BIOCHEMISTRY

KOSTIA BERGMAN, PHD
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:

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

with a grade of C or better.

Transferring into biochemistry requires the approval of the Biochemistry Coordinating Committee Chair. Acceptance into the major will be 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:

- BIO U101 Principles of Biology 1 4 SH
- with BIO U102 Lab for BIO U101 1 SH
- and BIO U103 Principles of Biology 2 4 SH
- with BIO U104 Lab for BIO U103 1 SH
- BIO U301 Genetics and Molecular Biology 4 SH
- with BIO U302 Lab for BIO U301 1 SH
- CHM U211 General Chemistry 1 4 SH
- with CHM U212 Lab for CHM U211 1 SH
- and 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
- and CHM U313 Organic Chemistry 2 4 SH
- with CHM U314 Lab for CHM U313 1 SH
- MTH U151 Calculus and Differential Equations for Biology 1 4 SH
- and MTH U152 Calculus and Differential Equations for Biology 2 4 SH

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 minimal grade-point average of 2.000 to remain in this program.

BS in Biochemistry

NU CORE REQUIREMENTS
See page 42 for requirement list.

BIOCHEMISTRY BREADTH COURSES

Mathematics Courses
Complete the following two courses:

- MTH U151 Calculus and Differential Equations 4 SH for Biology 1
- MTH U152 Calculus and Differential Equations 4 SH for Biology 2
Physics Courses
Complete a lecture/lab set for Physics 1 and Physics 2:

PHYSICS 1
PHY U145  Physics for Life Sciences 1     4 SH
with PHY U146  Lab for PHY U145     1 SH
PHY U151  Physics for Engineering 1     4 SH
with PHY U152  Lab for PHY U151     1 SH
PHY U161  Physics 1     4 SH
with PHY U162  Lab for PHY U161     1 SH

PHYSICS 2
PHY U147  Physics for Life Sciences 2     4 SH
with PHY U148  Lab for PHY U147     1 SH
PHY U155  Physics for Engineering 2     4 SH
with PHY U156  Lab for PHY U155     1 SH
PHY U165  Physics 2     4 SH
with PHY U166  Lab for PHY U165     1 SH

BIOCHEMISTRY MAJOR REQUIREMENTS

Principles of Biology
Complete the following two 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

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

BIO U301  Genetics and Molecular Biology     4 SH
with BIO U302  Lab for BIO U301     1 SH
BIO U407  Molecular Cell Biology     4 SH

Chemistry Courses
Complete the following six 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
CHM U321  Analytical Chemistry     4 SH
with CHM U322  Lab for CHM U321     1 SH
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 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:

CHM U750  Senior Research     4 SH
or other approved experiences.

Capstone
Complete the following course:

BIO U701  Biology Capstone     4 SH
or CHM U770  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 faculty lab.

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

Approved Labs
BIO U579  Biochemistry/Molecular Biology     5 SH
Experimental Approaches

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     4 SH
Characterization Lab
with CHM U531  Chemical Synthesis Characterization     1 SH
Academic Programs and Curriculum Guide

NORTHEASTERN UNIVERSITY

Faculty Labs

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>BIO U964</td>
<td>Research</td>
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<tr>
<td>BIO U970</td>
<td>Junior/Senior Honors Project 1</td>
<td>4</td>
</tr>
<tr>
<td>CHM U750</td>
<td>Senior Research</td>
<td>4</td>
</tr>
<tr>
<td>CHM U901</td>
<td>Undergraduate Research</td>
<td>4</td>
</tr>
<tr>
<td>CHM U970</td>
<td>Junior/Senior Honors Project 1</td>
<td>4</td>
</tr>
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</table>

BIOCHEMISTRY MAJOR CREDIT/GPA REQUIREMENTS

Complete 94 semester hours for 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.

COORDERATIVE 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 42 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>
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<tbody>
<tr>
<td>MTH U151</td>
<td>Calculus and Differential Equations</td>
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</tr>
<tr>
<td>MTH U152</td>
<td>Calculus and Differential Equations</td>
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</table>


Physics

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tr>
<td>PHYSICS 1</td>
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</tr>
<tr>
<td>PHY U145</td>
<td>Physics for Life Sciences 1</td>
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</tr>
<tr>
<td>PHY U146</td>
<td>Lab for PHY U145</td>
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</tr>
<tr>
<td>PHY U151</td>
<td>Physics for Engineering 1</td>
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</tr>
<tr>
<td>PHY U152</td>
<td>Lab for PHY U151</td>
<td>1</td>
</tr>
<tr>
<td>PHY U161</td>
<td>Physics 1</td>
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</tr>
<tr>
<td>PHY U162</td>
<td>Lab for PHY U161</td>
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BIOCHEMISTRY MAJOR REQUIREMENTS

Principles of Biology

Complete the following two courses with corresponding labs:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIO U101</td>
<td>Principles of Biology 1</td>
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<tr>
<td>BIO U102</td>
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<tr>
<td>BIO U111</td>
<td>General Biology 1</td>
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<tr>
<td>BIO U112</td>
<td>Lab for BIO U111</td>
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BIOLOGY 2

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>BIO U103</td>
<td>Principles of Biology 2</td>
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<tr>
<td>BIO U104</td>
<td>Lab for BIO U103</td>
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<tr>
<td>BIO U113</td>
<td>General Biology 2</td>
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</tr>
<tr>
<td>BIO U114</td>
<td>Lab for BIO U113</td>
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Molecular Biology

Complete the following course with corresponding lab:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>BIO U301</td>
<td>Genetics and Molecular Biology</td>
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</tr>
<tr>
<td>BIO U302</td>
<td>Lab for BIO U301</td>
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</table>

Chemistry Courses

Complete the following six courses with corresponding labs:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SH</th>
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</thead>
<tbody>
<tr>
<td>CHM U211</td>
<td>General Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>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>CHM U215</td>
<td>Lab for CHM U215</td>
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</tr>
<tr>
<td>CHM U311</td>
<td>Organic Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>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>CHM U314</td>
<td>Lab for CHM U314</td>
<td>1</td>
</tr>
<tr>
<td>CHM U321</td>
<td>Analytical Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>CHM U322</td>
<td>Lab for CHM U321</td>
<td>1</td>
</tr>
<tr>
<td>CHM U401</td>
<td>Physical Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>CHM U402</td>
<td>Lab for CHM U401</td>
<td>1</td>
</tr>
</tbody>
</table>

Biochemistry Courses

Complete the following course with corresponding lab:

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

Experiential Education Introduction

Complete the following course:

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

Experiential Education

Two undergraduate co-ops and one graduate co-op are required, preferably in the biotechnology industry.
Approved Lab
Complete one course with corresponding lab where applicable:

BIO U579  Biochemistry/Molecular Biology  5 SH
          Experimental Approaches

CHM U331  Bioanalytical Chemistry  4 SH
with CHM U332 Lab for CHM U331  1 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

Capstone
Complete the following course:

BIO U701  Biology Capstone  4 SH
or CHM U770  Chemistry 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
          Experimental Approaches

BIO G301  Molecular Cell Biology  4 SH

INT G120  Introduction to Biotechnology  2 SH

INT G245  Biotechnology Applications Laboratory  2 SH

PSC G100  Concepts in Pharmaceutical Science  2 SH

GRADUATE COURSES TAKEN
AS A GRADUATE STUDENT

Required Courses
Complete the following five courses:

BIO G382  Research Problem Solving  2 SH

CHM G211  Analytical Separations  3 SH

CHM G212  Principles of Mass Spectrometry  3 SH

CHM G316  Analytical Biochemistry  3 SH

MGT G219  The Business of Biotechnology  3 SH

Elective Course Work
Complete 2 semester hours of graduate electives.

BIOCHEMISTRY/BIOTECHNOLOGY MAJOR
CREDIT/GPA REQUIREMENTS
Complete 127 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.
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.