

# Integrated Biology, MS

The Department of Biology's graduate programs in integrated biology (iBio) emphasize original research and developing the skills essential for publishing and communicating research findings to the scientific community. Research programs in the department cover many areas of the biological sciences: cell biology, developmental biology, ecology, evolution, genetics, and neurobiology. Graduate study in the department provides students with a broad understanding of these basic areas.

Newly admitted graduate students choose a faculty research advisor and together they discuss the student's educational background to formulate a first-semester study plan before registration. The programs allow each student to tailor coursework to their own research interests. Students may be advised to take specific coursework in order to enhance their background in certain areas.

During the first year, students whose preparation in chemistry, genetics, mathematics, or physics is insufficient may need to remedy deficiencies by taking appropriate coursework.

Entering students typically will have taken the following courses: organic chemistry, biochemistry, calculus or physics, and 20 s.h. of coursework in biology including a fundamental genetics course.

Students with bachelor's degrees outside the biological sciences may request modification of certain area requirements. The Graduate Affairs Committee decides whether portions of the requirements may be waived.

## Learning Outcomes

Graduates will:

- master the skill of reading, understanding, and summarizing primary literature across a variety of biology subdisciplines, demonstrating effective scholarly communication in the process;
- explain in writing the experimental rationale, articulate the central hypothesis, and outline the major investigative steps that will be undertaken in a student's primary area of research;
- orally communicate established scientific concepts as well as ongoing research hypotheses, experimental design, and results to a wide array of audiences using established scientific communication norms;
- master in-depth pedagogical concepts through advanced lecture courses and engage in a vertically integrated critical analysis of a single topic over many levels of basic biology;
- learn and implement field-specific experimental processes, techniques, and data analyses in a responsible manner consistent with current bioethical protocols; and
- establish networking connections within the scientific profession, from peers to established, independent researchers.

## Requirements

The Master of Science in integrated biology requires 30 s.h. of graduate credit with thesis or 34 s.h. of graduate credit

without thesis. Students completing the MS with thesis must maintain a graduate college program grade-point average of at least 3.00. Entering students are typically admitted only to the thesis program; however, students who decide not to continue their studies may opt for the nonthesis program.

The MS in integrated biology requires the following coursework.

Requirements	Hours
Concepts, Models, and Systems Seminars	6
Core Courses	7
Data Informatics and Advanced Lectures	12-15
Electives	2-9

## Concepts, Models, and Systems Seminars

Students take BIOL:6299 Concepts, Models, and Systems in Biology (COSMOS) Seminar II on an A-F graded basis. They may substitute another 2 s.h. seminar for BIOL:6299 Concepts, Models, and Systems in Biology (COSMOS) Seminar II with approval of the director of graduate studies.

Course #	Title	Hours
All of these (6 s.h.):		
BIOL:6298	Concepts, Models, and Systems in Biology (COSMOS) Seminar I (taken two fall semesters for 1 s.h. each)	2
BIOL:6299	Concepts, Models, and Systems in Biology (COSMOS) Seminar II (taken two spring semesters for 2 s.h. each)	4

Students enrolled longer than the typical two years to complete the degree apply additional enrollments of these courses toward electives. Should a student complete the degree in less than two years, another elective course would be substituted to reach the overall credit hours for the degree.

## Core Courses

Students must earn a B-minus or above in both BIOL:5312 Critical Analysis of Biological Research: Concepts, Methods, and Interpretation and BIOL:5512 Readings in Genetics; students who earn a lower grade in either will be required to retake the course. A grade lower than B-minus in two attempts of either course will result in dismissal from the program.

Students must take BIOL:6188 Seminar: Writing in Natural Sciences on an A-F graded basis.

Students must take BIOL:7270 Principles of Scholarly Integrity every four years. Additional enrollments may be applied to elective credits.

Course #	Title	Hours
All of these (7 s.h.):		
BIOL:5312	Critical Analysis of Biological Research: Concepts, Methods, and Interpretation (taken in the first year, fall semester)	2

BIOL:5512	Readings in Genetics (taken in the second year, fall semester)	2
BIOL:6188	Seminar: Writing in Natural Sciences	2
BIOL:7270/ PSY:7270	Principles of Scholarly Integrity	1

## Data Informatics and Advanced Lectures

Students must take one data informatics course and two advanced lecture courses. Students take a fourth course in either category.

### Data Informatics Courses

Course #	Title	Hours
At least one of these:		
BIOL:3212/ IGPI:3212	Bioinformatics for Beginners	3
BIOL:4213/ GENE:4213/ IGPI:4213	Bioinformatics	4
BIOL:4386	Introduction to Scientific Computing for Biologists	3
BIOS:4120	Introduction to Biostatistics	3
BIOS:5710/ IGPI:5710	Biostatistical Methods I	4
BIOS:5720/ IGPI:5720	Biostatistical Methods II	4
BIOS:5730/ IGPI:5730	Biostatistical Methods in Categorical Data	3
BIOS:6810	Bayesian Methods and Design	3
BMB:4310/ BME:4310	Computational Biochemistry	3
BME:5335	Computational Bioinformatics	3
ISE:4172	Big Data Analytics	3
IGPI:4200/ STAT:4200	Statistical Methods and Computing	3
IGPI:5110/CS:5110	Introduction to Informatics	3

### Advanced Lecture Courses

Students must complete BIOL:5412 Fundamental Genetics: Graduate Lecture unless they completed an equivalent course during their undergraduate studies, in which case they select an additional course from this list.

Course #	Title	Hours
This course:		
BIOL:5412	Fundamental Genetics: Graduate Lecture	3
At least one of these:		
BIOL:3212/ IGPI:3212	Bioinformatics for Beginners	3
BIOL:3233	Introduction to Developmental Biology	3
BIOL:3244	Animal Behavior	3
BIOL:3245	Animal Behavior Laboratory	4
BIOL:3314/ IGPI:3314	Genomics	3

BIOL:3343	Animal Physiology	3
BIOL:3363	Plant Developmental Biology	3
BIOL:3713	Molecular Genetics	4
BIOL:4333	Genes and Development	3
BIOL:4373/ IGPI:4373	Molecular Evolution: Genes, Genomes, and Organisms	3
BIOL:4386	Introduction to Scientific Computing for Biologists	3
BIOL:5172	Evolution - Graduate Lecture	3
BIOL:5472	Foundations of Evolutionary Theory	3
BIOL:5653/ NSCI:5653/ PSY:5203	Fundamental Neurobiology I	3
BIOL:5654/ NSCI:5654/ PSY:5205	Fundamental Neurobiology II	3
BMED:5207	Principles of Molecular and Cellular Biology	3
EPID:4400	Epidemiology I: Principles	3
FRRB:7001/ CBIO:7001/ PATH:7001	Molecular and Cellular Biology of Cancer	3
GENE:7191	Human Molecular Genetics	3
IMMU:6247/ MICR:6247	Graduate Immunology and Human Disease	4
PATH:5270/ IGPI:5270/ MMED:5270	Pathogenesis of Major Human Diseases	3

### Alternative Advanced Lecture Courses

Students may substitute one advanced lecture course with three of the following 1 s.h. courses; they may substitute two advanced lecture courses with six of the following courses.

Course #	Title	Hours
ACB:5224	Graduate Seminar in Cell and Developmental Biology	1
ACB:6200/ GENE:6200	Current Topics in Genetics	1
ACB:6227/ MMED:6227/ MPB:6227	Cell Fate Decisions	1
ACB:6239	Critical Thinking in Cell Biology	1
ACB:6249	Critical Thinking in Cellular Physiology	1
BMB:5244/ PHAR:5542	Molecular Recognition	1
BMB:5875/ CBE:5875/ CEE:5875/ CHEM:5875/ MICR:5875/ PHAR:5875	Perspectives in Biotechnology	1
BMB:7254	Metabolism I	1
BMB:7255	Metabolism II	1
BMB:7256	Molecular Biology	1
PCOL:5204	Basic Biostatistics and Experimental Design	1

## Electives

Elective courses must bring the total credit for the degree to a minimum of 30 s.h. for students completing a thesis or a minimum of 34 s.h. for students who are not completing a thesis. The remaining coursework is tailored to a student's background and career goals and is selected in consultation with the student's advisory committee. Research may be counted toward elective credits; see the following section titled "Research."

Elective courses may include additional courses from the preceding data informatics or advanced lecture categories; biology coursework (prefix BIOL) numbered 3000 or above, excluding BIOL:3172, BIOL:3245, BIOL:3626, BIOL:3655, BIOL:3656, BIOL:3676, BIOL:3716, BIOL:3736, and BIOL:4314; biostatistics coursework (prefix BIOS) numbered 3000 or above; or courses from the following list. Additional courses not listed here may be considered for approval by the student's advisor.

Students may count BIOL:5110 Practicum: College Teaching for Biology Teaching Assistants a maximum of twice toward this elective requirement.

Course #	Title	Hours
BAIS:6480/ IGPI:6480	Knowledge Discovery	3
CS:3010	Software Engineering Fundamentals in Java	3
CS:3210	Programming Languages and Tools	arr.
CS:3980	Topics in Computer Science I	3
CS:4400	Database Systems	3
CS:4500	Research Methods in Human-Computer Interaction	3
CS:4510	Human-Computer Interaction for Computer Science	3
CS:5110/IGPI:5110	Introduction to Informatics	3
CS:5980	Topics in Computer Science III	arr.
EALL:7475	ePortfolio in College Teaching	3
GRAD:7400	Practicum in College Teaching	arr.
PSQF:4143/ STAT:4143	Introduction to Statistical Methods	3
PSQF:6203	Tools and External Representations in Individual and Social Learning	3
PSQF:6205	Design of Instruction	3
PSQF:6211	Universal Design and Accessibility for Online Instruction	3
PSQF:6214	Design of Learning Environments: Theory, Practice, and Method	3
PSQF:6215	Online Instruction: Design and Facilitation	3
PSQF:6216	Tools and Utilities for Online Teaching	3

PSQF:6217/ GRAD:6217	Seminar in College Teaching	1-3
RHET:5352	Seminar: Topics in Teaching and Professional Development	3
RHET:7940	Public Speaking for Academics	3
SEES:4580/ IGPI:4581	Introduction to Geographic Databases	3
STAT:4540/ BAIS:4540/ DATA:4540/ IGPI:4540	Statistical Learning	3

## Research

Students completing a thesis must first have the thesis accepted by the student's supervisor and advisory committee. Next, the student must pass an oral examination based on the thesis research and related subjects. Students completing a thesis are permitted, but not required, to apply a maximum of 5 s.h. of BIOL:6199 Research: Biology toward elective requirements.

Students not completing a thesis are instead required to write a library research report. These students are permitted, but not required, to apply a combined maximum of 4 s.h. of BIOL:6199 Research: Biology and BIOL:6899 Independent Study in Biology toward elective requirements.

## Admission

Individuals who wish to pursue graduate study in integrated biology may apply to the Master of Science with thesis program. The MS without thesis is an exit program and does not admit entering graduate students.

Application materials for the graduate program must be uploaded to the university's Admissions website. These are reviewed by the Department of Biology Graduate Recruitment and Admissions Committee. For detailed instructions, visit Graduate Admissions Process on the integrated biology graduate program website.

Applicants must hold a valid BA or BS from an accredited institution. They must supply official transcripts from each undergraduate and graduate institution they have attended. The Graduate Record Examination (GRE) General Test is not required for admission, but if students wish to have their results considered they must include their verbal, quantitative, and analytical writing scores.

Successful applicants for graduate admission typically have a grade-point average of at least 3.00 on a 4.00 scale. The admissions committee also considers letters of recommendation, a personal statement, and other appropriate criteria, especially prior research experience.

Although most applicants will have completed undergraduate programs in biology, the department also considers applicants with backgrounds in related sciences, provided they have taken the required coursework.

Students applying for admission to the MS with thesis program should have a bachelor's degree in one of the biological sciences. Students with bachelor's degrees in other areas may need to register as nondegree students and complete the equivalent of the department's bachelor's degree program prior to consideration for admission. Nondegree students must complete chemistry, physics, and calculus

requirements in addition to the biology courses listed in the undergraduate program. Nondegree students should consult the department's graduate program administrator before applying for admission.

Applications are reviewed on a rolling basis during the spring semester; visit the iBio Graduate Program website for updated deadline information.

Applicants must meet the minimum admission requirements of the Graduate College; see the Manual of Rules and Regulations on the Graduate College website.

## Career Advancement

The graduate program in integrated biology prepares students for careers in academic research, science education, industry, government, and a variety of other careers in which their scientific expertise can be used.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.

## Academic Plans

### Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

### Integrated Biology, MS

Course	Title	Hours
<b>Academic Career</b>		
<b>Any Semester</b>		
30 s.h. must be graduate level coursework; graduate transfer credits allowed upon approval. More information is included in the General Catalog and on department website. <sup>a, b</sup>		
<b>Hours</b>		<b>0</b>
<b>First Year</b>		
<b>Fall</b>		
BIOL:5312	Critical Analysis of Biological Research: Concepts, Methods, and Interpretation <sup>c</sup>	2
BIOL:5412	Fundamental Genetics: Graduate Lecture <sup>d, e</sup>	3
BIOL:6199	Research: Biology <sup>f, g</sup>	2
BIOL:6298	Concepts, Models, and Systems in Biology (COSMOS) Seminar I <sup>h</sup>	1
BIOL:7270	Principles of Scholarly Integrity	1
<b>Hours</b>		<b>9</b>
<b>Spring</b>		
BIOL:5512	Readings in Genetics <sup>c</sup>	2
BIOL:6199	Research: Biology <sup>f, g</sup>	1
BIOL:6299	Concepts, Models, and Systems in Biology (COSMOS) Seminar II <sup>i, j</sup>	2
Data informatics course <sup>g</sup>		3 - 4
<b>Hours</b>		<b>8-9</b>
<b>Second Year</b>		
<b>Fall</b>		
BIOL:6199	Research: Biology <sup>f, g</sup>	1

BIOL:6298	Concepts, Models, and Systems in Biology (COSMOS) Seminar I <sup>h</sup>	1
Advanced lecture course <sup>d, g</sup>		3 - 4
Elective course <sup>g</sup>		3
<b>Hours</b>		<b>8-9</b>
<b>Spring</b>		
BIOL:6188	Seminar: Writing in Natural Sciences <sup>k</sup>	2
BIOL:6199	Research: Biology <sup>f</sup>	1
BIOL:6299	Concepts, Models, and Systems in Biology (COSMOS) Seminar II <sup>i, j</sup>	2
Exam: Master's Final Exam <sup>l</sup>		
<b>Hours</b>		<b>5</b>
<b>Total Hours</b>		<b>30-32</b>

- a Students who take coursework to make up for undergraduate deficiencies (e.g., physics, biochemistry, or fundamental genetics) may not count that coursework towards the degree requirements.
- b Students must complete specific requirements in the University of Iowa Graduate College after program admission. Refer to the Graduate College website and the Manual of Rules and Regulations for more information.
- c Students must earn a B-minus or above in both BIOL:5312 and BIOL:5512; students who earn a lower grade in either will be required to retake the course.
- d Students may substitute one advanced lecture course with three 1 s.h. alternative advanced lecture courses; six of the 1 s.h. courses may be substituted for the two advanced lecture courses. See the General Catalog for list of approved courses.
- e Students who completed an equivalent course during their undergraduate studies may select another advanced lecture course; see the General Catalog for list of approved courses.
- f Students are permitted to apply a maximum of 5 s.h. of BIOL:6199 toward elective requirements.
- g See the General Catalog for list of approved courses.
- h Taken two fall semesters for 1 s.h. each.
- i Taken two spring semesters for 2 s.h. each.
- j Students must take BIOL:6299 on an A-F graded basis. They may substitute another 2 s.h. seminar with approval of the director of graduate studies.
- k Students must take BIOL:6188 on an A-F graded basis.
- l Thesis defense.