses may be used.
 - e) All three courses must be taken at UMass Amherst.

*Note that some courses on the list of courses approved for the major are restricted to Biology majors. These courses are not available to students pursuing a minor.

Honors

Highly motivated and academically accomplished majors may choose an honors track. The honors track provides opportunities for close interaction with faculty, and for participation in original biological research.

To be eligible for Departmental Honors, a student must be a member of the Commonwealth Honors College (for info about joining, see www.honors.umass.edu/joining-honors-college). Honors College members who wish to enroll in Departmental Honors should contact Gerry Downes or Lynn Adler (the Biology honors coordinators). This is best done during the sophomore or junior years.

The following academic requirements must be completed to graduate with Departmental Honors:

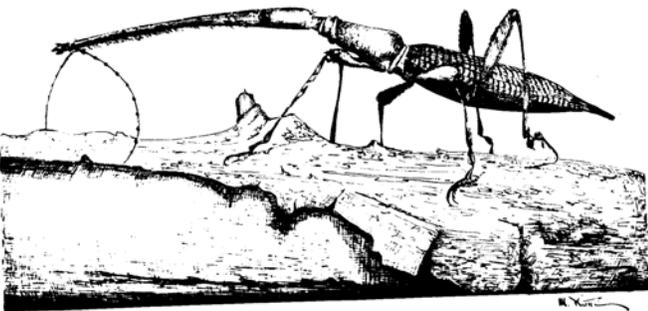
- One Biology honors course at any level with grade of B or better
- One Biology honors course numbered 300 or higher with grade of B or better
- Either BIOL 499Y “Honors Research” and BIOL 499T “Honors Thesis” with grade of B or better in both, OR an Honors Project Seminar. Contact a Biology honors coordinator to find out if any current seminars are accepted for Biology departmental honors.

Dissection

The laboratory component of some Biology courses includes the examination and/or dissection of animals. For a description of the use of animals in a particular course, contact the course instructor or the Biology Undergraduate Office.

Study Abroad

Students are encouraged to spend one or two semesters studying abroad. Study abroad offers a valuable opportunity for enrichment and to gain perspective on the field of biology.



Course requirements

At least 67 credits, with a minimum grade of C- required in courses in the Math and Physical Sciences Core, and a minimum grade of C in all other courses counted toward the major requirements.

Note: students considering a double major should be sure to read the stipulation described at the bottom of this page.

A. Math and Physical Sciences Core (30 credits)

1. PHYSIC 131 and 132 Introductory Physics;
2. CHEM 111 and 112 General Chemistry;
3. CHEM 261, 262, and 269 Organic Chem/Organic Lab for Nonmajors;
4. One of the following courses:
STATISTC 240 Intro to Statistics;
RES ECON 212 Intro Statistics/Life Science;
5. One of the following courses:
MATH 127 Calculus for Life & Social Sciences;
MATH 128 Calculus for Life & Social Sciences;
STATISTC 501 Methods of Applied Statistics;
CMPSCI 121 Problem Solving with Computers.

B. Biological Science Core (37 credits)

1. BIOL 151, 152, and 153 (lab) Introductory Biology;
Notes: 1) Biology majors must achieve a grade of C or better in BIOL 151, 152, and 153 before additional Biology courses may be taken.
2. BIOL 312 Writing in Biology.
3. At least 25 additional credits in biological science courses numbered 200 or above. These credits must include:
 - a) at least 13 credits in courses numbered 300 and above;
 - b) at least one course related to plant biology and one course related to animal biology;
 - c) at least two courses with a laboratory or field component;
 - d) at least one course in four of the following five areas: Genetics and Molecular Biology, Cellular Biology and Development, Physiology, Evolution and Biodiversity, Ecology and Behavior. (See next page for a list of acceptable courses in each of the five areas):

The 25 additional credits may include up to three credits of Independent Study. In addition, the credits may also include up to 3 credits of Undergraduate Teaching Practicum in a Biology Department course. Note that Biol 494LI, required as part of the Integrated Experience requirement, does not count toward the 25 additional credits.

The 25 additional credits MUST be taken at UMass Amherst. Note that this stipulation means that we do not accept courses taken in other departments at UMass Amherst (with the exception of the non-Biology UMass courses that are on the list of approved courses), or at other colleges. (Exceptions: With advance approval from his or her advisor, a student may substitute 500-level courses taken in a UMass Amherst department other than the Biology Department, Five College courses, or courses taken as part of a study-abroad program.)

For students pursuing a DOUBLE MAJOR, the 25 additional credits may NOT include any Biology course that is used to fulfill a requirement of the other major.

Elective courses for the biology core

The following lists specify the courses that may be taken toward fulfillment of the biology core requirement. If a course appears in more than one area, it may be used to fill only one area requirement.

GENETICS and MOLECULAR BIOLOGY

BIOL 283 General Genetics
BIOL 284 Genetics Lab [LAB]
BIOL 285 Cell & Molecular Biology
BIOL 379H Genomics and Bioinformatics
BIOL 383H Gene and Genome Analysis [LAB] [PLANT]
BIOL 397MH Cell & Molecular Biology Lab [LAB, PLANT]
BIOL 484 Cancer Genetics
BIOL 486H Molecular Biology of Model Systems [LAB] [PLANT]
BIOL 497G Human Genome Analysis
BIOL 514 Population Genetics
BIOL 583 Advanced Genetics
BIOL 597GE Evolutionary Genetics
ANIMSCI 385 Biotechnology Lab [LAB]

CELLULAR BIOLOGY and DEVELOPMENT

BIOL 285 Cell & Molecular Biology
BIOL 397MH Cell & Molecular Biology Lab [LAB, PLANT]
BIOL 475 Plant Cell Biology [PLANT]
BIOL 477H Bioimaging [LAB]
BIOL 523 Histology [LAB]
BIOL 559 Cell and Molecular Biology II
BIOL 580 Developmental Biology
BIOL 582 From DNA to Diversity: Evolution and Development of Animal Form
ANIMSCI 581 Cancer Biology

PHYSIOLOGY

BIOL 288 Introductory Physiology
BIOL 397N Neurobiology and Physiology Lab [LAB]
BIOL 497AM Animal Movement
BIOL 510 Plant Physiology [PLANT]
BIOL 564 Human Physiology
BIOL 566 Comparative Animal Physiology
BIOL 568 Endocrinology
BIOL 572 Neurobiology
BIOL 597MN Modern Methods in Neurobiology
BIOL 597NE The Neural Basis of Animal Behavior
ANIMSCI 372 Animal Diseases
ANIMSCI 421 Wildlife Reproduction
ANIMSCI 572 Infection and Immunity

EVOLUTION and BIODIVERSITY

BIOL 273 Marine Vertebrates
BIOL 280 Evolution
BIOL 424 Marine Biology
BIOL 426 New England Flora [LAB][PLANT]
BIOL 487H Tropical Field Biology [LAB] [PLANT]
BIOL 514 Population Genetics
BIOL 521 Comparative Vertebrate Anatomy [LAB]
BIOL 528 Principles of Evolution
BIOL 540 Herpetology [LAB]
BIOL 542 Ichthyology [LAB]
BIOL 544 Ornithology [LAB]
BIOL 548 Mammalogy [LAB]
BIOL 582 From DNA to Diversity: Evolution and Development of Animal Form
BIOL 597GE Evolutionary Genetics
BIOL 597PD Dimensions of Plant Diversity [LAB] [PLANT]
ENVIRSCI 515 Microbiology of the Soil

ECOLOGY and BEHAVIOR

BIOL 287 Introductory Ecology
BIOL 421 Plant Ecology [LAB] [PLANT]
BIOL 422H Experimental Methods in Ecology [LAB] [PLANT]
BIOL 426 New England Flora [LAB][PLANT]
BIOL 487H Tropical Field Biology [LAB] [PLANT]
BIOL 544 Ornithology [LAB]
BIOL 550 Animal Behavior [LAB]
BIOL 551 Animal Communication
BIOL 596Z Amazon Aquatic Ecology [LAB]
NRC 590AE Aquatic Ecology
NRC 590IE Invasion Ecology
NRC 590M Marine Ecology
NRC 547 Global Change Ecology
NRC 566 Restoration Ecology
NRC 470 Ecology of Fish [Lab]

MISCELLANEOUS

BIOL 335 Topics in Plant Biology [PLANT]
BIOL 401 Great Papers in Biology
BIOL 461 Vertebrate Collections Management

[PLANT] = Course that fulfills the “plant course” requirement.

[LAB] = Course that fulfills the “lab or field component” requirement.

CHECKLIST FOR BIOLOGY GRADUATION REQUIREMENTS

MATH COURSES (all grades C- or better)

TAKE **ONE** COURSE FROM GROUP A, AND **ONE** FROM GROUP B

group A	{	STAT 240 Intro to Stats	___	Cannot sub Stat 111, Stat 140, or equivalent
		RES ECON 212 Intro Stat/Soc Sci	___	
group B	{	MATH 127 Calculus I	___	
		MATH 128 Calculus II	___	
		STAT 501 Methods of Applied Stats	___	
		CMPSCI 121 Intro to Problem Solving	___	

PHYSICAL SCIENCE COURSES (all grades C- or better)

PHYSICS 131 and 132 Intro Physics I & II	___	___
CHEM 111 and 112 General Chem I & II	___	___
CHEM 261 and 262/269 Org Chem I & II	___	___

BIOLOGY COURSES (all grades C or better, except Biol 494LI, D or better)

BIOL 151 and 152/153 Intro Biology I & II	___	___	___
BIOL 312 Writing in Biology	___		
BIOL 494LI Life After Biology**	___		

Courses below this line must be from the approved courses list and must total 25 credits. # CR 200 # CR 300+ (at least 13 CR must be 300+)

Genetics COURSE	# _____	___	___] must have four of five
Cell COURSE	# _____	___	___	
Physiol COURSE	# _____	___	___	
Evolution COURSE	# _____	___	___	
Ecol COURSE	# _____	___	___	
other COURSE	# _____	___	___	animal course? _____
other COURSE	# _____	___	___	plant course? _____
other COURSE	# _____	___	___	IE course**? _____
other COURSE	# _____	___	___	two labs? _____
other COURSE	# _____	___	___	
other COURSE	# _____	___	___	

total credits ___ + ___ grand total _____

Integrative Experience for Biology majors

In addition to the major requirements, all Biology majors must complete a University general education requirement known as the Integrative Experience (IE). The IE should be completed in the junior or senior year. It has two components:

1. Take Biology 494 LI, Life After Biology (1-cr seminar, offered every semester)
2. Make sure that your upper-level elective courses include at least one of the following courses:

- Biology 383H Gene and Genome Analysis
- Biology 421 Plant Ecology
- Biology 477H BioImaging
- Biology 487H Tropical Field Biology
- Biology 514 Population Genetics
- Biology 523 Histology
- Biology 540 Herpetology
- Biology 550 Animal Behavior
- Biology 551 Animal Communication
- Biology 572 Neurobiology

Research Opportunities

One of the great advantages of attending a major research institution like UMass is that you can get into a real, working lab and do some research yourself. There's no better way to learn how science is really done, and no better way of gaining an in-depth understanding of your favorite sub-discipline. If you're considering a research career and want to get an idea of what a researcher's work life is like, if you want a chance to explore biology outside of the classroom, or if you just want a richer scientific education, you really should look into getting some research experience.

You can do research during the school year, either for credit (independent study), or as a paid job (funded by a faculty sponsor's research grant). Funds are also awarded each year to twelve Junior Fellows (actually seniors with good academic track records). This program has a competitive selection process. Contact the Biology Undergraduate Office for more info.

Useful contact information

Biology Undergraduate Office, 216 Morrill, 413-545-2287

Call or stop by for info or to make an advising appointment.

Or make an appointment online: <https://umass.campus.eab.com>.

Bruce Byers	Undergraduate Program Coordinator	bbyers@bio.umass.edu	413-545-1236
Meghan Gerson	Biology Advisor	mtgerson@bio.umass.edu	413-577-2929
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Wilmore Webley	PreMed Director	wilmore@microbio.umass.edu	
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Faith Nussbaum	PreMed Advisor	fnussbaum@cns.umass.edu	413-545-3819
Doug Smith	PreMed Advisor (freshmen only)	dgsmith@cns.umass.edu	413-545-1969
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Office, 213 Whitmore.

