Biology

Chair
•Bernd Fritzsch

Undergraduate major: biology (B.A., B.S.)
Undergraduate minor: biology
Graduate degrees: M.S. in integrated biology; Ph.D. in integrated biology
Faculty: http://biology.uiowa.edu/people/faculty
Web site: http://www.biology.uiowa.edu

The Department of Biology offers undergraduate and graduate programs that prepare students for careers in a wide variety of fields such as health science or biological research, technology, and education. It also offers several courses that undergraduate students in all majors may use to satisfy the General Education Program Natural Sciences requirement and other courses on topics of general interest for undergraduate non-biology majors, including a First-Year Seminar course designed for entering students. The department also administers the interdisciplinary Biomedical Sciences major leading to a Bachelor of Science degree.

Undergraduate Programs of Study

• Major in biology (Bachelor of Arts, Bachelor of Sciences)
• Minor in biology

The major in biology prepares students to enter research or service careers associated with private industry or government programs and for primary and secondary school teaching. It also prepares them to enter advanced degree programs leading to careers in higher education and to independent research in a variety of biological fields, or for practice in health professions such as medicine, dentistry, pharmacy, nursing, veterinary medicine, medical technology, and physical therapy.

Students majoring in biology may earn a Bachelor of Science or a Bachelor of Arts degree. All students complete the chemistry/physics/mathematics foundation and the biology core. In addition, B.S. students choose one of six tracks, while B.A. students choose courses from several breadth menus and have a wider selection of elective courses.

The department acquaints undergraduate students with the nature of practicing scientists’ work by offering BIOL:3994 Introduction to Research (requires a Department of Biology faculty sponsor), BIOL:4898 Communicating Research (a course supporting students involved in research), and BIOL:4999 Honors Investigations (requires membership in the Biology Honors Program). Students associate with one of the department’s research groups in experiments, discussion of current research, study of specialized topics, and attendance at research seminars.

Students interested in field biology, zoology, or botany may take varied courses in those subjects offered during the summer at Iowa Lakeside Laboratory, in northwestern Iowa.

Bachelor of Science

The Bachelor of Science with a major in biology requires a minimum of 120 s.h., including at least 65-76 s.h. of work for the major. Students must maintain a g.p.a. of at least 2.00 in all courses for the major and in all UI courses for the major. They also must complete the College of Liberal Arts and Sciences General Education Program.

The major is divided into six tracks that emphasize the most dynamic and active areas in the biological sciences. Five of the tracks—cell and developmental biology, genetics and biotechnology, evolutionary biology, neurobiology, and plant biology—emphasize distinct areas. The sixth track—comprehensive biology—provides highly diverse content. Students working toward a B.S. must complete the chemistry/physics/mathematics foundation, the biology core, and one of the six tracks.

Students who wish to apply transfer credit toward graduation with a major in biology should consult their biology advisor.

CHEMISTRY/PHYSICS/MATHEMATICS FOUNDATION

All of these:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM:1110 &amp; CHEM:1120 Principles of Chemistry I-II</td>
<td>8 s.h.</td>
</tr>
<tr>
<td>CHEM:2210 Organic Chemistry I</td>
<td>3 s.h.</td>
</tr>
</tbody>
</table>

One of these sequences:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS:1511-PHYS:1512 College Physics I-II</td>
<td>8 s.h.</td>
</tr>
<tr>
<td>PHYS:1611-PHYS:1612 Introductory Physics I-II</td>
<td>8 s.h.</td>
</tr>
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One of these:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>MATH:1460 Calculus for the Biological Sciences</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>MATH:1550 Engineering Mathematics I: Single Variable Calculus</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>MATH:1850 Calculus I</td>
<td>4 s.h.</td>
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</table>

One of these:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
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<tbody>
<tr>
<td>STAT:2010 Statistical Methods and Computing (preferred for evolution track)</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>STAT:3510 Biostatistics</td>
<td>3 s.h.</td>
</tr>
</tbody>
</table>

BIOLOGY CORE

All of these:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL:1411-BIOL:1412 Foundations of Biology - Diversity of Form and Function</td>
<td>8 s.h.</td>
</tr>
<tr>
<td>BIOL:2512 Fundamental Genetics</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>BIOL:3172 Evolution</td>
<td>4 s.h.</td>
</tr>
</tbody>
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Tracks for the Bachelor of Science

Bachelor of Science students majoring in biology must select a single track. Each track includes seven or eight courses. The experiential elective requirement may be satisfied by taking an appropriate investigative lab for the track, or through several other options: students who use BIOL:4999 Honors Investigations to fulfill the experiential elective requirement must complete a minimum of 6 s.h. in that course; students who use BIOL:3994 Introduction to Research must complete a minimum of 5 s.h. in that course in combination with 1 s.h. in BIOL:4898 Communicating Research; and students who
use BIOL:4897 Advanced Teaching Internship in Biology
must complete a minimum of 4 s.h. in that course.

CELL AND DEVELOPMENTAL BIOLOGY TRACK

The cell and developmental biology track provides education in the structure and function of cells and in the principles of development as they apply to animals and plants. This track is appropriate for students who wish to pursue graduate study in cellular and developmental biology, to prepare for professional study in medicine and other health-related fields, or to take positions in laboratories and companies engaged in cancer research and related fields.

Group 1 (Biochemistry)

One of these:
BIOC:3110 Biochemistry 3 s.h.
BIOC:3120 & BIOC:3130 Biochemistry and Molecular Biology I-II 6 s.h.

Group 2 (Cell/Developmental Biology Core)

This course:
BIOL:2723 Cell Biology 3 s.h.

One of these:
BIOL:3233 Introduction to Developmental Biology 3 s.h.
BIOL:3363 Plant Developmental Biology 3 s.h.

One of these:
BIOL:3626 Cell Biology Laboratory 4 s.h.
BIOL:3736 Developmental Biology Lab 4 s.h.

Group 3 (Experiential Elective)

One of these:
BIOL:3626 Cell Biology Laboratory (if not used for group 2 above) 4 s.h.
BIOL:3656 Neurobiology Laboratory 4 s.h.
BIOL:3676 Evolution Lab 4 s.h.
BIOL:3716 Genetics and Biotechnology Lab 4 s.h.
BIOL:3736 Developmental Biology Lab (if not used for group 2 above) 4 s.h.
BIOL:3994 & BIOL:4898 Introduction to Research - Communicating Research 6 s.h.
BIOL:4897 Advanced Teaching Internship in Biology 4 s.h.
BIOL:4999 Honors Investigations (in cell/developmental biology) 6 s.h.

Group 4 (Electives)

At least two of these, with a minimum of one course numbered 3000 or above:
BIOL:2254 Endocrinology 3 s.h.
BIOL:2603 Mechanisms of Aging 3 s.h.
BIOL:2753 Introduction to Neurobiology 3 s.h.
BIOL:3233 Introduction to Developmental Biology (if not used for group 2 above) 3 s.h.
BIOL:3253 Neurobiology 4 s.h.
BIOL:3314 Genomics 3 s.h.
BIOL:3343 Animal Physiology 3 s.h.

Group 4 (Electives)

At least two of these, with a minimum of one course numbered 3000 or above:
BIOL:2346 Vertebrate Zoology 4 s.h.
BIOL:2374 Biogeography 3 s.h.
BIOL:3244 Animal Behavior 3-5 s.h.
BIOL:3314 Genomics (if not used for group 2 above) 3 s.h.
BIOL:3663 Plant Response to the Environment 3 s.h.
BIOL:3713 Molecular Genetics 4 s.h.
BIOL:4213 Bioinformatics 4 s.h.
BIOL:4333 Genes and Development 3 s.h.
BIOL:4753 Developmental Neurobiology 3 s.h.
MICR:2157 General Microbiology 5 s.h.
MICR:3147 Survey of Immunology 3 s.h.

EVOLUTIONARY BIOLOGY TRACK

The evolutionary biology track provides education in the principles of evolution as they apply to understanding diversity within and among species, from genomic, ecological, and historical perspectives. This track is appropriate for students who wish to pursue graduate study in evolutionary biology and related fields or to take positions in laboratories using population genetics or phylogenetic approaches such as forensics, fisheries, and human disease mapping.

Group 1 (Biochemistry)

One of these:
BIOC:3110 Biochemistry 3 s.h.
BIOC:3120 & BIOC:3130 Biochemistry and Molecular Biology I-II 6 s.h.

Group 2 (Evolution Core)

Both of these:
BIOL:2673 Ecology 3 s.h.
BIOL:3676 Evolution Lab 4 s.h.

One of these:
BIOL:3314 Genomics 3 s.h.
BIOL:4273 Population Genetics and Molecular Evolution 3 s.h.
BIOL:4373 Molecular Phylogenetics 3 s.h.

Group 3 (Experiential Elective)

One of these:
BIOL:3716 Genetics and Biotechnology Lab 4 s.h.
BIOL:3994 & BIOL:4898 Introduction to Research - Communicating Research 6 s.h.
BIOL:4897 Advanced Teaching Internship in Biology 4 s.h.
BIOL:4999 Honors Investigations (in evolution) 6 s.h.
ENVS:3095 Field Ecology 4 s.h.
An approved Iowa Lakeside Laboratory course 4 s.h.

Group 4 (Electives)

At least two of these, with a minimum of one course numbered 3000 or above:
BIOL:2346 Vertebrate Zoology 4 s.h.
BIOL:2374 Biogeography 3 s.h.
BIOL:3244 Animal Behavior 3-5 s.h.
BIOL:3314 Genomics (if not used for group 2 above) 3 s.h.
BIOL:3663 Plant Response to the Environment 3 s.h.
BIOL:4213 Bioinformatics 4 s.h.
BIOL:4273 Population Genetics and Molecular Evolution (if not used for group 2 above) 3 s.h.
BIOL:4373 Molecular Phylogenetics (if not used for group 2 above) 3 s.h.
ANTH:3307 Modern Human Origins 3 s.h.
ANTH:3325 Human Evolutionary Genetics 3 s.h.
EES:3220 Evolution of the Vertebrates 3 s.h.
EES:4440 Phylogenetics and Biodiversity 3 s.h.
EES:4700 Evolution of Ecosystems 3 s.h.

GENETICS AND BIOTECHNOLOGY TRACK
The genetics and biotechnology track provides education in the key principles of transmission, maintenance, regulation, and manipulation of genes. This track is appropriate for students who wish to pursue graduate study in genetics or to enter the modern biotechnology industry. It also provides excellent preparation for professional study in medicine and other health-related fields.

Group 1 (Biochemistry)
One of these:
BIOC:3110 Biochemistry 3 s.h.
BIOC:3120 & BIOC:3130 Biochemistry and Molecular Biology I-II 6 s.h.

Group 2 (Genetics Core)
All of these:
BIOC:3314 Genomics 3 s.h.
BIOC:3713 Molecular Genetics 4 s.h.
BIOC:3716 Genetics and Biotechnology Lab 4 s.h.

Group 3 (Experiential Elective)
One of these:
BIOC:3626 Cell Biology Laboratory 4 s.h.
BIOC:3676 Evolution Lab 4 s.h.
BIOC:3736 Developmental Biology Lab 4 s.h.
BIOC:3994 & BIOC:4898 Introduction to Research - Communicating Research 6 s.h.
BIOC:4897 Advanced Teaching Internship in Biology 4 s.h.
BIOC:4999 Honors Investigations 6 s.h.

Group 4 (Electives)
At least two of these, with a minimum of one course numbered 3000 or above:
BIOC:2603 Mechanisms of Aging 3 s.h.
BIOC:2723 Cell Biology 3 s.h.
BIOC:3233 Introduction to Developmental Biology 3 s.h.
BIOC:3363 Plant Developmental Biology 3 s.h.
BIOC:3663 Plant Response to the Environment 3 s.h.
BIOC:4213 Bioinformatics 4 s.h.
BIOC:4273 Population Genetics and Molecular Evolution 3 s.h.
BIOC:4333 Genes and Development 3 s.h.
BIOC:4373 Molecular Phylogenetics 3 s.h.
MICR:3170 Microbial Genetics 3 s.h.

NEUROBIOLOGY TRACK
The neurobiology track provides education in nervous system function at all levels, from molecular to systems biology. This track is appropriate for students who wish to pursue graduate study in neurobiology and related areas, including psychology and the social sciences; to enter laboratories that study the therapeutic basis of neurological disorders; or to work in pharmaceutical companies. It also provides good preparation for professional study in medicine and other health-related fields.

Group 1 (Biochemistry)
One of these:
BIOC:3110 Biochemistry 3 s.h.
BIOC:3120 & BIOC:3130 Biochemistry and Molecular Biology I-II 6 s.h.

Group 2 (Neurobiology Core)
All of these:
BIOC:2753 Introduction to Neurobiology 3 s.h.
BIOC:3244 Animal Behavior 5 s.h.
BIOC:3253 Neurobiology 4 s.h.
BIOC:3656 Neurobiology Laboratory 4 s.h.

Group 3 (Experiential Elective)
One of these:
BIOC:3626 Cell Biology Laboratory 4 s.h.
BIOC:3676 Evolution Lab 4 s.h.
BIOC:3736 Developmental Biology Lab 4 s.h.
BIOC:3994 & BIOC:4898 Introduction to Research - Communicating Research 6 s.h.
BIOC:4897 Advanced Teaching Internship in Biology 4 s.h.
BIOC:4999 Honors Investigations (in neurobiology) 6 s.h.

Group 4 (Electives)
At least two of these, with a minimum of one course numbered 3000 or above:
BIOC:2254 Endocrinology 3 s.h.
BIOC:2603 Mechanisms of Aging 3 s.h.
BIOC:2723 Cell Biology 3 s.h.
BIOC:3233 Introduction to Developmental Biology 3 s.h.
BIOC:3343 Animal Physiology 3 s.h.
BIOC:4353 Neurophysiology 3 s.h.
BIOC:4753 Developmental Neurobiology 3 s.h.

PLANT BIOLOGY TRACK
The plant biology track provides education in how plants grow, how they have evolved, and how they interact with other organisms. This track is appropriate for students who wish to pursue graduate study in biology specializing in plants. It also is good preparation for positions in plant biotechnology companies that work in biofuels development, crop improvement, or carbon dioxide sequestration, or in agencies dedicated to the conservation of natural lands.
Group 1 (Biochemistry)
One of these:

BIOC:3110 Biochemistry 3 s.h.
BIOC:3120 & BIOC:3130 Biochemistry and Molecular Biology I-II 6 s.h.

Group 2 (Plant Biology Core)
Both of these:

BIOL:3363 Plant Developmental Biology 3 s.h.
BIOL:3663 Plant Response to the Environment 3 s.h.

One of these:

BIOL:3676 Evolution Lab 4 s.h.
BIOL:3716 Genetics and Biotechnology Lab 4 s.h.

Group 3 (Experiential Elective)
One of these:

BIOL:3626 Cell Biology Laboratory 4 s.h.
BIOL:3676 Evolution Lab (if not used for group 2 above) 4 s.h.
BIOL:3716 Genetics and Biotechnology Lab (if not used for group 2 above) 4 s.h.
BIOL:3736 Developmental Biology Lab 4 s.h.
BIOL:3994 & BIOL:4898 Introduction to Research - Communicating Research 6 s.h.
BIOL:4897 Advanced Teaching Internship in Biology 4 s.h.
BIOL:4999 Honors Investigations (in plant biology) 6 s.h.
ENVS:3095 Field Ecology 4 s.h.
An approved Iowa Lakeside Laboratory course on plant diversity or plant ecology 4 s.h.

Group 4 (Electives)
At least two of these, with a minimum of one course numbered 3000 or above:

BIOL:2374 Biogeography 3 s.h.
BIOL:2673 Ecology 3-4 s.h.
BIOL:2723 Cell Biology 3 s.h.
BIOL:3233 Introduction to Developmental Biology 3 s.h.
BIOL:3314 Genomics 3 s.h.
BIOL:3713 Molecular Genetics 4 s.h.
BIOL:4213 Bioinformatics 4 s.h.
BIOL:4273 Population Genetics and Molecular Evolution 3 s.h.
EES:4700 Evolution of Ecosystems 3 s.h.

COMPREHENSIVE BIOLOGY TRACK
The comprehensive biology track offers a diverse, well-balanced introduction to the major fields of biology. This track prepares students for graduate study in the biological sciences and in science education and for work in laboratories that engage in research and applications in many fields of biology. It also provides broadly based preparation for professional study in medicine and other health-related fields.

Group 1 (Biochemistry and Molecular Biology)
One of these sequences:

BIOC:3120 & BIOC:3130 Biochemistry and Molecular Biology I-II 6 s.h.
BIOC:3314 & BIOC:3110 Genomics - Biochemistry 6 s.h.
BIOC:3713 & BIOC:3110 Molecular Genetics - Biochemistry 7 s.h.

Group 2 (Cellular Biology)
One of these:

BIOL:2723 Cell Biology 3 s.h.
BIOL:2753 Introduction to Neurobiology 3 s.h.

Group 3 (Biological Systems)
One of these:

BIOL:2254 Endocrinology 3 s.h.
BIOL:3233 Introduction to Developmental Biology 3 s.h.
BIOL:3244 Animal Behavior 3-5 s.h.
BIOL:3343 Animal Physiology 3 s.h.
BIOL:3363 Plant Developmental Biology 3 s.h.
BIOL:3663 Plant Response to the Environment 3 s.h.

Group 4 (Population Biology)
One of these:

BIOL:2374 Biogeography 3 s.h.
BIOL:2673 Ecology 3 s.h.
BIOL:4273 Population Genetics and Molecular Evolution 3 s.h.

Group 5 (Investigative Lab)
One of these:

BIOL:3626 Cell Biology Laboratory 4 s.h.
BIOL:3716 Genetics and Biotechnology Lab 4 s.h.
BIOL:3736 Developmental Biology Lab 4 s.h.

Group 6 (Experiential Elective)
At least one of these:

BIOL:3626 Cell Biology Laboratory (if not used for group 5 above) 4 s.h.
BIOL:3656 Neurobiology Laboratory 4 s.h.
BIOL:3676 Evolution Lab 4 s.h.
BIOL:3716 Genetics and Biotechnology Lab 4 s.h.
BIOL:3736 Developmental Biology Lab 4 s.h.

BIOL:3994 & BIOL:4898 Introduction to Research - Communicating Research 6 s.h.
BIOL:4897 Advanced Teaching Internship in Biology 4 s.h.
BIOL:4999 Honors Investigations 6 s.h.
An approved Iowa Lakeside Laboratory course 4 s.h.
Suggested Schedule for First-Year Science Courses

The following first-year schedule of science courses is recommended for all biology majors (B.A. or B.S. students).

First-semester science courses:

CHEM:1110 Principles of Chemistry I 4 s.h.
Calculus or mathematics leading to calculus 5-10 s.h.

Second-semester science courses:

BIOL:1411 Foundations of Biology 4 s.h.
CHEM:1120 Principles of Chemistry II 4 s.h.
Calculus (if not taken during the first semester) 5 s.h.

Bachelor of Arts

The Bachelor of Arts with a major in biology requires a minimum of 120 s.h., including at least 62-73 s.h. of work for the major. Students must maintain a g.p.a. of at least 2.00 in all courses for the major and in all UI courses for the major. They also must complete the College of Liberal Arts and Sciences General Education Program.

The major for the Bachelor of Arts prepares students for graduate study in the biological sciences and is especially appropriate for those interested in careers in biological science education at all levels. It also provides suitable preparation for professional positions in laboratory or field research or for professional study in medicine and other health-related fields.

The B.A. program is broadly based. It introduces students to key concepts in important areas of biology and, compared to the B.S. program, provides more flexibility in choosing elective courses. Students working toward a Bachelor of Arts must complete the chemistry/physics/math foundation; the biology core; one course from each of three breadth menus; one course with a laboratory; and three elective courses, which may include one course in the history or philosophy of science.

Students who wish to apply transfer credit toward graduation with a major in biology should consult their biology advisor.

CHEMISTRY/PHYSICS/MATHEMATICS FOUNDATION

All of these:

CHEM:1110 & CHEM:1120 Principles of Chemistry I-II 8 s.h.
CHEM:2210 Organic Chemistry I 3 s.h.

One of these:

BIOL:3110 Biochemistry 3 s.h.
CHEM:2220 Organic Chemistry II 3 s.h.

One of these sequences:

PHYS:1511-PHYS:1512 College Physics I-II 8 s.h.
PHYS:1611-PHYS:1612 Introductory Physics I-II 8 s.h.

One of these:

MATH:1460 Calculus for the Biological Sciences 4 s.h.

One of these:

MATH:1550 Engineering Mathematics I: Single Variable Calculus 4 s.h.
MATH:1850 Calculus I 4 s.h.

BIOL:1411-BIOL:1412 Foundations of Biology - Diversity of Form and Function 8 s.h.
BIOL:2512 Fundamental Genetics 4 s.h.
BIOL:3172 Evolution 4 s.h.

BIOLOGY CORE

All of these:

BIOC:3140 Experimental Biochemistry 2 s.h.
EES:3210 Principles of Paleontology 3 s.h.
MIRC:2157 General Microbiology 5 s.h.
Iowa Lakeside Laboratory courses (students consult their advisors) 4-5 s.h.

BREADTH MENUS

Students must complete at least one course from each of the following three breadth menus.

Molecular and Cellular Biology

BIOL:2723 Cell Biology 3 s.h.
BIOL:2753 Introduction to Neurobiology 3 s.h.
BIOL:3314 Genomics 3 s.h.
BIOL:3713 Molecular Genetics 4 s.h.

Developmental Biology and Physiology

BIOL:2254 Endocrinology 3 s.h.
BIOL:3233 Introduction to Developmental Biology 3 s.h.
BIOL:3343 Animal Physiology 3 s.h.
BIOL:3363 Plant Developmental Biology 3 s.h.
BIOL:3663 Plant Response to the Environment 3 s.h.

Ecology and Evolutionary Biology

BIOL:2374 Biogeography 3 s.h.
BIOL:2673 Ecology 3 s.h.
BIOL:4273 Population Genetics and Molecular Evolution 3 s.h.

COURSE WITH A LABORATORY

One of these (must not have been used as a breadth menu course):

BIOL:2346 Vertebrate Zoology 4 s.h.
BIOL:3244 Animal Behavior 5 s.h.
BIOL:3626 Cell Biology Laboratory 4 s.h.
BIOL:3656 Neurobiology Laboratory 4 s.h.
BIOL:3676 Evolution Lab 4 s.h.
BIOL:3716 Genetics and Biotechnology Lab 4 s.h.
BIOL:3736 Developmental Biology Lab 4 s.h.
BIOL:4999 Honors Investigations 6 s.h.
BIOC:3140 Experimental Biochemistry 2 s.h.
EES:3210 Principles of Paleontology 3 s.h.
MICR:2157 General Microbiology 5 s.h.

ELECTIVES

Students complete at least three elective courses, which may include any course chosen from a breadth menu or from the list of courses with a laboratory that has not been used to satisfy those requirements, any other 2-4 s.h.
course numbered 2000 or above except for BIOL:2211 Genes, Genomes, and the Human Condition offered by the Department of Biology, any approved advanced biology course taught at Iowa Lakeside Laboratory (students should consult their advisors), and/or any course(s) chosen from the following list.

ANTH:3307 Modern Human Origins 3 s.h.
ANTH:3310 Primate Behavior: Sex Lives of Apes and Monkeys 3 s.h.
ANTH:3322 Primate Evolutionary Biology 3 s.h.
ANTH:3325 Human Evolutionary Genetics 3 s.h.
ASP:3160 Biology of Aging 3 s.h.
EES:3070 Marine Ecosystems and Conservation 3 s.h.
EES:3220 Evolution of the Vertebrates 3 s.h.
EES:4700 Evolution of Ecosystems 3 s.h.
HHP:4130 Skeletal Muscle Physiology 3 s.h.
MIRC:3147 Survey of Immunology 3 s.h.

One of the electives may be chosen from these:

GEOG:3110/GHS:4111 Geography of Health 3 s.h.
HIST:4160/GHS:4160 History of Public Health 3 s.h.
HIST:4162/GHS:4162 History of Global Health 3 s.h.
HIST:4419 Ancient and Medieval Science 3 s.h.
PHIL:3604 Introduction to Philosophy of Science 3 s.h.

In addition, students who have passed CHEM:2210 Organic Chemistry I, CHEM:2220 Organic Chemistry II, and BIOC:3110 Biochemistry may use BIOC:3110 Biochemistry as a biology elective. Students may count BIOL:3994 Introduction to Research (maximum of 3 s.h.) and BIOL:4897 Advanced Teaching Internship in Biology (maximum of 2 s.h.) only once toward the B.A. elective requirement.

**Suggested Schedule for First-Year Science Courses**

The following first-year schedule of science courses is recommended for all biology majors (B.A. or B.S. students).

First-year science courses:

CHEM:1110 Principles of Chemistry I 4 s.h.
CHEM:1110 Principles of Chemistry I 4 s.h.
MATH:1460 Calculus or mathematics leading to calculus 5-10 s.h.

Second-year science courses:

BIOL:1411 Foundations of Biology 4 s.h.
CHEM:1120 Principles of Chemistry II 4 s.h.
Calculus (if not taken during the first semester) 5 s.h.

**B.A. or B.S. with Teacher Licensure**

Biology majors interested in earning licensure to teach in elementary and/or secondary schools must complete the College of Education's Teacher Education Program (TEP) in addition to the requirements for the major and all requirements for graduation. The TEP requires several College of Education courses and student teaching. Contact the Office of Education Services for details.

Students must satisfy all degree requirements and complete Teacher Education Program licensure before degree conferral.

Students with a strong interest in science teaching may complete a major offered by the Science Education Program. Students choose one of five emphases—biology, chemistry, earth science, physics, or all-science—and earn a Bachelor of Science degree. They may apply for admission to the Teacher Education Program. See Science Education in the Catalog.

**Four-Year Graduation Plan**

The following checkpoints list the minimum requirements students must complete by certain semesters in order to stay on the University’s Four-Year Graduation Plan. (Courses in the major are those required to complete the major; they may be offered by departments other than the major department.)

**Bachelor of Science**

**Before the third semester begins:** MATH:1460 Calculus for the Biological Sciences or MATH:1850 Calculus I or MATH:1550 Engineering Mathematics I: Single Variable Calculus, CHEM:1110 Principles of Chemistry I, CHEM:1120 Principles of Chemistry II, and BIOL:1411 Foundations of Biology

**Before the fifth semester begins:** BIOL:1412 Diversity of Form and Function, CHEM:2210 Organic Chemistry I, STAT:2010 Statistical Methods and Computing or STAT:3510 Biostatistics, and two other courses in the major

**Before the seventh semester begins:** BIOL:2512 Fundamental Genetics, BIOL:3172 Evolution, PHYS:1511 College Physics I and PHYS:1512 College Physics II or equivalents; five or six more courses in the major, including an investigative lab; and at least 90 s.h. earned toward the degree

**Before the eighth semester begins:** two or three more courses in the major

**During the eighth semester:** enrollment in all remaining course work in the major, all remaining General Education courses, and a sufficient number of semester hours to graduate

**Bachelor of Arts**

**Before the third semester begins:** MATH:1460 Calculus for the Biological Sciences or MATH:1850 Calculus I or MATH:1550 Engineering Mathematics I: Single Variable Calculus, CHEM:1110 Principles of Chemistry I, CHEM:1120 Principles of Chemistry II, and BIOL:1411 Foundations of Biology

**Before the fifth semester begins:** BIOL:1412 Diversity of Form and Function, CHEM:2210 Organic Chemistry I, STAT:2010 Statistical Methods and Computing or STAT:3510 Biostatistics, and three other courses in the major
During the eighth semester: enrollment in all remaining course work in the major, all remaining General Education courses, and a sufficient number of semester hours to graduate

**Honors in the Major**

Students majoring in biology have the opportunity to graduate with honors in the major. The Biology Honors Program introduces students to the pursuits of practicing scientists. Honors students associate with one of the department’s research groups and participate in an independent research project guided by a faculty member (the research supervisor).

Biology honors students write a thesis based on an interesting biological problem, which is usually identified by the research supervisor. The thesis should clearly document that the student has acquired the necessary experimental skills to address specific questions and test specific hypotheses related to the research problem. Honors Seminar in Biology (BIOL:4998), or an equivalent seminar, provides students with an ideal opportunity to improve their skills in seminar presentation and in writing scientific English. Throughout undergraduate residence, departmental honors students also may enroll in honors sections of courses offered by the Department of Biology and by other departments and programs.

To graduate with honors in the biology major, students must fulfill the following requirements:

- complete the requirements for a major in biology (either B.S. or B.A.) with a g.p.a. of at least 3.33 in all course work in the major taken at the University of Iowa (including all biology courses and cognates in chemistry, physics, biochemistry, mathematics, and statistics);
- complete 2 s.h. in either BIOL:4998 Honors Seminar in Biology or an advanced biology seminar course;
- complete a minimum of 6 s.h. (taken over two or more semesters) of BIOL:4999 Honors Investigations;
- write a brief research proposal summarizing the background and goals of their proposed honors research;
- upon completion of their research, submit an acceptable honors thesis; and
- give a brief oral presentation of their research findings to other biology honors students.

Students pursuing a B.S. in biology may apply 6 s.h. of BIOL:4999 Honors Investigations toward the experiential elective requirement in an appropriate track. Students pursuing a B.A. in biology may apply 6 s.h. of BIOL:4999 toward the required course with a laboratory and count the 2 s.h. earned in BIOL:4998 Honors Seminar in Biology toward the elective requirement.

Students who satisfy the requirements for honors in the biology major will also satisfy the Level Two: Learning by Doing requirement of the University Honors Curriculum.

Biology majors interested in graduating with honors in the major should contact the biology honors advisor as early as possible, preferably during their sophomore or junior year, so that they may be matched with an appropriate lab. Visit Biology Honors Program to learn more about honors study in the department.

**Joint B.A./M.A.T. with Science Education Subprogram**

Bachelor of Arts students interested in pursuing a graduate degree in teaching may apply to the joint Bachelor of Arts/Master of Arts in Teaching program offered by the College of Liberal Arts and Sciences and the College of Education. Designed for undergraduates majoring in biology, chemistry, environmental sciences, or physics, the joint program enables students to earn a B.A. and an M.A.T. in five years by beginning to earn graduate credit during their fourth year of undergraduate study and by counting up to 18 s.h. of qualifying credit toward both degrees. For more information, see "Joint B.A./M.A.T.: Science Education" in the Teaching and Learning (College of Education) section of the Catalog. Interested students should consult an advisor.

**Joint B.A./Graduate Degrees in Epidemiology**

Bachelor of Arts students majoring in biology who are interested in earning a Master of Science in epidemiology or a Master of Public Health with epidemiology subprogram may apply to the joint B.A./M.P.H. or joint B.A./M.S. program offered by the College of Liberal Arts and Sciences and the College of Public Health. The joint programs permit students to count 12 s.h. of credit toward the requirements of both degrees, enabling them to begin the study of public health before they complete the bachelor’s degree. For information about the M.P.H., see "Epidemiology Subprogram" in the Master of Public Health section of the Catalog; for information about the M.S. program, see Epidemiology in the Catalog.

**Minor**

The minor in biology requires a minimum of 15 s.h. in biology courses, including 12 s.h. in courses numbered 2000 or above offered by the Department of Biology at the University of Iowa or in approved Iowa Lakeside Laboratory courses. Students must maintain a cumulative g.p.a. of at least 2.00 in all courses for the minor and in all UI courses for the minor. Course work in the minor may not be taken pass/nonpass. Students may not count transfer courses as courses numbered 2000 or above.

**Graduate Programs of Study**

- Master of Science in integrated biology
- Doctor of Philosophy in integrated biology

The Department of Biology’s graduate programs in integrated biology emphasize original research and developing the skills essential for publishing and communicating research findings to the scientific community. These programs prepare students for careers in academic research, science education, industry, government, and a variety of other careers in which their scientific expertise can be used. 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.

When a new graduate student is admitted, he or she is assigned a temporary advisor. The student and advisor discuss the student’s educational background and
formulate a first-semester study plan before the student registers for courses. The programs allow each student to tailor course work to his or her research interest. Students may be advised to take specific course work in order to enhance their background in certain areas.

During the first year, students whose preparation in chemistry, genetics, mathematics, and physics does not meet the department's graduate entry requirements must perform deficiencies by taking appropriate course work.

Minimum entry requirements are:
- two semesters of organic chemistry, or one semester of organic chemistry and one semester of biochemistry;
- one semester of calculus;
- two semesters of college physics; and
- 20 s.h. of course work in biology.

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

**Master of Science**

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. Entering students are admitted only to the thesis program; the nonthesis degree is an exit program.

All M.S. students take a seminar (2 s.h.) with a substantial writing and oral presentation requirement and two advanced lecture-based courses in biology (or courses approved by the Graduate Affairs Committee). Students receive academic credit for courses required for an M.S. or Ph.D. but not for courses taken to remedy undergraduate deficiencies.

Thesis students may count a maximum of 9 s.h. of research credit toward the 30 s.h. required for the master's degree with thesis. Remaining course work is tailored to the student's background and career goals and is selected in consultation with the student's advisory committee. The thesis is based on original research. After the thesis is accepted by the student's supervisor and advisory committee, the student must pass an oral examination based on the thesis research and on related subjects.

Nonthesis students must write a library research report for a maximum of 4 s.h. of credit. They may apply up to 8 s.h. of research credit toward the 34 s.h. required for the master's degree without thesis.

Visit Integrated Biology Graduate Program for more detailed information about the Master of Science program.

**Doctor of Philosophy**

The Doctor of Philosophy in integrated biology requires a minimum of 72 s.h. of graduate credit.

New Ph.D. students will do three laboratory rotations with different faculty during their first semester (August-December). Students consult with their temporary advisors and with prospective faculty research sponsors before identifying their preferences for research rotations. Based on their rotations, they choose a laboratory affiliation for their thesis. This is done late in the first semester.

During the first year (both semesters), students are required to enroll in BIOL:6298 Concepts, Models, and Systems in Biology (COSMOS) Seminar, which introduces them to multiple levels of biological analysis and provides them with significant opportunities to hone their skills in written and oral communication. At the end of the first year, students take a qualifying exam that consists of essay questions based on major themes in biology. Students must perform satisfactorily on this exam in order to continue in the program.

During the first two years, students must enroll in at least two advanced lecture courses (or courses approved by the Graduate Affairs Committee), one seminar course (2 s.h.) that has a significant writing component, and BIOL:6188 Seminar: Writing in Natural Sciences.

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. Students must demonstrate knowledge of biology fundamentals and the analytic and synthetic skills necessary to become creative, independent scientists. Once they complete the course work and proficiency requirements and pass the comprehensive examination, students may be admitted to full candidacy for the Ph.D.

Ph.D. students must serve as teaching assistants for at least two semesters in order to develop and demonstrate teaching. The first teaching semester takes place during the spring of the student's first year and preceded by extensive departmental training in effective teaching skills.

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 Ph.D. is awarded.

Visit Integrated Biology Graduate Program for more detailed information about the Doctor of Philosophy program.

**Admission**

Individuals who wish to pursue graduate study in integrated biology may apply to the Doctor of Philosophy program or the Master of Science with thesis program. The M.S. without thesis is an exit program; it does not admit entering graduate students.

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

Applicants must hold a valid B.A. or B.S. from an accredited institution. Applicants should supply official transcripts from each undergraduate and graduate institution they have attended along with scores from the Graduate Record Examination (GRE) General Test (verbal,
quantitative, and analytical writing). The GRE Subject Test in biology or biochemistry is optional but not required. Applicants whose first language is not English must score at least 100 (Internet-based) on the Test of English as a Foreign Language (TOEFL) and have their score sent to the Office of Admissions. International applicants who received their degrees (either bachelor's or master's) from a U.S. institution are exempt from this requirement. All international students whose first language is not English are required to take the on-campus English Proficiency Evaluation before they first enroll for classes.

Successful applicants for graduate admission typically have a g.p.a. of at least 3.00 (on a 4.00 scale) and a Graduate Record Examination (GRE) General Test score above 1200 (combined verbal and quantitative) on the old GRE or 308 (combined verbal and quantitative) on the revised GRE. The admissions committee also considers letters of recommendation, research experience, and other appropriate criteria.

Although most applicants have completed undergraduate programs in biology, the department also considers applicants with backgrounds in related sciences, providing they have taken the required course work.

Students applying for admission to the M.S. with thesis research rotation period and by teaching assistantships. Student assistantships during the spring semester. M.S. students are supported by department fellowships or research assistantships available toward the Ph.D. receive stipend and tuition support from non-University of Iowa fellowships and from teaching assistantships or research assistantships available through individual research grants administered by faculty members or by the University. First-year Ph.D. students are supported by department fellowships during the research rotation period and by teaching assistantships during the spring semester. M.S. students generally are supported by available research or teaching assistantships. Offers of admission include information about offers of financial support.

Facilities include the Keck Dynamic Image Analysis Facility, which couples sophisticated state-of-the-art microscopy and computerized motion analysis to permit three-dimensional real-time analysis of cell movement in vitro and in situ. The Roy J. Carver Center for Genomics houses the department's DNA sequencing, oligo synthesis, quantitative PCR, functional genomics/microarray facilities, and informatics facilities. The Roy J. Carver Center for Imaging is a microscopy and imaging facility; its confocal microscope is available for teaching and research.

A large greenhouse is used in plant research and education.

The department also houses animal-care facilities suitable for mice, rats, rabbits, Xenopus laevis, and zebra fish. These facilities are managed by the University's animal care unit, which is accredited by the Association for Assessment and Accreditation of Laboratory Animal Care.

A central University facility provides assistance in the preparation of transgenic mice.

The department is home to the Developmental Studies Hybridoma Bank, which is affiliated with the National Institutes of Health. The hybridoma bank collects and distributes monoclonal antibodies that originate in laboratories all over the world. Its collection now contains more than 3,500 monoclonal antibodies that are distributed to users internationally for a modest fee.

In addition to departmental facilities, the University offers genomic sequencing service, a DNA oligonucleotide synthesis and enzyme lab, oligopeptide synthesis and sequencing equipment, and mass- and NMR spectroscopy facilities. The Center for Biocatalysis and Bioprocessing is available for growing large amounts of microorganisms (e.g., 100 liters) for use in protein isolation.

Iowa Lakeside Laboratory

The Iowa Lakeside Laboratory is a field station run cooperatively by the University of Iowa, Iowa State University, and the University of Northern Iowa. Located on West Lake Okoboji, in northwestern Iowa, the laboratory affords excellent conditions for summer study in field biology, limnology, phycology, aquatic ecology, pollination biology, and plant taxonomy. It offers a wide variety of summer courses at the undergraduate and graduate levels. Students should check with their advisors to determine whether specific courses may be counted toward requirements for graduation. See Iowa Lakeside Laboratory (University College) in the Catalog or visit the Lakeside Laboratory web site.

Courses

Many courses include laboratory, discussion, and/or field components.

Lower-Level Undergraduate

BIOL:1411 Foundations of Biology 4 s.h.

Unifying concepts of living systems; emphasis on common properties and processes; chemical and cellular basis of life, genetics, and evolution. Prerequisites: CHEM:1110. GE: Natural Sciences with Lab.
Biology

**BIOL:1412 Diversity of Form and Function**  4 s.h.
Underlying unifying concepts of life; emphasis on diversity of living systems; the tree of life, cellular evolution, prokaryotic and eukaryotic diversity, plant and animal form and function; interactions among diverse forms of life and their environment. Prerequisites: BIOL:1411. Requirements: grade of C- or higher in BIOL:1411. GE: Natural Sciences with Lab.

**BIOL:1808 Ways of Knowing Science**  1 s.h.
Science as a powerful way of knowing based on experimentation and observation of natural world; introduction to subdisciplines of scientific research; scope and methods of scientific research; questions that scientific research seek answers for; methods that scientists use to obtain answers to their questions; how science affects us personally and how it affects the rest of society; research seminars, discussion, and exploration.

**BIOL:2254 Endocrinology**  3 s.h.
Production and effect of hormonal chemical messengers of secretory glands; emphasis on cell signaling in vertebrate systems; actions of hormones in regulating growth, physiology, and reproduction; organ to molecular levels. Prerequisites: BIOL:1411 and BIOL:1412. Recommendations: CHEM:2210.

**BIOL:2346 Vertebrate Zoology**  4 s.h.
Vertebrate diversity, success in relation to evolutionary history, and adaptive radiation of fish, amphibians, reptiles, birds, mammals; physiological, morphological, behavioral, life history adaptations; vertebrate zoogeography, systematics, patterns of reproduction, social systems. Prerequisites: BIOL:1411 and BIOL:1412.

**BIOL:2374 Biogeography**  3 s.h.
Patterns of plant and animal distribution and their interpretation; historical geography including glaciation and plate tectonics; ecological geography, including physical factors (e.g., climate and geology); applications to conservation in diverse regions. Prerequisites: GEOG:1020 or BIOL:1141 or BIOL:1261 or BIOL:1370 or BIOL:1412. Same as GEOG:2374.

**BIOL:2512 Fundamental Genetics**  4 s.h.

**BIOL:2603 Mechanisms of Aging**  3 s.h.
Evolutionary theories of aging, cellular and genetic basis of aging and repair, disruption of homeostasis in aging; focus on studies of biological and environmental causes of age-related diseases. Prerequisites: BIOL:1411 and (BIOL:1412 or HHP:3500).

**BIOL:2673 Ecology**  3-4 s.h.
Adaptations of organisms to their physical and biological environments; organism-environment interactions; population biology; interactions between species; ecology of communities, ecosystems; human impact on ecosystems. Prerequisites: BIOL:1411 and BIOL:1412 and (MATH:1460 or MATH:1550 or MATH:1850). Recommendations: a basic statistics course. Same as ENVS:2673.

**BIOL:2723 Cell Biology**  3 s.h.
Structures of cells and organelles in relation to their functions at molecular, cellular levels; emphasis on higher eukaryotic cells. Prerequisites: BIOL:1411 and BIOL:1412 and CHEM:1120.

**BIOL:2753 Introduction to Neurobiology**  3 s.h.
Techniques of molecular biology, genomics, neuropharmacology, and functional brain imaging applied to understanding how the brain works. Prerequisites: BIOL:1411 and BIOL:1412.

**Elementary Topics of General Interest, Lower-Level Undergraduate**
These courses are not open to graduate students and do not provide credit toward a biology major.

**BIOL:1000 First-Year Seminar**  1 s.h.
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities, field trips). Requirements: first- or second-semester standing.

**BIOL:1060 Origins of Life in the Universe (Part 1)**  3 s.h.
Fundamental questions (How old is the universe? What is the nature of life? How has life evolved on Earth? What are our human origins? Are there other habitable planets in the universe?) that revolve around understanding origins from different perspectives (i.e., astronomy, physics, geoscience, biology, chemistry, anthropology); work with faculty from several departments to investigate these questions; inquiry-based activities to build success in critical thinking, teamwork, effective written and oral communication; origin of the universe, biochemistry of life, and origin of life on Earth; first of a two-part sequence. Recommendations: first-year or sophomore standing. GE: Natural Sciences without Lab. Same as ASTR:1060, EES:1060.

**BIOL:1061 Origins of Life in the Universe (Part 2)**  4 s.h.
Fundamental questions (What is the nature of life? What is evolution and how has life evolved on Earth? What are our human origins? Are there other habitable planets in the universe?) that revolve around understanding origins from different perspectives (astronomy, physics, geoscience, biology, chemistry, anthropology); students work with faculty from several departments to investigate these questions; inquiry-based activities build success in critical thinking, teamwork, and effective written and oral communication; second of a two-part sequence. GE: Natural Sciences with Lab. Same as ASTR:1061, ANTH:1061, EES:1061.
BIOL:1140 Human Biology 4 s.h.
Molecular and cellular basis of human life; integration of humans and the biosphere through photosynthesis, respiration; structure, function of human tissues, organs, organ systems; reproduction, genetics, impact of molecular biology and genetic engineering; lecture, laboratory. GE: Natural Sciences with Lab.

BIOL:1141 Introductory Animal Biology 4 s.h.
Fundamental principles: cells and macromolecules, energy metabolism, organismic physiology, genetics, development, ecology, and evolution. Requirements: one year of high school chemistry. Recommendations: CHEM:1070. GE: Natural Sciences with Lab.

BIOL:1251 How the Brain Works (and Why it Doesn't) 3-4 s.h.
Introductory survey of neuroscience; structure and function of the brain; nature of consciousness; brain function in mental illness and degenerative disorders; genes and the mind; perception, sensation, memory, and emotions. Requirements: non-biology major. GE: Natural Sciences without Lab.

BIOL:1260 Plants and Human Affairs 2-3 s.h.
How plants are useful to people: food, clothing, shelter, medicines, psychoactive agents; plants' social, economic, ecological significance. GE: Natural Sciences without Lab.

BIOL:1261 Introduction to Botany 4 s.h.
Biology of plant life; emphasis on structure, function, reproduction, inheritance, diversity, evolution. Requirements: one year of high school chemistry. GE: Natural Sciences without Lab.

BIOL:1311 Human Genetics in the Twenty-First Century 3 s.h.
Organization and inheritance of human genes and genomes; genetic basis of simple and complex traits; genetic aspects of cancer; paleogenomics and tracing human migrations with DNA. GE: Natural Sciences without Lab. Same as ANTH:1310.

BIOL:1360 Spring Flora 3 s.h.
Recognition and identification of spring-flowering herbaceous plants, native woodland trees and shrubs, woody landscape plants; family characteristics, use of taxonomic key.

BIOL:1370 Understanding Evolution 3 s.h.
Evolution and diversity of living things, their patterns on Earth, their organization in ecological systems; dynamics of evolutionary processes. GE: Natural Sciences without Lab.

BIOL:2211 Genes, Genomes, and the Human Condition 3 s.h.
Organization, expression, and evolution of genes in context of genomes; focus on human genome; distribution and transmission of variation in human population. Prerequisites: BIOL:1411. Recommendations: BIOL:1412.

Upper-Level Undergraduate and Graduate

BIOL:3172 Evolution 4 s.h.
Nature, evidence, analysis, implications, molecular/genetic basis; historical record, phylogeny, speciation, adaptation, investigative methods. Prerequisites: BIOL:1411 and BIOL:1412 and BIOL:2512 and (MATH:1460 or MATH:1550 or MATH:1850 or STAT:2010 or STAT:3510). Requirements: grade of C- or higher in BIOL:2512.

BIOL:3233 Introduction to Developmental Biology 3 s.h.
Fundamental mechanisms in differentiation, organogenesis, morphogenesis; and pattern formation; mechanistic approach at molecular, cellular, tissue levels of organizations. Prerequisites: BIOL:1412 and CHEM:1120. Requirements: grade of C- or higher in BIOL:1412. Recommendations: BIOL:2512.

BIOL:3244 Animal Behavior 3.5 s.h.
Genetics, sensory physiology, migration, development of behavior, circadian rhythms, foraging strategies, aggression, sexual and parental behavior, group selection, social behavior. Prerequisites: BIOL:1411 and BIOL:1412.

BIOL:3253 Neurobiology 4 s.h.
Cellular neurobiology (cytoskeleton and transport, membrane physiology, synaptic transmission and plasticity, sensory transduction); systems neurobiology (peripheral and central sensory processing, autonomic and somatic motor systems); cognitive neurobiology (emotion, biological rhythms and sleep, memory, attention, language); developmental neurobiology. Prerequisites: BIOL:2753. Recommendations: BIOL:2723 and BIOL:3110.

BIOL:3314 Genomics 3 s.h.
Major areas of genomics, including DNA and protein sequence analysis, structural diversity of whole genomes, microarray applications, proteomics; computer workshop experience in applying bioinformatics tools. Prerequisites: BIOL:2512 or BIOL:3120.

BIOL:3343 Animal Physiology 3 s.h.
Principles of cellular and systems physiology; emphasis on experimental and quantitative aspects. Prerequisites: BIOL:1411 and BIOL:1412 and (PHYS:1511 or PHYS:1611). Corequisites: PHYS:1512 or PHYS:1612, if not taken as a prerequisite.

BIOL:3363 Plant Developmental Biology 3 s.h.
Developmental processes throughout life cycle of vascular plants; current knowledge of mechanisms, control; emphasis on molecular and genetic approaches to studying development. Prerequisites: BIOL:2512.

BIOL:3373 Human Population Genetics and Variation 3 s.h.
Principles of evolutionary change of genes and genomes applied to human populations and to comparisons between humans and their closest primate relatives; emphasis on consequences of mutation, natural selection, and demographic changes. Prerequisites: BIOL:2211 or BIOL:2512. Requirements: grade of C- or higher in BIOL:2211 or BIOL:2512, or graduate standing.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisites/Recommendations</th>
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<tr>
<td>BIOL:3626</td>
<td>Cell Biology Laboratory</td>
<td>4 s.h.</td>
<td>Conceptual understanding and technical skills in fluorescence microscopy and digital imaging, mammalian cell culture, tissue fractionation, centrifugation, electrophoresis, and expression of recombinant proteins.</td>
<td>Prerequisites: BIOL:1411 and BIOL:1412 and BIOL:2723.</td>
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<tr>
<td>BIOL:3656</td>
<td>Neurobiology Laboratory</td>
<td>4 s.h.</td>
<td>Principles and practice of neurobiology research, including microscopy and imaging, cellular and molecular neurobiology, and electrophysiology.</td>
<td>Prerequisites: BIOL:2753.</td>
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<tr>
<td>BIOL:3663</td>
<td>Plant Response to the Environment</td>
<td>3 s.h.</td>
<td>Mechanisms of plant responses to environmental factors (biotic and abiotic) at organismal and molecular levels.</td>
<td>Prerequisites: BIOL:2512 or BIOL:3120.</td>
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<tr>
<td>BIOL:3676</td>
<td>Evolution Lab</td>
<td>4 s.h.</td>
<td>Methods of sampling and describing variation in natural populations; application of molecular genetic, bioinformatic, and computational techniques to describe genetic variation through sequence analysis; use of controlled laboratory experiments and computer simulations to illustrate evolutionary principles.</td>
<td>Prerequisites: BIOL:2512. Corequisites: BIOL:3172, if not taken as a prerequisite. Recommendations: grade of C or higher in BIOL:3172.</td>
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<tr>
<td>BIOL:3713</td>
<td>Molecular Genetics</td>
<td>4 s.h.</td>
<td>Mechanism, regulation of RNA, DNA, protein biosynthesis, with emphasis on methods of genetic analysis; application of modern recombinant DNA techniques to basic problems.</td>
<td>Requirements: BIOL:2512 or BIOL:3120 or first-year graduate standing.</td>
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<tr>
<td>BIOL:3716</td>
<td>Genetics and Biotechnology Lab</td>
<td>4 s.h.</td>
<td>Expansion of genetic concepts introduced in BIOL:2512; introduction to genetic/molecular techniques currently used in genetic analysis and biotechnology.</td>
<td>Corequisites: BIOL:2512, if not taken as a prerequisite. Recommendations: grade of C or higher in BIOL:2512.</td>
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<tr>
<td>BIOL:3736</td>
<td>Developmental Biology Lab</td>
<td>4 s.h.</td>
<td>Experimental manipulation of embryos to examine mechanisms of early development, including gametogenesis and fertilization, cleavage, gastrulation, pattern formation and organogenesis; in vivo imaging of development, methods to visualize gene expression and independent research; model organisms including sea urchin, fish, frog, chick, mouse.</td>
<td>Prerequisites: BIOL:2512 and BIOL:3233.</td>
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<tr>
<td>BIOL:3743</td>
<td>Basic Biology of Human Disease</td>
<td>2 s.h.</td>
<td>Basic problems of infectious disease; selected viral, bacterial, and fungal pathogens, with emphasis on fungal pathogenesis; DNA fingerprinting; epidemiological study of disease dynamics.</td>
<td>Prerequisites: BIOL:2512.</td>
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<tr>
<td>BIOS:3898</td>
<td>Teaching Internship in Biology</td>
<td>2 s.h.</td>
<td>Training in teaching the laboratory component of a large General Education biology course; weekly session with instructor, shadowing and assisting a graduate teaching assistant in a lab section, leading laboratory exercises.</td>
<td>Prerequisites: BIOL:1411 and BIOL:1412. Requirements: grades of B or higher in BIOL:1411 and BIOL:1412, and junior or senior standing.</td>
</tr>
<tr>
<td>BIOL:3994</td>
<td>Introduction to Research</td>
<td>2-3 s.h.</td>
<td>Conduct independent scientific research related to the field of biology.</td>
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<tr>
<td>BIOL:4213</td>
<td>Bioinformatics</td>
<td>4 s.h.</td>
<td>Overview of bioinformatics topics, including access to sequence data, pairwise and multiple sequence alignment algorithms, molecular phylogeny, microarray data analysis, protein analysis, proteomics and protein structure analysis; emphasis on each topic includes biological motivation, computational approach (practical and theoretical), and interpretation of output.</td>
<td>Prerequisites: BIOL:2512 or BIOL:3120. Requirements: grade of B+ or higher in BIOL:2512 or BIOL:3120, or graduate standing. Same as GENE:6170.</td>
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<tr>
<td>BIOL:4273</td>
<td>Population Genetics and Molecular Evolution</td>
<td>3 s.h.</td>
<td>Nucleotide sequences, genes, and mutation; rates and patterns of nucleotide substitution; selection at the molecular level and the neutral theory; population genetics theory; genome evolution. Requirements: grade of C- or higher in BIOL:2211 or BIOL:2512, or graduate standing. Recommendations: grade of C- or higher in BIOL:3172.</td>
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<tr>
<td>BIOL:4316</td>
<td>Summer Practicum in Genomics</td>
<td>2 s.h.</td>
<td>Major areas of genomics, including sequence similarity searching, whole genome comparisons, phylogenetic analysis, and regulatory informatics; computer workshop experience in application of bioinformatics tools.</td>
<td>Prerequisites: BIOL:3314 or BIOL:4213 or GENE:6170.</td>
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<tr>
<td>BIOL:4333</td>
<td>Genes and Development</td>
<td>3 s.h.</td>
<td>Mechanisms by which genes control development of multicellular animals; methodology of scientific research applied to developmental genetics. Requirements: grade of B or higher in BIOL:2512. Recommendations: BIOL:3233.</td>
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<tr>
<td>BIOL:4353</td>
<td>Neurophysiology</td>
<td>3-4 s.h.</td>
<td>Physiological properties of nerve cells, nervous systems; axonal conduction, synaptic transmission, sensory transduction, integrative processes, higher functions.</td>
<td>Prerequisites: (BIOL:2753 or BIOL:3253) and (MATH:1460 or MATH:1850) and (PHYS:1512 or PHYS:1612). Same as NSCI:4353.</td>
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<tr>
<td>BIOL:4373</td>
<td>Molecular Phylogenetics</td>
<td>3 s.h.</td>
<td>Theory underlying phylogenetic analysis with application of these methods to molecular data sets; analysis of multigene data, organellar, and nuclear genome sequences to reconstruct the history of cells. Requirements: grade of C- or higher in BIOL:3172 or graduate standing.</td>
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</table>
BIOL:4753 Developmental Neurobiology 3 s.h.
Neural induction and nervous system patterning; neurogenesis, axon and dendrite outgrowth and targeting; synapse formation, specificity, refinement; mechanisms of neuronal cell death; myelination; neural stem cells; introduction to cellular, molecular, and genetic techniques in studies of neural development. Prerequisites: BIOL:2753. Corequisites: BIOL:3253. Requirements: grade of B- or higher in BIOL:2753 or graduate standing. Same as MPB:4753, NSCI:4753.

BIOL:4897 Advanced Teaching Internship arr.
Teaching the laboratory component of a large introductory-level biology course; weekly training session with instructor; shadowing and assisting a graduate teaching assistant in a weekly lab section. Prerequisites: BIOL:1411 and BIOL:1412. Requirements: grades of B- or higher in BIOL:1411 and BIOL:1412, junior or senior standing, and interview with instructor.

BIOL:4898 Communicating Research 1 s.h.
Independent, investigative research experience; research process and communication—establishing goals and expectations with a mentor, developing and framing a research hypothesis or question, communicating results in written and oral form to scientist and nonscientist audiences; supportive learning environment to share research experiences and develop identities as scientists, learn skills to become effective independent researchers and science communicators. Corequisites: BIOL:3994 or BIOL:4999.

BIOL:4998 Honors Seminar in Biology 2 s.h.
Requirements: honors standing.

BIOL:4999 Honors Investigations arr.
Conduct independent scientific research related to the field of biology. Requirements: honors standing in biology, UI g.p.a. of at least 3.33, and biology g.p.a. of at least 3.33.

Graduate

BIOL:5117 Topics in Molecular Genetics 1-2 s.h.
Requirements: grade of C+ or higher in BIOL:2512 or graduate standing.

BIOL:5127 Topics in Cell and Development 1-2 s.h.

BIOL:5157 Topics in Neurobiology 1-2 s.h.
Topics vary. Requirements: BIOL:3253 or graduate standing.

BIOL:5177 Topics in Evolution and Ecology 1-2 s.h.
Requirements: grades of B- or higher in BIOL:2512 and BIOL:3172, or graduate standing.

BIOL:5199 Critical Readings in Biology arr.

BIOL:5211 Genes, Genomes, and the Human Condition Graduate Lecture 3 s.h.
Organization, expression, and evolution of genes in context of genomes; focus on human genome; distribution and transmission of variation in human population. Recommendations: BIOL:1411 highly recommended.

BIOL:5218 Microscopy for Biomedical Research arr.
Basic microscopy methods for research including optics, preparation, and analysis of biomedical specimens; light, fluorescence, confocal, transmitting electron, scanning electron, atomic force microscopes, elemental analysis; immunohistochemistry and stereology techniques; individualized laboratory instruction. Prerequisites: BIOL:2723. Same as ACB:5218, MICR:5218.

BIOL:5220 Advanced Microscopy for Biomedical Research arr.
Technically advanced microscopy and instrumentation for research; individualized laboratory experience with opportunity to explore applications of microscopy methods. Requirements: for ACB:5220 — an introductory microscopy course; for BIOL:5220 — ACB:4156 or ACB:5218 or CBE:4156 or EES:4156 or MICR:5218; for MICR:5220 — an introductory EM course. Same as ACB:5220, MICR:5220.

BIOL:5270 Biosciences Critical Thinking and Communication 2 s.h.
Selected papers and oral and written presentations tied to students' research rotations; introductory seminar. Same as BISC:5265, MPB:5342.

BIOL:5289 Research Method and Theory 2 s.h.
Materials and methods of scientific investigation; lab techniques; library resources usage, NCBI database training; lab safety; research ethics; reading, writing, presenting scientific papers. Requirements: new graduate standing in biology.

BIOL:5320 Computational Genomics 3 s.h.
Introduction to computational methods used in genome analysis and functional genomics; biological sequence analysis, sequence database search, microarray data analysis, biological network analysis; in-depth coverage of principal genome science challenges and recent solutions. Prerequisites: BME:5320 and CS:3110 and (BIOS:4120 or STAT:3510). Same as BME:5330, GENE:5173, ECE:5220.

BIOL:5412 Fundamental Genetics—Graduate Lecture 3 s.h.

BIOL:5512 Fundamental Genetics—Graduate Discussion 1 s.h.
Critical evaluation of classic genetics papers. Requirements: biology graduate standing.

BIOL:5653 Fundamental Neurobiology 4 s.h.
Neurobiology from molecular/cellular to systems levels, including cell biology of neuron; membrane electrophysiology, synaptic transmission and plasticity, functional neuroanatomy, sensory systems from periphery to CNS, peripheral and central motor systems, autonomic systems emotion, memory, sleep, language, attention and cognition, development of nervous system; discussion of classic and recent journal articles. Same as PSY:5203, NSCI:5653.
BIOL:6188 Seminar: Writing in Natural Sciences 2 s.h.
Writing and critiquing skills in the natural sciences.

BIOL:6199 Research: Biology arr.

BIOL:6265 Neuroscience Seminar 0-1 s.h.
Research presentations. Offered fall and spring semesters. Same as PSY:6265, ACB:6265, MPB:6265, NSCI:6265.

Primary research on central biological questions utilizing full array of organisms and analytical approaches; opportunity to improve skills in public speaking, presentation, and scientific writing. Requirements: integrated biology graduate standing.

BIOL:6759 Molecular Neurobiology of Hearing Development, Function, and Disease 3 s.h.
Up-to-date overview of auditory system, function, and development; molecular basis for development, function, and disease; auditory system as basis for most human communication; prominent functional reduction during senescence; structure, function, development, and disease mechanisms that provide long-term solutions to cure or prevent beyond currently available treatment of hearing loss with a cochlear implant; series of lectures organized to provide an overview of various aspects of this system. Prerequisites: BIOL:3253.

BIOL:6899 Independent Study in Biology arr.