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
- Two courses in physics, typically: 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: CHEM 0330 Equilibrium, Rate, and Structure CHEM 0350/0360 Organic Chemistry
- One course in biophysical chemistry: CHEM 0400 Biophysical and Bioinorganic Chemistry
- Four courses in biochemistry: 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.

- BIOL 1950 Directed Research/Independent Study
- BIOL 1960 Directed Research/Independent Study
- CHEM 0970 Undergraduate Research
- CHEM 0980 Undergraduate Research
- 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.

**Biochemistry Electives:**

- BIOL 0070 Principles of Nutrition
- BIOL 0080 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 0520 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

#### Computer Science Electives:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CSCI 0080</td>
<td>A First Byte of Computer Science</td>
</tr>
<tr>
<td>CSCI 0150</td>
<td>Introduction to Object-Oriented Programming and Computer Science</td>
</tr>
<tr>
<td>CSCI 0160</td>
<td>Introduction to Algorithms and Data Structures</td>
</tr>
<tr>
<td>CSCI 0170</td>
<td>Computer Science: An Integrated Introduction</td>
</tr>
<tr>
<td>CSCI 0180</td>
<td>Computer Science: An Integrated Introduction</td>
</tr>
<tr>
<td>CSCI 1810</td>
<td>Computational Molecular Biology</td>
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</tbody>
</table>

#### Engineering Electives:

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ENGN 0410</td>
<td>Materials Science</td>
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#### Neuroscience Electives:

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>NEUR 0010</td>
<td>The Brain: An Introduction to Neuroscience</td>
</tr>
<tr>
<td>NEUR 0650</td>
<td>Biology of Hearing</td>
</tr>
<tr>
<td>NEUR 1020</td>
<td>Principles of Neurobiology</td>
</tr>
<tr>
<td>NEUR 1030</td>
<td>Neural Systems</td>
</tr>
<tr>
<td>NEUR 1040</td>
<td>Introduction to Neurogenetics</td>
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<tr>
<td>NEUR 1670</td>
<td>Neuropharmacology and Synaptic Transmission</td>
</tr>
<tr>
<td>NEUR 1740</td>
<td>The Diseased Brain: Mechanisms of Neurological and Psychiatric Disorders</td>
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#### Physics Electives:

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>PHYS 0160</td>
<td>Introduction to Relativity, Waves and Quantum Physics</td>
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</table>

#### Public Health Electives:

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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>PHP 1501</td>
<td>Essentials of Data Analysis</td>
</tr>
</tbody>
</table>

**Total Credits**: 20

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1. Note that the mathematics and physics requirements may be satisfied by Advanced Placement credit.
2. BIOL 0285 is required for the class of 2022 onward. Students in the classes of 2019-2021 are required to take only three courses in biochemistry yet may take BIOL 0285 as an elective.
3. Students in the classes of 2019-2021 are required to take six electives. The five elective requirement applies to the class of 2022 and after.
4. 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 0970, CHEM 0980 or BIOL 1950, 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 will be provided by the Concentration Advisor in the first half of the fall semester.