Biology, B.S.

Learning Outcomes
Graduates with a bachelor’s degree in biology will be able to demonstrate the following.

• Foundational Knowledge: Comprehension of Fundamental Principles and Concepts of Biology
  Graduates will be able to:
  - explain fundamental biological principles within and across levels of organization, from molecules to ecosystem;
  - apply foundational knowledge and conceptual frameworks to new situations;
  - recognize the consequences of evolutionary history in contrasts between living organisms;
  - appreciate the historical sequence and significant achievements of biological discovery; and
  - evaluate new information reported in the news and/or in scientific publications against prior knowledge.

• New Discovery: Scientific Reasoning and Experimental Process in Biology
  Graduates will be able to:
  - perform basic laboratory procedures, including correct operation of devices;
  - formulate questions about biological processes based on current knowledge;
  - construct a hypothesis to guide experimental enquiry;
  - design experiments, identifying variables of analysis and controls for error;
  - consider appropriate strategies or technologies applicable to investigate a novel problem;
  - collect, organize, summarize, and interpret biological data;
  - analyze and evaluate experimental results to inform a hypothesis; and
  - distinguish between necessary and sufficient causes.

• Quantitative Skills: Mathematical Reasoning and Basic Numeracy Applied to Biology
  Graduates will be able to:
  - perform essential mathematical operations such as unit conversions, dilutions, and molarity calculations;
  - apply mathematical concepts and rules of probability to make predictions;
  - select and apply appropriate statistical tests to determine significance of experimental results; and
  - use mathematical and/or statistical expressions to evaluate hypotheses with experimental data.

• Information Literacy: Acquisition, Analysis, and Summary of Published Biological Information
  Graduates will be able to:
  - locate and evaluate the relevance and credibility of information from electronic and print sources;
  - navigate and obtain relevant information from public databases;
  - recognize and appropriately cite sources of information;
  - identify questions addressed and methodologies used; and
  - assess findings reported and conclusions drawn in published scientific articles.

• Communication Proficiency: Written and Oral Presentation of Biological Information
  Graduates will be able to:
  - write concise scientific reports based on findings or literature searches;
  - construct visual presentations of results or findings from the scientific literature; and
  - orally present findings or results from the literature with appropriate media.

Overview
All biology majors complete the chemistry/mathematics foundation and the biology core. In addition, B.S. students complete physics foundation courses and choose one of four 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 Research in Biology (requires membership in the Biology Honors Program). Students associate with one of the department's research groups for experiments, discuss current research, study specialized topics, and attend 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.

Requirements
The Bachelor of Science with a major in biology requires a minimum of 120 s.h., including at least 73-82 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.

Students who wish to apply transfer credit toward graduation with a major in biology should consult their biology advisor. They also must complete the College of Liberal Arts and Sciences GE CLAS Core.

Students must complete the chemistry/mathematics/physics foundation, the biology core, and one of four tracks. The four tracks emphasize dynamic and active areas in the biological sciences. Three of the tracks—cell and developmental biology, genetics and biotechnology, and neurobiology—emphasize distinct areas. The fourth track—integrative biology—provides highly diverse content.

The B.S. with a major in biology requires the following course work.
### Chemistry/Mathematics/Physics Foundation

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Chemistry/Mathematics/Physics Foundation Courses</strong></td>
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<tr>
<td></td>
<td>Biology Core Courses</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Track Courses</td>
<td>29-38</td>
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<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>73-82</td>
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### Biology Core

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<tr>
<th>Code</th>
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<tr>
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<tr>
<td></td>
<td><strong>Biology Core Courses</strong></td>
<td>15</td>
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<td><strong>Track Courses</strong></td>
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<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>73-82</td>
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</tbody>
</table>

### Track Courses

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<tr>
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<tbody>
<tr>
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<td></td>
<td><strong>Track Courses</strong></td>
<td>29-38</td>
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<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>73-82</td>
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</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td></td>
<td><strong>Chemistry/Mathematics/Physics Foundation Courses</strong></td>
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<td></td>
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<td></td>
<td><strong>Track Courses</strong></td>
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<td><strong>Total Hours</strong></td>
<td>73-82</td>
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### Experiential Elective

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<td><strong>Chemistry/Mathematics/Physics Foundation Courses</strong></td>
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<tr>
<td></td>
<td><strong>Biology Core Courses</strong></td>
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<td></td>
<td><strong>Track Courses</strong></td>
<td>29-38</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
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### Electives

At least four of these, with a minimum of one course numbered 3000 or above:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Chemistry/Mathematics/Physics Foundation Courses</strong></td>
<td></td>
</tr>
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<td></td>
<td><strong>Biology Core Courses</strong></td>
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<tr>
<td></td>
<td><strong>Track Courses</strong></td>
<td>29-38</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td>73-82</td>
</tr>
</tbody>
</table>

### Tracks

Bachelor of Science students must select a single track. Each track includes nine 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 Teaching Internship in Biology must complete a minimum of 4 s.h. in that course.
BIOL:3233  Introduction to Developmental Biology (if not taken as a track course) 3
BIOL:3253  Neurobiology 4
BIOL:3314  Genomics 3
BIOL:3343  Animal Physiology 3
BIOL:3363  Plant Developmental Biology (if not taken as a track course) 3
BIOL:3663  Plant Response to the Environment 3
BIOL:3713  Molecular Genetics 4
BIOL:3753  Developmental Neurobiology 3
BIOL:4333  Genes and Development 3

**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 fields related to genetics or to enter the modern biotechnology industry. It also provides excellent preparation for professional study in medicine and other health-related fields.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>BIOL:3172</td>
<td>Evolution</td>
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</tr>
<tr>
<td>BIOL:3314</td>
<td>Genomics</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3713</td>
<td>Molecular Genetics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3716</td>
<td>Genetics and Biotechnology Lab</td>
<td>4</td>
</tr>
</tbody>
</table>

One of these:

- BIOL:3172  Evolution 4
- BIOL:3314  Genomics 3

- BIOL:3713  Molecular Genetics 4

Expansive Electives

One of these:

- BIOL:3626  Cell Biology Laboratory 4
- BIOL:3676  Evolution Lab 4
- BIOL:3736  Developmental Biology Lab 4
- BIOL:3994  Introduction to Research - Communicating Research (BIOL:3994 must be taken for a total of 5 s.h.) 6
- BIOL:4213  Bioinformatics 4
- BIOL:4897  Teaching Internship in Biology (must be taken two different semesters for a total of 4 s.h.) 4
- BIOL:4999  Honors Research in Biology 6

**Electives**

At least three of these, with a minimum of one course numbered 3000 or above:

- BIOL:2254  Endocrinology 3
- BIOL:2603  Mechanisms of Aging 3
- BIOL:2673  Ecology 3
- BIOL:2753  Introduction to Neurobiology 3
- BIOL:3233  Introduction to Developmental Biology 3
- BIOL:3244  Animal Behavior 3,5
- BIOL:3253  Neurobiology 4
- BIOL:3343  Animal Physiology 3
- BIOL:3363  Plant Developmental Biology 3
- BIOL:3373  Human Population Genetics and Variation 3
- BIOL:3383  Introduction to Systems Biology 3
- BIOL:3663  Plant Response to the Environment 3
- BIOL:4333  Genes and Development 3
- BIOL:4373  Molecular Evolution: Genes, Genomes, and Organisms 3

**Integrative Biology Track**

The integrative 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.

<table>
<thead>
<tr>
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<tr>
<td>BIOL:2673</td>
<td>Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3172</td>
<td>Evolution</td>
<td>4</td>
</tr>
</tbody>
</table>

One of these:

- BIOL:3172  Evolution 4
- BIOL:3314  Genomics 3

- BIOL:3713  Molecular Genetics 4
- BIOL:3716  Genetics and Biotechnology Lab 4

Expansive Electives

One of these:

- BIOL:3626  Cell Biology Laboratory 4
- BIOL:3676  Evolution Lab 4
- BIOL:3736  Developmental Biology Lab 4
- BIOL:3994  Introduction to Research - Communicating Research (BIOL:3994 must be taken for a total of 5 s.h.) 6
- BIOL:4213  Bioinformatics 4
- BIOL:4897  Teaching Internship in Biology (must be taken two different semesters for a total of 4 s.h.) 4
- BIOL:4999  Honors Research in Biology 6

**Breadth Menus:**

**Genes and Genomes**

Two of these:

- BIOL:3314  Genomics 3
- BIOL:3373  Human Population Genetics and Variation 3
- BIOL:3713  Molecular Genetics 4
- BIOL:4333  Genes and Development 3
- BIOL:4373  Molecular Evolution: Genes, Genomes, and Organisms 3

**Biological Systems**

Two of these:

- BIOL:2254  Endocrinology 3
- BIOL:2603  Mechanisms of Aging 3
- BIOL:2753  Introduction to Neurobiology 3
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Track Courses</strong></td>
<td></td>
</tr>
<tr>
<td>BIOL:3233</td>
<td>Introduction to Developmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3244</td>
<td>Animal Behavior</td>
<td>3,5</td>
</tr>
<tr>
<td>BIOL:3253</td>
<td>Neurobiology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3343</td>
<td>Animal Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3363</td>
<td>Plant Developmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3383</td>
<td>Introduction to Systems Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3663</td>
<td>Plant Response to the Environment</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3753</td>
<td>Developmental Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Investigative Lab</strong></td>
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<tr>
<td>BIOL:3626</td>
<td>Cell Biology Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3656</td>
<td>Neurobiology Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3676</td>
<td>Evolution Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3716</td>
<td>Genetics and Biotechnology Lab</td>
<td>4</td>
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<tr>
<td>BIOL:3736</td>
<td>Developmental Biology Lab</td>
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<tr>
<td></td>
<td><strong>Experiential Elective</strong></td>
<td></td>
</tr>
<tr>
<td>BIOL:3626</td>
<td>Cell Biology Laboratory (if not used for investigative lab course)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3656</td>
<td>Neurobiology Laboratory (if not used for investigative lab course)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3676</td>
<td>Evolution Lab (if not used for investigative lab course)</td>
<td>4</td>
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<tr>
<td>BIOL:3716</td>
<td>Genetics and Biotechnology Lab (if not used for investigative lab course)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:3736</td>
<td>Developmental Biology Lab (if not used for investigative lab course)</td>
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</tr>
<tr>
<td>BIOL:3994 &amp; BIOL:4898</td>
<td>Introduction to Research - Communicating Research (BIOL:3994 must be taken for a total of 5 s.h.)</td>
<td>6</td>
</tr>
<tr>
<td>BIOL:4213</td>
<td>Bioinformatics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:4897</td>
<td>Teaching Internship in Biology (must be taken two different semesters for a total of 4 s.h.)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:4999</td>
<td>Honors Research in Biology (in plant biology)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>An approved Iowa Lakeside Laboratory course</td>
<td>4</td>
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</table>

**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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BIOL:2753</td>
<td>Introduction to Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL:3244</td>
<td>Animal Behavior</td>
<td>5</td>
</tr>
<tr>
<td>BIOL:3253</td>
<td>Neurobiology</td>
<td>4</td>
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<tr>
<td>BIOL:3656</td>
<td>Neurobiology Laboratory</td>
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</tr>
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<tr>
<td>BIOC:3130</td>
<td>Biochemistry and Molecular Biology II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:2220</td>
<td>Organic Chemistry II</td>
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<tr>
<td>CS:2110</td>
<td>Programming for Informatics</td>
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<td>MICR:2157</td>
<td>General Microbiology</td>
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<tr>
<td>PHYS:2703</td>
<td>Physics III</td>
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<tr>
<td>PHYS:3850</td>
<td>Electronics</td>
<td>4</td>
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<tr>
<td>PSY:3040</td>
<td>Psychology of Learning</td>
<td>3</td>
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<tr>
<td>PSY:3230</td>
<td>Psychopharmacology</td>
<td>3</td>
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<tr>
<td>PSY:3240</td>
<td>Motivation, Addiction, and the Brain</td>
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<tr>
<td>PSY:3250</td>
<td>Neuroscience of Learning and Memory</td>
<td>3</td>
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<td></td>
<td>Other courses by permission of advisor</td>
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<tr>
<td></td>
<td><strong>Experiential Elective</strong></td>
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<tr>
<td></td>
<td>One of these:</td>
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</tr>
<tr>
<td>BIOL:3626</td>
<td>Cell Biology Laboratory</td>
<td>4</td>
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<tr>
<td>BIOL:3676</td>
<td>Evolution Lab</td>
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<td>Developmental Biology Lab</td>
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</tr>
<tr>
<td>BIOL:3994 &amp; BIOL:4898</td>
<td>Introduction to Research - Communicating Research (BIOL:3994 must be taken for a total of 5 s.h.)</td>
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<tr>
<td>BIOL:4213</td>
<td>Bioinformatics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:4897</td>
<td>Teaching Internship in Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL:4999</td>
<td>Honors Research in Biology (in neurobiology)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Electives</strong></td>
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<tr>
<td></td>
<td>At least three of these, with a minimum of one course numbered 3000 or above:</td>
<td></td>
</tr>
<tr>
<td>BIOL:2254</td>
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<td>3</td>
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<tr>
<td>BIOL:2603</td>
<td>Mechanisms of Aging</td>
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<td>Evolution</td>
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<td>BIOL:3343</td>
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<td>BIOL:3383</td>
<td>Introduction to Systems Biology</td>
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<td>BIOL:3753</td>
<td>Developmental Neurobiology</td>
<td>3</td>
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<tr>
<td>BIOL:4333</td>
<td>Genes and Development</td>
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</tr>
<tr>
<td>BIOL:4353</td>
<td>Neurophysiology: Cells and Systems</td>
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Suggested Schedule for First-Year Science Courses

The following first-year schedule of science courses is recommended for all biology majors.

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<tr>
<td>CHEM:1110</td>
<td>Principles of Chemistry I</td>
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<tr>
<td>Calculus or mathematics leading to calculus</td>
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</tr>
<tr>
<td>BIOL:1411</td>
<td>Foundations of Biology</td>
<td>4</td>
</tr>
<tr>
<td>CHEM:1120</td>
<td>Principles of Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>Calculus (if not taken during the first semester)</td>
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**Teacher Licensure**

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 Student 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 science education major. 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 B.S. in Science Education in the Teaching and Learning section of the Catalog.

**Honors**

**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).

Biological 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 courses with honors sections 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 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 Research in Biology;
- 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 Research in Biology toward the experiential elective requirement in an appropriate track.

Biological honors students majoring in biology 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.

Students who are interested in the University of Iowa Honors Program satisfy the level two requirements when they satisfy the biology honors requirements; see University Honors Program below.

**University of Iowa Honors Program**

In addition to honors in the major, students have opportunities for honors study and activities through membership in the University of Iowa Honors Program. Visit Honors at Iowa to learn about the University’s honors program.

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

Membership in the UI Honors Program is not required to earn honors in the biology major.

**Academic Plans**

**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.

**Before the third semester begins:** MATH:1460 Calculus for the Biological Sciences or MATH:1550 Engineering Mathematics I: Single Variable Calculus or MATH:1850 Calculus I, 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 Function and Form, 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; PHYS:1511 College Physics I and PHYS:1512 College Physics II, or equivalents; six or seven
more courses in the major; 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 GE CLAS Core courses, and a sufficient number of semester hours to graduate

### Career Advancement

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.

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