CHM U401  Physical Chemistry 1  4 SH
with CHM U402 Lab for CHM U401  1 SH

**Biochemistry Course**
Complete the following course with corresponding lab:
BIO U323  Biochemistry  4 SH
with BIO U324  Lab for BIO U323  1 SH

**Experiential Education Introduction**
Complete the following course:
BIO U106  Introduction to Experiential Education  1 SH

**Experiential Education**
An activity related to biochemistry and approved by the experiential education adviser must be completed before the capstone. Among the possibilities are co-op experience, junior/senior honors thesis, research project in a faculty lab, study abroad with submission of a paper. 120 hours of supervised volunteer work in a biochemistry-related area, completion of the following course:
CHM U750  Senior Research  4 SH
or other approved experiences.

**Capstone**
Complete the following course:
BIO U701  Biology Capstone  4 SH

**BIOLOGY AND CHEMISTRY ADVANCED ELECTIVES**
Complete four advanced courses for a total of at least 17 semester hours from biology and chemistry with a minimum of one from each department. At least one course must be an approved lab course from the “Approved Labs” list below. Up to 4 semester hours may be research in a faculty lab.

**Biology**
BIO U311 to BIO U699
BIO U970  Junior/Senior Project 1  4 SH
BIO U971  Junior/Senior Project 2  4 SH

**Chemistry**
CHM U310 to CHM U699
CHM U901  Undergraduate Research  4 SH
CHM U921  Directed Study  1 SH
CHM U922  Directed Study  2 SH
CHM U923  Directed Study  3 SH
CHM U924  Directed Study  4 SH
CHM U970  Junior/Senior Project 1  4 SH
CHM U971  Junior/Senior Project 2  4 SH

**Approved Labs**
BIO U579  Biochemistry/Molecular Biology Experimental Approaches  5 SH
CHM U332  Lab for CHM U331  1 SH
with CHM U331  Bioanalytical Chemistry  4 SH
CHM U522  Instrumental Methods of Analysis Lab  4 SH
with CHM U521  Instrumental Methods of Analysis  1 SH
CHM U532  Chemical Synthesis Characterization Lab  4 SH
with CHM U531  Chemical Synthesis Characterization  1 SH

**Faculty Labs**
BIO U964  Research  4 SH
BIO U970  Junior/Senior Project 1  4 SH

CHM U750  Senior Research  4 SH
CHM U901  Undergraduate Research  4 SH
CHM U970  Junior/Senior Project 1  4 SH

**BIOCHEMISTRY MAJOR CREDIT/GPA REQUIREMENTS**
Complete 98 semester hours in the major with a cumulative GPA of 2.000.
Due to overlap in course content, double majoring in biochemistry and biology or biochemistry and behavioral neuroscience is not permitted.

**GENERAL ELECTIVES**
Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

**COOPERATIVE EDUCATION**
If elected

**UNIVERSITY-WIDE REQUIREMENTS**
136 total semester hours required
Minimum 2.000 GPA required

**BS in Biochemistry/MS in Biotechnology**
Undergraduate students apply to the combined program through the graduate school. Once admitted, students may count a limited amount of graduate credit toward the undergraduate degree.

**BS in Biochemistry/MS in Chemistry**
Undergraduate students apply to the combined program through the graduate school. Once admitted, students may count a limited amount of graduate credit toward the undergraduate degree.

**BIOLOGY**
www.biology.neu.edu

SUSAN POWERS-LEE, PhD
Professor and Chair

MATTHEWS DISTINGUISHED UNIVERSITY PROFESSORS
Phyllis R. Strauss, PhD
Carol M. Warner, PhD

PROFESSORS
Ahmed T. Abdelal, PhD
Frederick C. Davis, PhD
H. William Detrich, PhD
Edward L. Jarroll, PhD
Gwilym S. Jones, PhD
Kim Lewis, PhD
James M. Manning, PhD
Richard L. Marsh, PhD
Charles A. M. Meszoely, PhD
Michail V. Sitkovsky, PhD
By majoring in biology, students develop a basic understanding of the organization and the processes of life, from molecules and cells through organs and organ systems to populations, species, ecosystems, and evolution. The major offers the mathematical, chemical, and physical background necessary for understanding biology and the practical scientific skills associated with each of these areas. It allows students to begin to specialize in a subdiscipline of biology such as animal physiology, cell biology, ecology, marine biology, microbiology, molecular biology, plant biology, zoology, and so forth. Numerous opportunities for relevant positions are available through Northeastern’s program of cooperative education.

There are several interdisciplinary opportunities involving biology: BS in biochemistry; BS in behavioral neuroscience; BS in computer science and biology; BS in biology and geology; BS in biology and environmental geology; BS in biology/MS in biotechnology; and BS in biochemistry/MS in biotechnology. A marine biology concentration, designed to provide biology majors with a strong foundation in marine biology and related disciplines, is offered through the Northeastern University Marine Science Center in Nahant.

The undergraduate biology major prepares students for careers in the life sciences, including medical, dental, and other health-related fields. Students may find employment in federal, state, industrial, hospital, or university laboratories or in industries involved in the manufacture and distribution of pharmaceuticals, biological products, food, or scientific equipment. Biologists also work in fisheries, forestry services, county and state agencies, museums, aquariums, research vessels, and marine stations. Graduate study culminating in a master’s or doctoral degree can lead to careers in upper-level teaching or research in any of the life sciences.

Preprofessional students are urged to consult with the preprofessional advisory committee early in their careers at Northeastern.

The Biology department strongly encourages undergraduate research by providing opportunities and support through a number of departmental programs, including research co-ops and internships, course credit for research in faculty labs, honors theses, and work-study research positions. Undergraduates are encouraged to present their findings at Northeastern’s annual Scholarship and Technology Expo, as well as at external research conferences and in scholarly journals.

To graduate with a major in biology, a student must have a cumulative GPA of 2.000 for all science and mathematics courses required for the major. No double majors are offered in biology and biochemistry or in biology and behavioral neuroscience due to similarity in course curricula. See pages 283–289 for course descriptions.

**BS in Biology**

**COLLEGE OF ARTS AND SCIENCES BS CORE REQUIREMENTS FOR NATURAL SCIENCE MAJORS**

See page 51 for requirement list.

**BREADTH COURSES FOR BIOLOGY**

**Mathematics**

Complete the following two courses:

- MTH U151 Calculus and Differential Equations for Biology 1 4 SH
- MTH U152 Calculus and Differential Equations for Biology 2 4 SH

**Chemistry**

Complete the following four courses with corresponding labs:

- CHM U211 General Chemistry 1 4 SH with CHM U212 Lab for CHM U211 1 SH
- CHM U214 General Chemistry 2 4 SH with CHM U215 Lab for CHM U214 1 SH
- CHM U311 Organic Chemistry 1 4 SH with CHM U312 Lab for CHM U311 1 SH
- CHM U313 Organic Chemistry 2 4 SH with CHM U314 Lab for CHM U313 1 SH

**Physics**

Complete two courses from the following list with corresponding labs (PHY U145 and PHY U147 are recommended):

- PHY U145 Physics for Life Sciences 1 4 SH with PHY U146 Lab for PHY U145 1 SH
- or PHY U151 Physics for Engineering 1 4 SH with PHY U152 Lab for PHY U151 1 SH
- or PHY U161 Physics 1 4 SH with PHY U162 Lab for PHY U161 1 SH
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY U147</td>
<td>Physics for Life Sciences 2</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U148</td>
<td>Lab for PHY U147</td>
<td>1</td>
</tr>
<tr>
<td>or PHY U155</td>
<td>Physics for Engineering 2</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U156</td>
<td>Lab for PHY U155</td>
<td>1</td>
</tr>
<tr>
<td>or PHY U165</td>
<td>Physics 2</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U166</td>
<td>Lab for PHY U165</td>
<td>1</td>
</tr>
</tbody>
</table>

**Intermediate or Advanced Science**

Complete one intermediate or advanced science course from the following list:

- BIO U311 to BIO U699
- CHM U321 Analytical Chemistry                          | 4   |
- CHM U331 to CHM U699
- GEO U300 to GEO U699
- PHY U303 to PHY U699
- PSY U202 Biological Basis of Mental Illness           | 4   |
- PSY U458 Psychobiology                                | 4   |
- PSY U510 Psychopharmacology                           | 4   |
- PSY U608 Laboratory in Animal Behavior Research      | 4   |

**BIOLOGY MAJOR REQUIREMENTS**

**Required Biology**

Complete the following three courses with corresponding labs:

- **BIOLOGY 1**
  - BIO U101 Principles of Biology 1                      | 4   |
  - with BIO U102 Lab for BIO U101                        | 1   |
  - or BIO U111 General Biology 1                         | 4   |
  - with BIO U112 Lab for BIO U111                        | 1   |

- **BIOLOGY 2**
  - BIO U103 Principles of Biology 2                      | 4   |
  - with BIO U104 Lab for BIO U103                        | 1   |
  - or BIO U113 General Biology 2                         | 4   |
  - with BIO U114 Lab for BIO U113                        | 1   |

- **GENETICS**
  - BIO U301 Genetics and Molecular Biology              | 4   |
  - with BIO U302 Lab for BIO U301                        | 1   |

**Experiential Education Introduction**

Complete the following course:

- BIO U106 Introduction to Experiential Education        | 1   |

**BIOLOGY MAJOR ELECTIVES**

**Cellular and Molecular Biology**

Complete one course with corresponding lab from the following list:

- BIO U319 Regulatory Cell Biology                       | 4   |
- with BIO U320 Lab for BIO U319                         | 1   |
- or BIO U321 Microbiology                              | 4   |
- with BIO U322 Lab for BIO U321                         | 1   |
- or BIO U323 Biochemistry                              | 4   |
- with BIO U324 Lab for BIO U323                         | 1   |

**Organismal and Population Biology**

Complete one course with corresponding lab from the following list:

- BIO U311 Ecology                                      | 4   |
- with BIO U312 Lab for BIO U311                         | 1   |

**Intermediate and Advanced Biology**

Complete three biology courses (at least 13 semester hours) from the following list. Up to 4 semester hours may be research in a faculty lab.

- BIO U311 to BIO U699
- CHM U321 Analytical Chemistry                          | 4   |
- CHM U331 to CHM U699
- GEO U300 to GEO U699
- PHY U303 to PHY U699
- PSY U202 Biological Basis of Mental Illness           | 4   |
- PSY U458 Psychobiology                                | 4   |
- PSY U510 Psychopharmacology                           | 4   |
- PSY U608 Laboratory in Animal Behavior Research      | 4   |

**Experiential Education**

An activity related to biology and approved by the experiential education adviser must be completed before the capstone. Among the possibilities are co-op experience, junior/senior honors thesis, research project in a faculty lab, study abroad with submission of a paper, 120 hours of supervised volunteer work in a biology-related area, participation in the Three Seas Program with submission of a project paper, or other approved experiences.

**Biology Capstone**

Complete the following course:

- BIO U701 Biology Capstone                              | 4   |

**BIOLOGY MAJOR CREDIT/GPA REQUIREMENTS**

Complete 85 semester hours in the major with a cumulative GPA of 2.000.

Due to overlap in course content, double majoring in biology and biochemistry or biology and behavioral neuroscience is not permitted.

**GENERAL ELECTIVES**

Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

**COOPERATIVE EDUCATION**

If elected

**UNIVERSITY-WIDE REQUIREMENTS**

136 total semester hours required
Minimum 2.000 GPA required

**BS in Biology with Concentration in Marine Biology**

**COLLEGE OF ARTS AND SCIENCES BS CORE REQUIREMENTS FOR NATURAL SCIENCE MAJORS**

See page 51 for requirement list.
BREADTH COURSES FOR BIOLOGY

Mathematics
Complete the following two courses:
MTH U151 Calculus and Differential Equations for Biology 1 4 SH
MTH U152 Calculus and Differential Equations for Biology 2 4 SH

Chemistry
Complete the following four courses with corresponding labs:
CHM U211 General Chemistry 1 4 SH
with CHM U212 Lab for CHM U211 1 SH
CHM U214 General Chemistry 2 4 SH
with CHM U215 Lab for CHM U214 1 SH
CHM U311 Organic Chemistry 1 4 SH
with CHM U312 Lab for CHM U311 1 SH
CHM U313 Organic Chemistry 2 4 SH
with CHM U314 Lab for CHM U313 1 SH

Physics
Complete two courses from the following list with corresponding labs (PHY U145 and PHY U147 are recommended):
PHY U145 Physics for Life Sciences 1 4 SH
with PHY U146 Lab for PHY U145 1 SH
or PHY U151 Physics for Engineering 1 4 SH
with PHY U152 Lab for PHY U151 1 SH
or PHY U161 Physics 1 4 SH
with PHY U162 Lab for PHY U161 1 SH
PHY U147 Physics for Life Sciences 2 4 SH
with PHY U148 Lab for PHY U147 1 SH
or PHY U155 Physics for Engineering 2 4 SH
with PHY U156 Lab for PHY U155 1 SH
or PHY U165 Physics 2 4 SH
with PHY U166 Lab for PHY U165 1 SH

REQUIREMENTS FOR BIOLOGY MAJOR WITH MARINE BIOLOGY CONCENTRATION

Required Biology
Complete the following three courses with corresponding labs:
BIO U101 Principles of Biology 1 4 SH
with BIO U102 Lab for BIO U101 1 SH
or BIO U111 General Biology 1 4 SH
with BIO U112 Lab for BIO U111 1 SH
BIO U103 Principles of Biology 2 4 SH
with BIO U104 Lab for BIO U103 1 SH
or BIO U113 General Biology 2 4 SH
with BIO U114 Lab for BIO U113 1 SH
BIO U301 Genetics and Molecular Biology 4 SH
with BIO U302 Lab for BIO U301 1 SH

Experiential Education Introduction
Complete the following course:
BIO U106 Introduction to Experiential Education 1 SH

Cellular and Molecular Biology
Complete one course with corresponding lab from the following list:
BIO U319 Regulatory Cell Biology 4 SH
with BIO U320 Lab for BIO U319 1 SH
or BIO U321 Microbiology 4 SH
with BIO U322 Lab for BIO U321 1 SH
or BIO U323 Biochemistry 4 SH
with BIO U324 Lab for BIO U323 1 SH

Organismal and Population Biology
Complete the following course with corresponding lab:
BIO U311 Ecology 4 SH
with BIO U312 Lab for BIO U311 1 SH

Marine Biology Courses
Complete four marine biology electives from the course range below for a minimum total of 16 semester hours:
BIO U501 to BIO U531

Experiential Education
An activity related to biology and approved by the experiential education adviser must be completed before the capstone. Among the possibilities are co-op experience, junior/senior honors thesis, research project in a faculty lab, study abroad with submission of a paper, 120 hours of supervised volunteer work in a biology-related area, participation in the Three Seas Program with submission of a project, paper, or other approved experiences.

Biology Capstone
Complete the following course:
BIO U701 Biology Capstone 4 SH

BIOLOGY MAJOR CREDIT/GPA REQUIREMENTS
Complete 88 semester hours for the major with a cumulative GPA of 2.00.

GENERAL ELECTIVES
Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

COOPERATIVE EDUCATION
If elected

UNIVERSITY-WIDE REQUIREMENTS
136 total semester hours required
Minimum 2.000 GPA required

BS in Biology and Geology

COLLEGE OF ARTS AND SCIENCES BS CORE REQUIREMENTS FOR NATURAL SCIENCE MAJORS
See page 51 for requirement list.
BREADTH COURSES FOR BIOLOGY/GEOLGY DUAL MAJOR

**Mathematics**
Complete the following two courses:
- MTH U151 Calculus and Differential Equations for Biology 1 4 SH
- MTH U152 Calculus and Differential Equations for Biology 2 4 SH

**Chemistry**
Complete the following four courses with corresponding labs:
- CHM U211 General Chemistry 1 4 SH
  - with CHM U212 Lab for CHM U211 1 SH
- CHM U214 General Chemistry 2 4 SH
  - with CHM U215 Lab for CHM U214 1 SH
- CHM U311 Organic Chemistry 1 4 SH
  - with CHM U312 Lab for CHM U311 1 SH
- CHM U313 Organic Chemistry 2 4 SH
  - with CHM U314 Lab for CHM U313 1 SH

**Physics**
Complete two courses with corresponding labs from the following list (PHY U145 and PHY U147 are recommended):
- PHY U145 Physics for Life Sciences 1 4 SH
  - with PHY U146 Lab for PHY U145 1 SH
- or PHY U151 Physics for Engineering 1 4 SH
  - with PHY U152 Lab for PHY U151 1 SH
- or PHY U161 Physics 1 4 SH
  - with PHY U162 Lab for PHY U161 1 SH
- PHY U147 Physics for Life Sciences 2 4 SH
  - with PHY U148 Lab for PHY U147 1 SH
- or PHY U155 Physics for Engineering 2 4 SH
  - with PHY U156 Lab for PHY U155 1 SH
- or PHY U165 Physics 2 4 SH
  - with PHY U166 Lab for PHY U165 1 SH

BIOLOGY/GEOLGY DUAL-MAJOR REQUIREMENTS

**Required Biology**
Complete the following three courses with corresponding labs:
- BIO U101 Principles of Biology 1 4 SH
  - with BIO U102 Lab for BIO U101 1 SH
- or BIO U111 General Biology 1 4 SH
  - with BIO U112 Lab for BIO U111 1 SH
- BIO U103 Principles of Biology 2 4 SH
  - with BIO U104 Lab for BIO U103 1 SH
- or BIO U113 General Biology 2 4 SH
  - with BIO U114 Lab for BIO U113 1 SH
- BIO U301 Genetics and Molecular Biology 4 SH
  - with BIO U302 Lab for BIO U301 1 SH

**Required Geology**
Complete the following four courses with corresponding labs:
- GEO U200 Dynamic Earth 4 SH
  - with GEO U201 Lab for GEO U200 1 SH
- GEO U220 History of Earth and Life 4 SH
  - with GEO U221 Interpreting Earth History 1 SH

**BIOLOGY/GEOLGY DUAL-MAJOR ELECTIVES**

**Intermediate and Advanced Biology**
Complete two biology courses with at least one lab (for a minimum total of 9 semester hours) from the following list:
- BIO U311 to BIO U699

**Intermediate and Advanced Geology**
Complete one geology course and lab elective (for a total of 5 semester hours) from the following list:
- GEO U300 to GEO U699

**Integrative Courses**
Complete two courses with corresponding labs from the following list:
- BIO U571 to BIO U699

**Experiential Education**
An activity related to biology or geology and approved by the experiential education adviser must be completed before the capstone. Among the possibilities are co-op experience, junior/senior honors thesis, research project in a faculty lab, study abroad with submission of a paper, 120 hours of supervised volunteer work in a biology-related area, participation in the Three Seas Program with submission of a project paper, or other approved experiences.

**Biology Capstone**
Complete the following course:
- BIO U701 Biology Capstone 4 SH

**BIOLOGY/GEOLGY DUAL-MAJOR CREDIT/GPA REQUIREMENTS**
Complete 99 semester hours in the major with a cumulative GPA of 2.000.

**GENERAL ELECTIVES**
Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

**COOPERATIVE EDUCATION**
If elected

**UNIVERSITY-WIDE REQUIREMENTS**
136 total semester hours required
Minimum 2.000 GPA required
### Mathematics

Complete the following two courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH U151</td>
<td>Calculus and Differential Equations for Biology 1</td>
<td>4</td>
</tr>
<tr>
<td>MTH U152</td>
<td>Calculus and Differential Equations for Biology 2</td>
<td>4</td>
</tr>
</tbody>
</table>

### Chemistry

Complete the following four courses with corresponding labs:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM U211</td>
<td>General Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>with CHM U212</td>
<td>Lab for CHM U211</td>
<td>1</td>
</tr>
<tr>
<td>CHM U214</td>
<td>General Chemistry 2</td>
<td>4</td>
</tr>
<tr>
<td>with CHM U215</td>
<td>Lab for CHM U214</td>
<td>1</td>
</tr>
<tr>
<td>CHM U311</td>
<td>Organic Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>with CHM U312</td>
<td>Lab for CHM U311</td>
<td>1</td>
</tr>
<tr>
<td>CHM U313</td>
<td>Organic Chemistry 2</td>
<td>4</td>
</tr>
<tr>
<td>with CHM U314</td>
<td>Lab for CHM U313</td>
<td>1</td>
</tr>
</tbody>
</table>

### Physics

Complete two courses with corresponding labs from the following list (PHY U145 and PHY U147 are recommended):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY U145</td>
<td>Physics for Life Sciences 1</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U146</td>
<td>Lab for PHY U145</td>
<td>1</td>
</tr>
<tr>
<td>or PHY U151</td>
<td>Physics for Engineering 1</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U152</td>
<td>Lab for PHY U151</td>
<td>1</td>
</tr>
<tr>
<td>or PHY U161</td>
<td>Physics 1</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U162</td>
<td>Lab for PHY U161</td>
<td>1</td>
</tr>
<tr>
<td>PHY U147</td>
<td>Physics for Life Sciences 2</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U148</td>
<td>Lab for PHY U147</td>
<td>1</td>
</tr>
<tr>
<td>or PHY U155</td>
<td>Physics for Engineering 2</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U156</td>
<td>Lab for PHY U155</td>
<td>1</td>
</tr>
<tr>
<td>or PHY U165</td>
<td>Physics 2</td>
<td>4</td>
</tr>
<tr>
<td>with PHY U166</td>
<td>Lab for PHY U165</td>
<td>1</td>
</tr>
</tbody>
</table>

### Biology/Environmental Geology Dual-Major

#### Required Biology

Complete the following three courses with corresponding labs:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO U101</td>
<td>Principles of Biology 1</td>
<td>4</td>
</tr>
<tr>
<td>with BIO U102</td>
<td>Lab for BIO U101</td>
<td>1</td>
</tr>
<tr>
<td>or BIO U111</td>
<td>General Biology 1</td>
<td>4</td>
</tr>
<tr>
<td>with BIO U112</td>
<td>Lab for BIO U111</td>
<td>1</td>
</tr>
<tr>
<td>BIO U103</td>
<td>Principles of Biology 2</td>
<td>4</td>
</tr>
<tr>
<td>with BIO U104</td>
<td>Lab for BIO U103</td>
<td>1</td>
</tr>
<tr>
<td>or BIO U113</td>
<td>General Biology 2</td>
<td>4</td>
</tr>
<tr>
<td>with BIO U114</td>
<td>Lab for BIO U113</td>
<td>1</td>
</tr>
<tr>
<td>BIO U301</td>
<td>Genetics and Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>with BIO U302</td>
<td>Lab for BIO U301</td>
<td>1</td>
</tr>
</tbody>
</table>

### Required Geology

Complete the following four courses with corresponding labs:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEO U200</td>
<td>Dynamic Earth</td>
<td>4</td>
</tr>
<tr>
<td>with GEO U201</td>
<td>Lab for GEO U200</td>
<td>1</td>
</tr>
<tr>
<td>GEO U220</td>
<td>History of Earth and Life</td>
<td>4</td>
</tr>
<tr>
<td>with GEO U221</td>
<td>Interpreting Earth History</td>
<td>1</td>
</tr>
<tr>
<td>GEO U310</td>
<td>Earth Materials</td>
<td>4</td>
</tr>
<tr>
<td>with GEO U311</td>
<td>Lab for GEO U310</td>
<td>1</td>
</tr>
<tr>
<td>GEO U340</td>
<td>Earth Landforms and Processes</td>
<td>4</td>
</tr>
<tr>
<td>with GEO U341</td>
<td>Lab for GEO U340</td>
<td>1</td>
</tr>
</tbody>
</table>

### Experiential Education Introduction

Complete the following course:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO U106</td>
<td>Introduction to Experiential Education</td>
<td>1</td>
</tr>
</tbody>
</table>

### Biology/Environmental Geology Dual-Major Electives

#### Intermediate and Advanced Biology

Complete two biology courses with at least one lab (for a minimum total of 9 semester hours) from the following list:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO U311</td>
<td>Microbial Ecology</td>
<td>4</td>
</tr>
<tr>
<td>with BIO U312</td>
<td>Lab for BIO U312</td>
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</tr>
<tr>
<td>BIO U585</td>
<td>Evolution</td>
<td>4</td>
</tr>
<tr>
<td>with BIO U586</td>
<td>Lab for BIO U586</td>
<td>1</td>
</tr>
<tr>
<td>GEO U523</td>
<td>Soil Science</td>
<td>4</td>
</tr>
<tr>
<td>GEO U560</td>
<td>Geographic Information Systems</td>
<td>4</td>
</tr>
<tr>
<td>with GEO U561</td>
<td>Lab for GEO U560</td>
<td>1</td>
</tr>
</tbody>
</table>

### Experiential Education

An activity related to biology or geology and approved by the experiential education adviser must be completed before the capstone. Among the possibilities are co-op experience, junior/senior honors thesis, research project in a faculty lab, study abroad with submission of a paper, 120 hours of supervised volunteer work in a biology-related area, participation in the Three Seas Program with submission of a project paper, or other approved experiences.

### Biology Capstone

Complete the following course:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO U701</td>
<td>Biology Capstone</td>
<td>4</td>
</tr>
</tbody>
</table>

### General Electives

Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.
COOPERATIVE EDUCATION
If elected

UNIVERSITY-WIDE REQUIREMENTS
136 total semester hours required
Minimum 2.000 GPA required

BS in Computer Science and Biology
See page 211.

BS in Biology/MS in Biotechnology
Students should apply for the BS/MS program during their fifth academic semester. Before applying, students must have completed 80 semester hours and one co-op experience.

COLLEGE OF ARTS AND SCIENCES BS CORE REQUIREMENTS FOR NATURAL SCIENCE MAJORS
See page 51 for requirement list.

INTRODUCTION TO COLLEGE
Complete the following course:
BIO U100  College: An Introduction  1 SH

BREADTH COURSES FOR BIOLOGY

Mathematics
Complete the following two courses:
MTH U151  Calculus and Differential Equations for Biology 1  4 SH
MTH U152  Calculus and Differential Equations for Biology 2  4 SH

Chemistry
Complete the following four courses with corresponding labs:
CHM U211  General Chemistry 1  4 SH
CHM U212  Lab for CHM U211  1 SH
CHM U214  General Chemistry 2  4 SH
CHM U215  Lab for CHM U214  1 SH
CHM U311  Organic Chemistry 1  4 SH
CHM U312  Lab for CHM U311  1 SH
CHM U313  Organic Chemistry 2  4 SH
CHM U314  Lab for CHM U313  1 SH

Physics
Complete two courses with corresponding labs from the following list:
PHY U145  Physics for Life Sciences 1  4 SH
PHY U146  Lab for PHY U145  1 SH
PHY U151  Physics for Engineering 1  4 SH
PHY U152  Lab for PHY U151  1 SH
PHY U161  Physics 1  4 SH
PHY U162  Lab for PHY U161  1 SH
PHY U147  Physics for Life Sciences 2  4 SH
PHY U148  Lab for PHY U147  1 SH
PHY U155  Physics for Engineering 2  4 SH
PHY U156  Lab for PHY U155  1 SH
PHY U165  Physics 2  4 SH
PHY U166  Lab for PHY U165  1 SH

BIOLOGY MAJOR REQUIREMENTS

Required Biology
Complete the following three courses with corresponding labs:
BIOLOGY 1
BIO U101  Principles of Biology 1  4 SH
with BIO U102  Lab for BIO U101  1 SH
or BIO U111  General Biology 1  4 SH
with BIO U112  Lab for BIO U111  1 SH

BIOLOGY 2
BIO U103  Principles of Biology 2  4 SH
with BIO U104  Lab for BIO U103  1 SH
or BIO U113  General Biology 2  4 SH
with BIO U114  Lab for BIO U113  1 SH

GENETICS
BIO U301  Genetics and Molecular Biology  4 SH
with BIO U302  Lab for BIO U301  1 SH

Experiential Education Introduction
Complete the following course:
BIO U106  Introduction to Experiential Education  1 SH

BIOLOGY MAJOR ELECTIVES

Cellular and Molecular Biology
Complete the following course with corresponding lab:
BIO U323  Biochemistry  4 SH
with BIO U324  Lab for BIO U323  1 SH

Organismal and Population Biology
Complete one course with corresponding lab from the following list:
BIO U311  Ecology  4 SH
with BIO U312  Lab for BIO U311  1 SH
BIO U313  Plant Biology  4 SH
with BIO U314  Lab for BIO U313  1 SH
BIO U315  Invertebrate Zoology  4 SH
with BIO U316  Lab for BIO U315  1 SH
BIO U317  Vertebrate Zoology  4 SH
with BIO U318  Lab for BIO U317  1 SH

Biology Capstone
Complete the following course:
BIO U701  Biology Capstone  4 SH

GRADUATE COURSES TAKEN AS AN UNDERGRADUATE

Required Courses
Complete the following five courses for graduate credit:
BIO G279  Biochemistry/Molecular Biology  5 SH
INT G120  Introduction to Biotechnology  2 SH
INT G245  Biotechnology Applications Laboratory  2 SH
PSC G100  Concepts in Pharmaceutical Science  2 SH

Elective Course Work
Complete one additional advanced biology elective at the 500 level or a biology course with a graduate equivalent for 4 semester hours of credit.
GRADUATE COURSES TAKEN
AS A GRADUATE STUDENT

Required Courses
Complete the following four courses:
- BIO G382 Research Problem Solving 2 SH
- CHM G211 Analytical Separations 3 SH
- CHM G212 Principles of Mass Spectrometry 3 SH
- CHM G317 Analytical Biotechnology 3 SH

Elective Course Work
Complete 5 semester hours of graduate electives.

GENERAL ELECTIVES
Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

COOPERATIVE EDUCATION
Required Co-op
Complete three co-op assignments.

GRADUATE GPA REQUIREMENT
Minimum 3.00 GPA required for all graduate courses

Minor in Biology
This minor is not available for students who major in biochemistry, behavioral neuroscience, or any dual major that involves biology.

REQUIRED BIOLOGY COURSES/LABS
Complete five biology courses from the following list for a total of at least 23 semester hours. At least three courses must be intermediate or advanced. Three of the five courses must contain a lab co-requisite.

Introductory
- BIO U101 to BIO U299

Intermediate to Advanced
- BIO U301 to BIO U599

BREADTH COURSE
To provide breadth of knowledge, complete one additional science course from the BIO, CHM, GEO, or PHY departments or any course from the following list:
- PSY U202 Biological Basis of Mental Illness 4 SH
- PSY U458 Psychobiology 4 SH
- PSY U510 Psychopharmacology 4 SH

GPA REQUIREMENT
2.000 GPA required in the minor

Minor in Marine Biology
This minor is not available for students who major in biochemistry, behavioral neuroscience, or any dual major that involves biology.

REQUIRED COURSES
Complete the following two courses with corresponding labs:
- BIO U101 Principles of Biology 1 4 SH
  with BIO U102 Lab for BIO U101 1 SH
- or BIO U111 General Biology 1 4 SH
  with BIO U112 Lab for BIO U111 1 SH

Elective Courses
Complete three courses from the following list:
- BIO U151 Introduction to Marine Biology 4 SH
- BIO U135 Invertebrate Zoology 4 SH
- BIO U501 Marine Botany 4 SH
  with BIO U502 Lab for BIO U501 1 SH
- BIO U503 Marine Invertebrate Zoology 4 SH
  with BIO U504 Lab for BIO U503 1 SH
- BIO U505 Biology of Corals and Coral Reefs 3 SH
- BIO U507 Biology and Ecology of Fishes 3 SH
- BIO U509 Marine Birds and Mammals 2 SH
  with BIO U510 Lab for BIO U509 1 SH
- BIO U511 Adaptations of Aquatic Organisms 3 SH
- BIO U515 Benthic Marine Ecology 3 SH
- BIO U517 Oceanography 2 SH
  with BIO U518 Lab for BIO U517 1 SH
- BIO U519 Ocean and Coastal Processes 3 SH
  with BIO U522 Lab for BIO U521 1 SH
- BIO U523 Molecular Marine Biology 3 SH
- BIO U525 Marine Microbial Ecology 2 SH
  with BIO U526 Lab for BIO U525 1 SH
- BIO U527 Marine Conservation Biology 3 SH
- BIO U529 Physiological and Molecular Marine Ecology 3 SH
- BIO U589 Diving Research Methods 2 SH

BREADTH COURSE
To provide breadth of knowledge, complete one additional science course from the BIO, CHM, GEO, or PHY department or from the following list:
- PSY U202 Biological Basis of Mental Illness 4 SH
- PSY U458 Psychobiology 4 SH
- PSY U510 Psychopharmacology 4 SH

GPA REQUIREMENT
2.000 GPA required in the minor
The Department of Chemistry and Chemical Biology provides education in basic chemistry and modern chemistry-related disciplines. The department offers an American Chemical Society–certified program leading to a Bachelor of Science in Chemistry, and also offers a Bachelor of Science in Biochemistry jointly with the Department of Biology. The overall objective of the Bachelor of Science in Chemistry major program is to provide the fundamental scientific background and practical training for students as they prepare for chemically related careers or advanced study in fields including the traditional chemical specialties, as well as biochemistry, materials science, forensic science, medicine, education, law, and other endeavors that may draw upon an understanding of the chemical basis of the world around us.

Key general objectives are the development of qualitative and quantitative problem-solving skills and effective communication skills. Specific learning objectives for the chemistry major include to develop conceptual understanding and problem-solving abilities in the fundamental chemical subfields of analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry; gain a foundation of physics and mathematics and integrate these areas with chemical principles; perform quantitative measurements; synthesize and characterize compounds; learn proper laboratory practices including safety; develop proficiency with modern instruments and computers for data acquisition and analysis; and learn the relevance of chemistry to biology, pharmacology, medicine, manufactured and natural materials, and the environment.

Most of our chemistry majors participate in the cooperative education program and thereby gain invaluable professional experience to augment their classroom and laboratory work. Not only does that experience add immensely to the overall education received, it also provides contacts and references for later employment or graduate school admissions. Chemistry majors also undertake a research project for at least one semester under the supervision of a faculty member. Sufficient electives are available in the program either to take more advanced courses or research within the department, or to add courses in an area of special interest, such as criminal justice in the case of an interest in forensic science. Qualified students may also participate in a five-year combined BS/MS program. See pages 296–301 for course descriptions.

### BS in Chemistry

**COLLEGE OF ARTS AND SCIENCES BS CORE REQUIREMENTS FOR NATURAL SCIENCE MAJORS**

See page 51 for requirement list.

**CHEMISTRY MAJOR TECHNICAL REQUIREMENTS**

**Mathematics**

Complete the following two courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH U151</td>
<td>Calculus and Differential Equations for Biology 1</td>
<td>4 SH</td>
</tr>
<tr>
<td>MTH U152</td>
<td>Calculus and Differential Equations for Biology 2</td>
<td>4 SH</td>
</tr>
</tbody>
</table>

**Biochemistry**

Complete the following course with corresponding lab:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO U323</td>
<td>Biochemistry</td>
<td>4 SH</td>
</tr>
<tr>
<td>BIO U324</td>
<td>Lab for BIO U323</td>
<td>1 SH</td>
</tr>
</tbody>
</table>

**Physics**

Complete the following two courses with corresponding labs:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY U145</td>
<td>Physics for Life Sciences 1</td>
<td>4 SH</td>
</tr>
<tr>
<td>with PHY U146</td>
<td>Lab for PHY U145</td>
<td>1 SH</td>
</tr>
<tr>
<td>or PHY U161</td>
<td>Physics 1</td>
<td>4 SH</td>
</tr>
<tr>
<td>with PHY U162</td>
<td>Lab for PHY U161</td>
<td>1 SH</td>
</tr>
<tr>
<td>PHY U147</td>
<td>Physics for Life Sciences 2</td>
<td>4 SH</td>
</tr>
<tr>
<td>with PHY U148</td>
<td>Lab for PHY U147</td>
<td>1 SH</td>
</tr>
<tr>
<td>or PHY U165</td>
<td>Physics 2</td>
<td>4 SH</td>
</tr>
<tr>
<td>with PHY U166</td>
<td>Lab for PHY U165</td>
<td>1 SH</td>
</tr>
</tbody>
</table>

**CHEMISTRY MAJOR REQUIREMENTS**

**General Chemistry**

Complete the following two courses with corresponding labs:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM U217</td>
<td>General Chemistry 1 for Chemical Science Majors</td>
<td>4 SH</td>
</tr>
<tr>
<td>with CHM U218</td>
<td>Lab for CHM U217</td>
<td>2 SH</td>
</tr>
</tbody>
</table>
Cinema Studies

CHM U220  General Chemistry 2 for Chemical Science Majors 4 SH
with CHM U221 Lab for CHM U220 2 SH

Intermediate-Level Chemistry
Complete the following five courses with corresponding labs:
CHM U315  Organic Chemistry 1 for Chemistry Majors 4 SH
with CHM U316 Lab for CHM U315 2 SH
CHM U317  Organic Chemistry 2 for Chemistry Majors 4 SH
with CHM U318 Lab for CHM U317 2 SH
CHM U331  Bioanalytical Chemistry 4 SH
with CHM U332 Lab for CHM U331 1 SH
CHM U401  Physical Chemistry 1 4 SH
with CHM U402 Lab for CHM U401 1 SH
CHM U403  Physical Chemistry 2 4 SH
with CHM U404 Lab for CHM U403 1 SH

Advanced-Level Chemistry
Complete the following four courses with corresponding labs:
CHM U501  Inorganic Chemistry 4 SH
CHM U521  Instrumental Methods of Analysis 1 SH
with CHM U522 Instrumental Methods of Analysis Lab 4 SH
CHM U531  Chemical Synthesis Characterization 1 SH
with CHM U532 Chemical Synthesis Characterization Lab 4 SH
CHM U628  Spectroscopy of Organic Compounds 3 SH
with CHM U629 Identification of Organic Compounds 2 SH

Senior Research
Complete the following course:
CHM U750  Senior Research 4 SH

Chemistry Capstone
Complete the following course:
CHM U770  Chemistry Capstone 4 SH

EXPERIENTIAL EDUCATION REQUIREMENT
Complete one course in experiential education. Please see department for approved courses.

CHEMISTRY MAJOR CREDIT REQUIREMENT
Complete 89 semester hours in the major.

GENERAL ELECTIVES
Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

COOPERATIVE EDUCATION
If elected

UNIVERSITY-WIDE REQUIREMENTS
136 total semester hours required
Minimum 2.000 GPA required

BS in Environmental Geology and Chemistry
See page 88.

BS in Geology and Chemistry
See page 87.

BS/MS in Chemistry
Undergraduate students apply to the combined program through the graduate school. Once admitted, students may count a limited amount of graduate credit toward the undergraduate degree.

Minor in Chemistry

REQUIRED COURSES
Complete the following six courses with corresponding labs. Engineering students may take CHM U151 in place of CHM U211 and two other chemistry courses in place of CHM U214 and CHM U401:

GENERAL CHEMISTRY 1
CHM U211  General Chemistry 1 4 SH
with CHM U212 Lab for CHM U211 1 SH

GENERAL CHEMISTRY 2
CHM U214  General Chemistry 2 4 SH
with CHM U215 Lab for CHM U214 1 SH

ORGANIC CHEMISTRY 1
CHM U311  Organic Chemistry 1 4 SH
with CHM U312 Lab for CHM U311 1 SH

ORGANIC CHEMISTRY 2
CHM U313  Organic Chemistry 2 4 SH
with CHM U314 Lab for CHM U313 1 SH

PHYSICAL CHEMISTRY 1
CHM U401  Physical Chemistry 1 4 SH
with CHM U402 Lab for CHM U401 1 SH

PHYSICAL CHEMISTRY 2
CHM U403  Physical Chemistry 2 4 SH
with CHM U404 Lab for CHM U403 1 SH

GPA REQUIREMENT
2.000 GPA required in the minor

CINEMA STUDIES

www.cinemastudies.neu.edu

INEZ HEDGES, PhD, Stotsky Professor of Jewish Historical and Cultural Studies, Modern Languages
KATHY HOWLETT, PhD, Associate Professor, English
Codirectors of the Program in Cinema Studies

MATTHEWS DISTINGUISHED UNIVERSITY PROFESSOR
Harlow L. Robinson, PhD, History and Modern Languages

PROFESSORS
Kathleen Kelly, PhD, English and Education
Michael Ryan, PhD, English