

BIOLOGY, BS

More Information: <https://biology.case.edu/>

Degree: Bachelor of Science (BS)

Major: Biology

Program Overview

The Biology BS degree program has a core of foundation courses and provides options for specialization in a variety of areas, including biotechnology and genetic engineering, molecular and cellular biology, genetics, immunology, chemical biology, physiology and biophysics, neurobiology and animal behavior, developmental biology, population biology, ecology, and environmental science. Individual research projects form a significant part of the curriculum for many undergraduates in all programs and are specifically required for students in the Biology BS program. Advanced biology majors may register, with permission, for graduate-level courses in the department and in the School of Medicine.

The Biology BS program is intended to prepare students for work as traditional bench or field research scientists. In addition to a general background in biology (the same as provided for Biology BA), the Biology BS program requires two semesters of undergraduate research, plus additional courses in quantitative methods (computer programming, statistics, data analysis) and physical chemistry. The research may be done at the university or at any of its affiliated institutions; the department does not formally place students in laboratories. Because of the extra coursework and research requirements, the Biology BS may present scheduling challenges to students who wish to pursue multiple majors, study abroad, internships, or significant extracurricular activities.

Early, careful planning in consultation with the major advisor is essential to stay on schedule.

Ordinarily, all students begin their biology programs in their first year.

Learning Outcomes

- Students will be able to demonstrate and apply knowledge of fundamental biological concepts, including those in molecular, cellular, organismal, ecological, and evolutionary biology.
- Students will be able to make key observations, propose hypotheses, design experiments to test hypotheses and develop models to generate predictions, collect and analyze data, and draw appropriate conclusions.
- Students will be able to critically analyze published scientific research in the biological sciences, connecting previously learned information to current research.
- Students will be able to communicate biological ideas, arguments and experimental data both in oral and written forms to diverse audiences ranging from experts to lay persons.
- Students will be able to synthesize biological principles across other fields of science to arrive at holistic conclusions based on sound rationale, data, or modeling approaches. In addition, students will be able to contextualize biological discoveries on society and understand ethical implications of research.
- Students will be able to develop models to generate predictions or collect and analyze data and use mathematical or statistical skills to draw appropriate conclusions.

Advising

Biology faculty advisors are assigned to students at the time of major or minor declaration. All biology majors are required to meet with their departmental advisors at least once each semester to discuss their academic program, receive clearance for electronic course registration, and obtain approval for any drops, adds, or withdrawals. Please contact the undergraduate coordinator for the Department of Biology for information about major or minor declaration.

Undergraduate Policies

For undergraduate policies and procedures, please review the Undergraduate Academics section of the General Bulletin.

Accelerated Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the policies and procedures related to accelerated studies, please visit the Undergraduate Academics section of the General Bulletin.

Program Requirements

Students seeking to complete this major and degree program must meet the general requirements for bachelor's degrees and the Unified General Education Requirements. Students completing this program as a secondary major while completing another undergraduate degree program do not need to satisfy the school-specific requirements associated with this major.

Code	Title	Credit Hours
Biology Core Courses		
BIOL 214	Genes, Evolution and Ecology	3
BIOL 215	Cells and Proteins	3
BIOL 214L & BIOL 215L or BIOL 222L	Genes, Evolution and Ecology Lab and Cells and Proteins Laboratory Introductory Research Lab in Biology	2
BIOL 216	Development and Physiology	3
BIOL 216L	Development and Physiology Lab	1
BIOL 326	Genetics	3
Choose one course from any two of the following three subject areas 6-8 (breadth requirement)		
<i>Cell and Molecular Biology Electives</i>		
BIOL 303	From Black Box to Toolbox: How Molecular Biology Moves Forward	
BIOL 316	Fundamental Immunology	
BIOL 324	Introduction to Stem Cell Biology	
BIOL 325	Cell Biology	
BIOL 328	Plant Genomics and Proteomics	
BIOL 329	Genome Dynamics	
BIOL 341	Basic Biology of Blood and Blood Diseases	
BIOL 342	Parasitology	
BIOL 343	Microbiology	
BIOL 365	Evo-Devo: Evolution of Body Plans and Pathologies	
<i>Organismal Biology Electives</i>		
BIOL 223	Vertebrate Biology ^a	
BIOL 302	Human Learning and the Brain	

BIOL 312	Introductory Plant Biology	
BIOL 305	Herpetology	
BIOL 318	Introductory Entomology ^a	
BIOL 322	Sensory Biology	
BIOL 333	The Human Microbiome	
BIOL 338	Ichthyology ^a	
BIOL 340	Human Physiology	
BIOL 346	Human Anatomy	
BIOL 362	Principles of Developmental Biology	
BIOL 373	Introduction to Neurobiology ^a	
BIOL 374	Neurobiology of Behavior	
BIOL 379	Transformative Animal Models in Modern Biology	
<i>Population Biology and Ecology Electives</i>		
BIOL 225	Evolution	
BIOL 336	Aquatic Biology	
BIOL 351	Principles of Ecology	
BIOL 358	Animal Behavior ^a	
BIOL 364	Research Methods in Evolutionary Biology	
BIOL 368	Topics in Evolutionary Biology	
BIOL 375	Brain Evolution and Function	
Quantitative Biology Laboratory Course		3-4
<i>Choose one of the following:</i>		
BIOL 300	Dynamics of Biological Systems: A Quantitative Introduction to Biology	
BIOL 304	Fitting Models to Data: Maximum Likelihood Methods and Model Selection	
BIOL 315	Quantitative Biology Laboratory	
BIOL 321	Design and Analysis of Biological Experiments	
BIOL 327	Functional Genomics	
BIOL 352	Ecology and Evolution of Infectious Diseases	
BIOL 354	Evolutionary Game Theory	
BIOL 373	Introduction to Neurobiology ^a	
BIOL 381	Nervous System Development	
Additional Laboratory Course^b		2-4
BIOL 223	Vertebrate Biology ^a	
BIOL 301	Biotechnology Laboratory: Genes and Genetic Engineering	
BIOL 305L	Herpetology Lab	
BIOL 309	Biology Field Studies	
BIOL 314	Taming the Tree of Life: Phylogenetic Comparative Methods-from Concept to Practical Application	
BIOL 318	Introductory Entomology ^a	
BIOL 338	Ichthyology ^a	
BIOL 339	Aquatic Biology Laboratory	
BIOL 344	Laboratory for Microbiology	
BIOL 345	Mammal Diversity and Evolution	
BIOL 351L	Principles of Ecology Laboratory	
BIOL 353	Ecophysiology of Global Change	
BIOL 354	Evolutionary Game Theory	
BIOL 358	Animal Behavior ^a	
BIOL Electives ^c		3-6
<i>Undergraduate research</i>		6
BIOL 388S	Undergraduate Research - SAGES Capstone	

BIOL 390	Advanced Undergraduate Research	
Mathematics Core Courses		
MATH 125	Math and Calculus Applications for Life, Managerial, and Social Sci I	4
or MATH 121	Calculus for Science and Engineering I	
MATH 126	Math and Calculus Applications for Life, Managerial, and Social Sci II	4
or MATH 122	Calculus for Science and Engineering II	
Chemistry Core Courses		
CHEM 105	Principles of Chemistry I	3
CHEM 106	Principles of Chemistry II	3
CHEM 113	Principles of Chemistry Laboratory	2
CHEM 223	Introductory Organic Chemistry I	3
or CHEM 323	Organic Chemistry I	
CHEM 224	Introductory Organic Chemistry II	3
or CHEM 324	Organic Chemistry II	
CHEM 233	Introductory Organic Chemistry Laboratory I	2
CHEM 301	Introductory Physical Chemistry I	3
Physics Core Courses		
PHYS 115	Introductory Physics I	4
or PHYS 121	General Physics I - Mechanics	
PHYS 116	Introductory Physics II	4
or PHYS 122	General Physics II - Electricity and Magnetism	
Advanced Mathematics or Statistics Course		
MATH 201	Introduction to Linear Algebra for Applications	3
MATH 304	Discrete Mathematics	
STAT 312	Basic Statistics for Engineering and Science	
or STAT 312	Basic Statistics for Engineering and Science Using R Programming	
Computer Programming Course		
ENGR 131	Elementary Computer Programming	3
Total Credit Hours		76-84

- a Can count as an elective or a laboratory course, not both.
b Can be any quantitative or non-quantitative laboratory course. Excluding BIOL 388, BIOL 388S, and BIOL 390.
c Excluding 100-level courses.

At least 11 credit hours of the selected electives and additional laboratory courses must be at the 300-level or higher.

Concentrations in Areas of the Biological Sciences

Students are encouraged to utilize their elective courses in the biology major to take advantage of concentrations in various specialized areas. These concentrations have been developed between the biology department, the basic science departments of the School of Medicine, and other departments. Currently, concentrations have been developed in the following areas: biotechnology and genetic engineering; computational biology; developmental biology; genetics; cell and molecular biology; neurobiology and animal behavior; population biology, ecology and environmental science. Note: these concentrations are informal; they are not declared, and will not appear on the student's diploma or transcript.

Departmental Honors

To receive a bachelor's degree "with Honors in Biology" (formally noted on the transcript), the student must meet the following criteria:

- Maintain a 3.4 overall grade point average, with a 3.6 in BIOL courses
- Carry out two semesters of independent research (taken as BIOL courses) at Case Western Reserve University
- Write a senior honors thesis with the approval of the faculty supervisor
- Submit the thesis for review by an ad hoc honors committee
- Successfully defend the thesis at an oral examination

Additional information and application forms are available from the biology department office.

Sample Plan of Study

First Year

Fall		Credit Hours
BIOL 214	Genes, Evolution and Ecology	3
BIOL 214L or BIOL 222L	Genes, Evolution and Ecology Lab or Introductory Research Lab in Biology	1
MATH 125 or MATH 121	Math and Calculus Applications for Life, Managerial, and Social Sci I or Calculus for Science and Engineering I	4
CHEM 105	Principles of Chemistry I	3
Academic Inquiry Seminar, Breadth, or Elective course ^a		3
Credit Hours		14
Spring		Credit Hours
BIOL 215	Cells and Proteins	3
BIOL 215L or BIOL 222L	Cells and Proteins Laboratory or Introductory Research Lab in Biology	1
MATH 126 or MATH 122	Math and Calculus Applications for Life, Managerial, and Social Sci II or Calculus for Science and Engineering II	4
CHEM 106	Principles of Chemistry II	3
CHEM 113	Principles of Chemistry Laboratory	2
Academic Inquiry Seminar, Breadth, or Elective course ^a		3
Credit Hours		16

Second Year

Fall		Credit Hours
BIOL 216	Development and Physiology	3
BIOL 216L	Development and Physiology Lab	1
CHEM 223 or CHEM 323	Introductory Organic Chemistry I or Organic Chemistry I	3
CHEM 233	Introductory Organic Chemistry Laboratory I	2
Breadth, or Elective course ^a		3

Elective		3
Credit Hours		15
Spring		Credit Hours
BIOL 326	Genetics	3
CHEM 224 or CHEM 324	Introductory Organic Chemistry II or Organic Chemistry II	3
ENGR 131	Elementary Computer Programming	3
Breadth, or Elective course ^a		3
Elective		3
Credit Hours		15
Third Year		Credit Hours
Fall		Credit Hours
PHYS 115 or PHYS 121	Introductory Physics I or General Physics I - Mechanics	4
Breadth, or Elective course ^a		3
BIOL Elective		3
BIOL Laboratory		2-4
Advanced Mathematics or Statistics Course		3
Credit Hours		15-17
Spring		Credit Hours
PHYS 116 or PHYS 122	Introductory Physics II or General Physics II - Electricity and Magnetism	4
BIOL Subject Area Breadth		3
Quantitative BIOL Laboratory or Other BIOL Laboratory		3-4
Breadth, or Elective course ^a		3
Breadth, or Elective course ^a		3
Credit Hours		16-17
Fourth Year		Credit Hours
Fall		Credit Hours
BIOL 388S	Undergraduate Research - SAGES Capstone	3
CHEM 301	Introductory Physical Chemistry I	3
Breadth, or Elective course ^a		3
BIOL Subject Area Breadth		3
BIOL Laboratory or Quantitative BIOL Laboratory (if needed)		2-4
Credit Hours		14-16
Spring		Credit Hours
BIOL 390	Advanced Undergraduate Research	3
Electives		9
BIOL Elective		3
Credit Hours		15
Total Credit Hours		120-125

a Unified General Education Requirement.