

# Biochemistry & Molecular Biology

How does life work at the molecular level? This question is at the core of the concentration program Biochemistry and Molecular Biology. In earlier years of this discipline, the focus was on structure and function of proteins, nucleic acids, lipids, carbohydrates and small molecules such as vitamins. Today the logical approach and tools of biochemical science are being expanded to new areas in neuroscience, developmental biology, immunology, pharmacology and synthetic biology (the design of analogs of biological systems). Training in biochemistry begins with a foundation in mathematics, physics, chemistry and biology. Some courses offered in other departments, including engineering, geology and computer science, are also useful. A key component of this program is the year of hands-on research carried out in collaboration with a faculty member here at Brown. Faculty sponsors are drawn from both the Chemistry Department and the Division of Biology and Medicine, and include basic science and clinical faculty.

## Standard program for the Sc.B. degree

Students must take twenty courses in biology, chemistry, mathematics, and physics, including the following core requirements, some of these may be fulfilled with AP credits.

Three courses in mathematics including two courses in MATH 0090/0100 or MATH 0170/0180 with a third class in statistics, math, or computer science <sup>1</sup> 3

Options for statistics courses include: <sup>1</sup>

APMA 0650	Essential Statistics
APMA 1650	Statistical Inference I
BIOL 0495	Statistical Analysis of Biological Data
CLPS 0900	Statistical Methods
PHP 1501	Essentials of Data Analysis

Two courses in physics, typically: <sup>1</sup> 2

PHYS 0030	Basic Physics A
or PHYS 0050	Foundations of Mechanics
or ENGN 0030	Introduction to Engineering
PHYS 0040	Basic Physics B
or PHYS 0060	Foundations of Electromagnetism and Modern Physics
or ENGN 0040	Dynamics and Vibrations

Three courses in physical and organic chemistry: 3

CHEM 0330	Equilibrium, Rate, and Structure
CHEM 0350/0360	Organic Chemistry I

One course in biophysical chemistry: 1

CHEM 0400	Biophysical and Bioinorganic Chemistry
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Four courses in biochemistry: 4

BIOL 0280	Biochemistry
BIOL 0285	Inquiry in Biochemistry: From Gene to Protein Function

Plus two of three upper level biochemistry courses:

BIOL 1270	Advanced Biochemistry
or CHEM 1230	Chemical Biology
or CHEM 1240	Biochemistry

The two semester research requirement may be satisfied by any two of the following. Students should discuss alternative arrangements or special situations directly with their concentration advisor to obtain prior approval. 2

BIOL 1950	Directed Research/Independent Study
BIOL 1960	Directed Research/Independent Study
CHEM 0980	Undergraduate Research

CHEM 0980S Undergraduate Research - Writing Designated and Mandatory S/NC

CHEM 0981 Undergraduate Research - Writing Designated

Select biology or chemistry COEX courses (BIOL 0190R, BIOL 0190S, BIOL 0440, BIOL 0600, BIOL 0940G, CHEM 0500)

A summer research experience with faculty in Biology or Chemistry at Brown equivalent or greater in scope and scale to work the student would pursue in a Biology or Chemistry independent study course to satisfy one semester of the research requirement.

### Suggested Elective Courses:

Students are required to take five courses from the chart below or, with approval from a concentration advisor, from any science or mathematics course relevant to biochemistry, cell and molecular biology. 5

### Applied Mathematics Electives:

APMA 0330	Methods of Applied Mathematics I
APMA 0410	Mathematical Methods in the Brain Sciences
APMA 0650	Essential Statistics

### Biology Electives:

BIOL 0030	Principles of Nutrition
BIOL 0150D	Techniques in Regenerative Medicine: Cells, Scaffolds and Staining
BIOL 0170	Biotechnology in Medicine
BIOL 0190R	Phage Hunters, Part I
BIOL 0190S	Phage Hunters, Part II
BIOL 0200	The Foundation of Living Systems
BIOL 0380	The Ecology and Evolution of Infectious Disease
BIOL 0415	Microbes in the Environment
BIOL 0440	Inquiry in Plant Biology: Analysis of Plant Growth, Reproduction and Adaptive Responses
BIOL 0470	Genetics
BIOL 0500	Cell and Molecular Biology
BIOL 0510	Introductory Microbiology
BIOL 0530	Principles of Immunology
BIOL 0800	Principles of Physiology
BIOL 1050	Biology of the Eukaryotic Cell
BIOL 1090	Polymer Science for Biomaterials
BIOL 1100	Cell Physiology and Biophysics
BIOL 1110	Topics in Signal Transduction
BIOL 1120	Biomaterials
BIOL 1150	Stem Cell Engineering
BIOL 1200	Protein Biophysics and Structure
BIOL 1210	Synthetic Biological Systems
BIOL 1260	Physiological Pharmacology
BIOL 1290	Cancer Biology
BIOL 1300	Biomolecular Interactions: Health, Disease and Drug Design
BIOL 1310	Developmental Biology
BIOL 1330	Biology of Reproduction
BIOL 1520	Innate Immunity
BIOL 1540	Molecular Genetics
BIOL 1560	Virology
BIOL 1600	Development of Vaccines to Infectious Diseases
BIOL 2110	Drug and Gene Delivery
BIOL 2350	The Biology of Aging

**Chemistry Electives:**

CHEM 0500	Inorganic Chemistry
CHEM 1140	Physical Chemistry: Quantum Chemistry
CHEM 1150	Physical Chemistry: Thermodynamics and Statistical Mechanics
CHEM 1220	Computational Tools in Biochemistry and Chemical Biology
CHEM 1230	Chemical Biology
CHEM 1240	Biochemistry
CHEM 1450	Advanced Organic Chemistry
CHEM 2420	Organic Reactions

will be provided by the Concentration Advisor in the first half of the fall semester.

**Computer Science Electives:**

CSCI 0080	A First Byte of Computer Science
CSCI 0111	Computing Foundations: Data
CSCI 0150	Introduction to Object-Oriented Programming and Computer Science
CSCI 0160	Introduction to Algorithms and Data Structures
CSCI 0170	Computer Science: An Integrated Introduction
CSCI 0180	Computer Science: An Integrated Introduction
CSCI 0190	Accelerated Introduction to Computer Science
CSCI 1810	Computational Molecular Biology

**Engineering Electives:**

ENGN 0410	Materials Science
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**Neuroscience Electives:**<sup>2</sup>

NEUR 0010	The Brain: An Introduction to Neuroscience
NEUR 1020	Principles of Neurobiology
NEUR 1030	Neural Systems
NEUR 1040	Introduction to Neurogenetics
NEUR 1670	Neuropharmacology and Synaptic Transmission
NEUR 1740	The Diseased Brain: Mechanisms of Neurological and Psychiatric Disorders

**Physics Electives:**

PHYS 0160	Introduction to Relativity, Waves and Quantum Physics
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**Public Health Electives:**

PHP 1501	Essentials of Data Analysis
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**Total Credits** **20**

<sup>1</sup> Note that the mathematics and physics requirements may be satisfied by Advanced Placement credit.

<sup>2</sup> or any NEUR course in Cell, Genetics, Molecular Biology, or Development.

## Honors Requirements for Biochemistry

All ScB Biochemistry concentrators are candidates for Honors; no separate application is necessary.

The requirements for Honors in Biochemistry are:

\* Students must have a majority of either As or S with distinction grades in concentration courses.

\* Two semesters of Independent Study (CHEM 0980, CHEM 0980S, CHEM 0981, BIOL 1950, or BIOL 1960). Guidelines and requirements associated with Independent Study are in the Undergraduate Concentration Handbook which can be found at the department website (<http://www.brown.edu/academics/chemistry/undergraduate/>).

\* A Thesis in a form approved by the research advisor, and recommended by the research advisor. Additional information about thesis guidelines