Academic Programs and Curriculum Guide

BIOCHEMISTRY

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Associate Professor and Chair
of the Biochemistry Steering Committee

Advising Web site: www.biology.neu.edu/bioadvising.html

Biochemistry includes nearly the entire spectrum of science—from physics and chemistry to biology and medicine. The biochemistry major, sponsored jointly by the Departments of Biology and Chemistry and Chemical Biology, provides a strong foundation in mathematics and the physical sciences as well as thorough training in biochemistry, biology, and chemistry. In addition to formal class work, opportunities are available for participation in faculty research programs on an individual basis or through the Honors Program. The large number of biotechnology companies and biomedical facilities in the Boston area provides a rich source of opportunities through Northeastern’s program of cooperative education. Two combined BS/MS programs are also available: BS in biochemistry/MS in biotechnology and BS in biochemistry/MS in chemistry.

A Bachelor of Science degree in biochemistry allows students to enter the job market directly or go on to graduate, medical, veterinary, dental, law, or business school. Students may find positions in biotechnology companies, pharmaceutical companies, or government agencies, working in laboratory or clinical research, quality control, production, information systems, marketing, or technical sales. Students may also pursue graduate study in biochemistry, molecular biology, cell biology, biophysics, genetics, toxicology, biotechnology, clinical chemistry, animal science, nutrition, plant science, or other biomedical sciences.

Students who are interested in attending medical, dental, or veterinary school following graduation are urged to consult with the preprofessional advisory committee early in their careers at Northeastern.

Transferring to the Major

Upperclass students transferring to biochemistry must have a minimum GPA of 2.000 and have completed a year in chemistry and a year in calculus, preferably the following courses:

MATH 1251 Calculus and Differential Equations for Biology 1 4 SH
MATH 1252 Calculus and Differential Equations for Biology 2 4 SH

with a grade of C or better.

Transferring into biochemistry requires the approval of the Biochemistry Coordinating Committee Chair. Acceptance into the major is based on students’ meeting the criteria for admission and availability of space in the program.

Academic Progression Standards

After four semesters in the major, students must have a GPA of at least 2.000 in all science and math courses and have completed at least six of the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1101</td>
<td>Principles of Biology 1</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 1102</td>
<td>Lab for BIOL 1101</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 1103</td>
<td>Principles of Biology 2</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 1104</td>
<td>Lab for BIOL 1103</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 2301</td>
<td>Genetics and Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 2302</td>
<td>Lab for BIOL 2301</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 1211</td>
<td>General Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 1212</td>
<td>Lab for CHEM 1211</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 1214</td>
<td>General Chemistry 2</td>
<td>4</td>
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<tr>
<td>CHEM 1215</td>
<td>Lab for CHEM 1214</td>
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</tr>
<tr>
<td>CHEM 2311</td>
<td>Organic Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 2312</td>
<td>Lab for CHEM 2311</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 2313</td>
<td>Organic Chemistry 2</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 2314</td>
<td>Lab for CHEM 2313</td>
<td>1</td>
</tr>
<tr>
<td>MATH 1251</td>
<td>Calculus and Differential Equations for Biology 1</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1252</td>
<td>Calculus and Differential Equations for Biology 2</td>
<td>4</td>
</tr>
</tbody>
</table>

Students who transfer into the biochemistry major will be allowed two semesters after entering the major to meet the minimum standards for their class. Students who fail to meet the above standards will be placed on departmental probation. Two consecutive semesters on departmental probation will result in dismissal from the major.

To graduate with a major in biochemistry, 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 biochemistry and biology or in biochemistry and behavioral neuroscience due to similarity in course curricula. Students must maintain a minimum grade-point average of 2.000 to remain in this program.

BS in Biochemistry

NU CORE REQUIREMENTS

See page 26 for requirement list.

BIOCHEMISTRY BREADTH COURSES

Mathematics Courses

Complete the following two courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1251</td>
<td>Calculus and Differential Equations for Biology 1</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1252</td>
<td>Calculus and Differential Equations for Biology 2</td>
<td>4</td>
</tr>
</tbody>
</table>

Physics Courses

Complete a lecture/lab set for Physics 1 and for Physics 2:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 1145</td>
<td>Physics for Life Sciences 1</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 1146</td>
<td>Lab for PHYS 1145</td>
<td>1</td>
</tr>
</tbody>
</table>
College of Arts and Sciences

PHYS 1151  Physics for Engineering 1  4 SH
with PHYS 1152  Lab for PHYS 1151  1 SH
PHYS 1161  Physics 1  4 SH
with PHYS 1162  Lab for PHYS 1161  1 SH
PHYSICS 2
PHYS 1147  Physics for Life Sciences 2  4 SH
with PHYS 1148  Lab for PHYS 1147  1 SH
PHYS 1155  Physics for Engineering 2  4 SH
with PHYS 1156  Lab for PHYS 1155  1 SH
PHYS 1165  Physics 2  4 SH
with PHYS 1166  Lab for PHYS 1165  1 SH

BIOCHEMISTRY MAJOR REQUIREMENTS

Principles of Biology
Complete the following two courses with corresponding labs:

Biology 1
BIOL 1101  Principles of Biology 1  4 SH
with BIOL 1102  Lab for BIOL 1101  1 SH
or BIOL 1111  General Biology 1  4 SH
with BIOL 1112  Lab for BIOL 1111  1 SH

Biology 2
BIOL 1103  Principles of Biology 2  4 SH
with BIOL 1104  Lab for BIOL 1103  1 SH
or BIOL 1113  General Biology 2  4 SH
with BIOL 1114  Lab for BIOL 1113  1 SH

Molecular Biology
Complete the following two courses with corresponding lab, as indicated:

BIOL 2301  Genetics and Molecular Biology  4 SH
with BIOL 2302  Lab for BIOL 2301  1 SH
BIOL 3407  Molecular Cell Biology  4 SH

Chemistry Courses
Complete the following six courses with corresponding labs:

CHEM 1211  General Chemistry 1  4 SH
with CHEM 1212  Lab for CHEM 1211  1 SH
CHEM 1214  General Chemistry 2  4 SH
with CHEM 1215  Lab for CHEM 1214  1 SH
CHEM 2311  Organic Chemistry 1  4 SH
with CHEM 2312  Lab for CHEM 2311  1 SH
CHEM 2313  Organic Chemistry 2  4 SH
with CHEM 2314  Lab for CHEM 2313  1 SH
CHEM 2321  Analytical Chemistry  4 SH
with CHEM 2322  Lab for CHEM 2321  1 SH
CHEM 3401  Physical Chemistry 1  4 SH
with CHEM 3402  Lab for CHEM 3401  1 SH

Biochemistry Course
Complete the following course with corresponding lab:

BIOL 2323  Biochemistry  4 SH
with BIOL 2324  Lab for BIOL 2323  1 SH

Experiential Education Introduction
Complete the following course:

BIOL 1106  Introduction to Experiential Education  1 SH

Experiential Education
An activity related to biochemistry and approved by the experiential education advisor 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:

CHEM 4750  Senior Research  4 SH
or other approved experiences.

Capstone
Complete the following course:

BIOL 4701  Biology Capstone  4 SH
or CHEM 4770  Chemistry 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 list “Approved Labs” below. Up to 4 semester hours may be research in a biology or chemistry faculty lab.

Biology
BIOL 2311 to BIOL 5999

Chemistry
CHEM 2310 to CHEM 5999

Approved Labs

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 2301</td>
<td>Genetics and Molecular Biology</td>
<td>4 SH</td>
</tr>
<tr>
<td>with BIOL 2302</td>
<td>Lab for BIOL 2301</td>
<td>1 SH</td>
</tr>
<tr>
<td>BIOL 3407</td>
<td>Molecular Cell Biology</td>
<td>4 SH</td>
</tr>
<tr>
<td>BIOL 1101</td>
<td>Principles of Biology 1</td>
<td>4 SH</td>
</tr>
<tr>
<td>with BIOL 1102</td>
<td>Lab for BIOL 1101</td>
<td>1 SH</td>
</tr>
<tr>
<td>or BIOL 1111</td>
<td>General Biology 1</td>
<td>4 SH</td>
</tr>
<tr>
<td>with BIOL 1112</td>
<td>Lab for BIOL 1111</td>
<td>1 SH</td>
</tr>
<tr>
<td>BIOL 1103</td>
<td>Principles of Biology 2</td>
<td>4 SH</td>
</tr>
<tr>
<td>with BIOL 1104</td>
<td>Lab for BIOL 1103</td>
<td>1 SH</td>
</tr>
<tr>
<td>or BIOL 1113</td>
<td>General Biology 2</td>
<td>4 SH</td>
</tr>
<tr>
<td>with BIOL 1114</td>
<td>Lab for BIOL 1113</td>
<td>1 SH</td>
</tr>
<tr>
<td>BIOL 1121</td>
<td>General Chemistry 1</td>
<td>4 SH</td>
</tr>
<tr>
<td>CHEM 2331</td>
<td>Bioanalytical Chemistry</td>
<td>4 SH</td>
</tr>
<tr>
<td>with CHEM 2331</td>
<td>Lab for CHEM 2331</td>
<td>1 SH</td>
</tr>
<tr>
<td>CHEM 3521</td>
<td>Instrumental Methods of Analysis</td>
<td>4 SH</td>
</tr>
<tr>
<td>with CHEM 3521</td>
<td>Lab for CHEM 3521</td>
<td>1 SH</td>
</tr>
<tr>
<td>CHEM 3532</td>
<td>Chemical Synthesis Characterization</td>
<td>4 SH</td>
</tr>
<tr>
<td>with CHEM 3531</td>
<td>Lab for CHEM 3531</td>
<td>1 SH</td>
</tr>
<tr>
<td>BIOL 4970</td>
<td>Junior/Senior Honors Project</td>
<td>4 SH</td>
</tr>
<tr>
<td>BIOL 4991</td>
<td>Research</td>
<td>4 SH</td>
</tr>
<tr>
<td>CHEM 4750</td>
<td>Senior Research</td>
<td>4 SH</td>
</tr>
<tr>
<td>CHEM 4901</td>
<td>Undergraduate Research</td>
<td>4 SH</td>
</tr>
<tr>
<td>CHEM 4970</td>
<td>Junior/Senior Honors Project</td>
<td>4 SH</td>
</tr>
</tbody>
</table>

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.

NORTHEASTERN UNIVERSITY
COOPERATIVE EDUCATION

If elected

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

BS in Biochemistry/MS in Biotechnology

APPLICATION PROCEDURES
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.

NU CORE REQUIREMENTS
See page 26 for requirement list.

BIOCHEMISTRY BREADTH COURSES

Mathematics Courses
Complete the following two courses:
MATH 1251 Calculus and Differential Equations for Biology 1
MATH 1252 Calculus and Differential Equations for Biology 2

Physics Courses
Complete a lecture/lab set for Physics 1 and Physics 2:
PHYSICS 1
PHYS 1145 Physics for Life Sciences 1
with PHYS 1146 Lab for PHYS 1145
PHYS 1151 Physics for Engineering 1
with PHYS 1152 Lab for PHYS 1151
PHYS 1161 Physics 1
with PHYS 1162 Lab for PHYS 1161

PHYSICS 2
PHYS 1147 Physics for Life Sciences 2
with PHYS 1148 Lab for PHYS 1147
PHYS 1155 Physics for Engineering 2
with PHYS 1156 Lab for PHYS 1155
PHYS 1165 Physics 2
with PHYS 1166 Lab for PHYS 1165

BIOCHEMISTRY MAJOR REQUIREMENTS

Principles of Biology
Complete the following two courses with corresponding labs:
BIOLOGY 1
Biol 1101 Principles of Biology 1
with BIOL 1102 Lab for BIOL 1101
or BIOL 1111 General Biology 1
with BIOL 1112 Lab for BIOL 1111

Biology 2
BIOL 1103 Principles of Biology 2
with BIOL 1104 Lab for BIOL 1103
or BIOL 1113 General Biology 2
with BIOL 1114 Lab for BIOL 1113

Molecular Biology
Complete the following course with corresponding lab:
BIOL 2301 Genetics and Molecular Biology
with BIOL 2302 Lab for BIOL 2301

Chemistry Courses
Complete the following six courses with corresponding labs:
CHEM 1211 General Chemistry 1
with CHEM 1212 Lab for CHEM 1211
CHEM 1214 General Chemistry 2
with CHEM 1215 Lab for CHEM 1214
CHEM 2311 Organic Chemistry 1
with CHEM 2312 Lab for CHEM 2311
CHEM 2313 Organic Chemistry 2
with CHEM 2314 Lab for CHEM 2313
CHEM 2321 Analytical Chemistry
with CHEM 2322 Lab for CHEM 2321
CHEM 3401 Physical Chemistry 1
with CHEM 3402 Lab for CHEM 3401

Biochemistry Courses
Complete the following course with corresponding lab:
BIOL 2303 Biochemistry
with BIOL 2304 Lab for BIOL 2303

Experiential Education Introduction
Complete the following course:
BIOL 1106 Introduction to Experiential Education

Experiential Education
Two undergraduate co-op experiences are required, preferably in the biotechnology industry.

Approved Lab
Complete one of the following courses with corresponding lab, as indicated:
BIOL 5579 Biochemistry/Molecular Biology
with BIOL 5580 Lab for BIOL 5579
CHEM 2331 Bioanalytical Chemistry
with CHEM 2332 Lab for CHEM 2331
CHEM 3521 Instrumental Methods of Analysis
with CHEM 3522 Lab for CHEM 3521
CHEM 3531 Chemical Synthesis Characterization
with CHEM 3532 Lab for CHEM 3531

Capstone
Complete the following course:
BIOL 4701 Biology Capstone
or CHEM 4770 Chemistry Capstone
BIOTECHNOLOGY REQUIREMENTS—GRADUATE COURSES TAKEN AS AN UNDERGRADUATE

Required Courses
Complete the following four courses for graduate credit:

- BIOL 6301 Molecular Cell Biology 4 SH
- IDSC 5120 Introduction to Biotechnology 2 SH
- IDSC 7245 Biotechnology Applications Laboratory 2 SH
- PHSC 5100 Concepts in Pharmaceutical Science 2 SH

Elective Course Work
Complete one additional graduate-level biology or chemistry elective course.

BIOTECHNOLOGY REQUIREMENTS—GRADUATE COURSES TAKEN AS A GRADUATE STUDENT

Track
Complete either the molecular track or the pharmaceutical track:

MOLECULAR TRACK
Complete the following five courses:

- BIOL 7382 Research Problem Solving 2 SH
- CHEM 5611 Analytical Separations 3 SH
- CHEM 5612 Principles of Mass Spectrometry 3 SH
- CHEM 5660 Analytical Biochemistry 3 SH
- MGMT 6219 The Business of Biotechnology 3 SH

PHARMACEUTICAL TRACK
Complete the following seven courses:

- MGMT 6219 The Business of Biotechnology 3 SH
- PHSC 6210 Drug Design, Evaluation, and Development 2 SH
- PHSC 6214 Experimental Design and Biometrics 2 SH
- PHSC 6216 Human Physiology and Pathophysiology 2 SH
- PHSC 6218 Biomedical Chemical Analysis 2 SH
- PMST 6252 Pharmacokinetics and Drug Metabolism 3 SH
- PMST 6254 Advanced Drug Delivery System 3 SH

Elective Course Work
Complete 2 semester hours of graduate electives chosen in consultation with your advisor.

Graduate-Level Co-op
Complete one graduate-level co-op assignment, preferably in the biotechnology industry.

UNIVERSITY-WIDE REQUIREMENTS
136 total semester hours required in the undergraduate program
Minimum 2.000 GPA required in undergraduate courses
Minimum 3.000 GPA required in graduate courses

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. Consult the department for information on this program.

UNDERGRADUATE BIOCHEMISTRY MAJOR CREDIT/GPA REQUIREMENTS
Complete 94 semester hours for the undergraduate 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.