

Integrated Biology, PhD

Requirements

The Doctor of Philosophy in integrated biology requires a minimum of 72 s.h. of graduate credit. Students must maintain a graduate college program grade-point average of at least 3.00.

New PhD students typically go through three laboratory rotations with different faculty during their first semester (August-December). Students with existing mentors in the Department of Biology may also seek to directly affiliate with that laboratory. Students consult with their temporary advisor and prospective faculty research sponsors before identifying their preferences for research rotations. Based on their rotations, they choose a laboratory affiliation for their thesis late in the first semester.

The PhD in integrated biology requires the following coursework.

Requirements	Hours
Concepts, Models, and Systems Seminars	11
Core Courses	7
Data Informatics and Advanced Lectures	12-15
Research	6
Electives	33-36

Additional Requirements

Concepts, Models, and Systems Seminars

Students must 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 with approval of the director of graduate studies.

Course #	Title	Hours
All of these (11 s.h.):		
BIOL:6298	Concepts, Models, and Systems in Biology (COSMOS) Seminar I (taken five fall semesters for 1 s.h. each)	5
BIOL:6299	Concepts, Models, and Systems in Biology (COSMOS) Seminar II (taken three spring semesters for 2 s.h. each)	6

Students enrolled longer than the typical five years to complete the degree apply additional enrollments of these courses toward electives. Should a student complete the degree in less than five 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 apply to elective credits.

Course #	Title	Hours
All of these (7 s.h.):		
BIOL:5312	Critical Analysis of Biological Research: Concepts, Methods, and Interpretation	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 class 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:4123	Cell Biology of the Nervous System	3
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 3 s.h. from the following courses; they may substitute two advanced lecture courses with 6 s.h. from 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: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
PHAR:5542	Molecular Recognition	3

Research

Students are required to complete a minimum of 6 s.h. in BIOL:6199 Research: Biology. Additional enrollments beyond the 6 s.h. minimum can be applied toward the electives requirement.

Electives

Elective courses must bring the total credit for the degree to a minimum of 72 s.h. 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 as described in the preceding section titled "Research."

Elective courses may include additional courses from the preceding data informatics and 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:6899; 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	3
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

Additional PhD Requirements

The comprehensive examination is taken in the summer of the second year in residence. Students prepare a National Institutes of Health/National Science Foundation-style grant application on their planned thesis work and orally defend this work in front of a review committee. They must demonstrate knowledge of biology fundamentals and the analytic and synthetic skills necessary to become creative, independent scientists. Once they complete the coursework and proficiency requirements and pass the comprehensive examination, students may be admitted to full candidacy for the PhD.

Students must serve as teaching assistants for at least two semesters in order to develop and demonstrate teaching proficiency. The first teaching semester takes place during the spring of a student's first year and is preceded by extensive departmental training in effective teaching skills (BIOL:5110).

The department also offers career seminars that explore types of employment outside of academic research, including teaching careers and other topics.

The program culminates in students' preparation of a dissertation based on original independent research. Students must pass a final examination that covers the thesis and its specialized field before the PhD is awarded.