### Biology

The Biology concentration invites students to study, in depth and in breadth, the science of life and living matter. Whether pursuing the Bachelor of Arts (A.B.) or Science (Sc.B.) in biology, students can expect to learn broadly in the discipline through a selection of courses in three areas: cell and molecular biology, structure and function, and organismal biology. In addition, students pursuing the Sc.B. complete a thematic track through which they gain an in-depth understanding of a particular subfield such as, Immunopathology, Ecology and Evolutionary Biology, Physiology/Biotechnology, Cell and Molecular Biology, Physical Sciences. The concentration also emphasizes practical skills and experimental design. Concentrators are required to take at least 3 courses with a laboratory or fieldwork component. Within all of these requirements, students have a high degree of flexibility and choice. Broad research opportunities are also available across several departments within the basic sciences as well.

#### Standard program for the A.B. Biology

The concentration program for the A.B. in Biology consists of four prerequisite courses in math, chemistry, and a statistics course as well as ten courses in biological sciences, including at least one course in each of the following three areas: Area 1: Cell/Molecular Biology, Area 2: Structure/Function, and Area 3: Organismal Biology.


### Prerequisites:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 0330</td>
<td>Equilibrium, Rate, and Structure</td>
</tr>
<tr>
<td>CHEM 0350</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>MATH 0090</td>
<td>Introductory Calculus, Part I (or placement. MATH 0050/MATH 0060 may be substituted for MATH 0090.)</td>
</tr>
</tbody>
</table>

One of the following:

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>MATH 0100</td>
<td>Introductory Calculus, Part II (or placement)</td>
</tr>
<tr>
<td>MATH 0170</td>
<td>Advanced Placement Calculus (or equivalent placement)</td>
</tr>
</tbody>
</table>

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### Ten Core Courses:

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>BIOL 0200</td>
<td>The Foundation of Living Systems (Required course; AP credit or similar IB or A-levels accepted, placement test available.)</td>
</tr>
</tbody>
</table>

#### Area 1 (Cell/Molecular Biology)

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<td>BIOL 1865</td>
<td>Toxicology</td>
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<td>NEUR 1020</td>
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#### Area 2 (Structure/Function)

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<tr>
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<tr>
<td>BIOL 0400</td>
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#### Area 3 (Organismal Biology)

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<th>Course</th>
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<tr>
<td>BIOL 0210</td>
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<td>BIOL 0380</td>
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<tr>
<td>ENVS 0490</td>
<td>Environmental Science in a Changing World</td>
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</table>

Six additional courses chosen from BIOL and/or NEUR offerings for concentrators. The Core may include up to two related sciences, with advisor approval. The Core must also include a Senior Capstone.

**SENIOR CAPSTONE:** "Only applies to students who have declared in Fall 2019 or later." To be fulfilled via ONE of the following:

1. One of the following approved courses: BIOL 1100, 1250, 1515, 1555, 1565, 1575, 1600, 1820, 1970A.

2. One semester of independent research/independent study (BIOL 1950 or BIOL 1960).

3. A senior Honors thesis in Biology; Students can register for BIOL 1950 or BIOL 1960 or both.

Please visit the BUE webpage for more information.

### Total Credits

10

1. AP scores of 4 or 5 may substitute Math courses.

2. Biology courses for concentration credit include those numbered between 0100 - 2999. Exclusions: BIOL 1070, 1920 series courses, and BIOL 1880 can only be used as related sciences with advisor approval and do not fulfill advanced course requirements.

3. At least two biology and/or neuroscience courses must be at the advanced level (between 1000-2999). Senior Capstone can be used towards one advanced requirement. At least three of the Biology and/or Neuroscience courses must include laboratory or fieldwork. BIOL 1950/BIOL 1960, (Directed Research) may be included, but is not required. If a lab project, this can count for one of the three lab course requirements, and one advanced course.

4. No substitutions per above Area list. If a course is listed in more than one area, it may be used to fulfill one area only; the other area must be fulfilled by a different course.

**Honors:** Honors in biology requires a thesis and presentation based on a research project (conducted via BIOL 1950/BIOL 1960), and quality
grades in the concentration. Guidelines and information on faculty research are available in the Office of Biology Undergraduate Education or found at http://www.brown.edu/academics/biology/undergraduate-education/.

**Standard Program for the Sc.B. Biology**

The concentration program for the Sc.B. in Biology consists of seven prerequisite courses in math, chemistry, and physics as well as thirteen to fourteen courses in biological sciences, including courses in each of the following three areas: Area 1: Cell/Molecular Biology, Area 2: Structure/Function, and Area 3: Organismal Biology, and the three-course Track. The biological sciences requirement also requires research (BIOL 1950/BIOL 1960), which should reflect the advanced cluster.

Students pursuing a ScB in Biology have the option to substitute a course for CHEM 0360 (Organic Chemistry) in their background core. For students pursuing the Marine Biology track, an upper level course in Geological Sciences may replace CHEM 0360. For students pursuing all other tracks, BIOL 0280 (Introductory Biochemistry) may serve as the replacement course. Please note that approval from the concentration advisor is required for these background course substitutions. If the student has already declared, then a revised concentration plan must be submitted and approved via the ASK system. If BIOL 0280 is used as a substitute for CHEM 0360, it cannot be counted as a core course or as an Area 1 course. Students planning to apply to medical or graduate school should seek additional advising (such as from the Health Careers Office) in crafting their course plan.


**Prerequisites:**

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<td>CHEM 0360 or BIOL 0280</td>
<td>Organic Chemistry or Biochemistry</td>
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<td>PHYS 0030</td>
<td>Basic Physics A (or equivalent. PHYS 0050 PHYS 0070, or ENGN 0030 may be substituted for PHYS 0030.)</td>
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<td>PHYS 0040</td>
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**RESEARCH:**

The two semester research requirement may be satisfied by any two of the opportunities listed below. Students may find the following resources useful in planning for research: the annual BUE-PLME Finding, Securing and Succeeding in Research workshop, the BUE Research webpage, and the Sheridan Center’s Undergraduate Research & Experiential Opportunities webpage. Following conversation and agreement with the advisor, students articulate the research plan in the ASK declaration (in the designated text box) which is submitted for review and approval by the advisor.

Choose two:

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<tbody>
<tr>
<td>BIOL 1950</td>
<td>Directed Research/Independent Study</td>
</tr>
<tr>
<td>BIOL 1960</td>
<td>Directed Research/Independent Study</td>
</tr>
<tr>
<td>NEUR 1970</td>
<td>Independent Study</td>
</tr>
</tbody>
</table>

Independent study course in a related discipline (i.e. STEM disciplines, ENVS, PH, etc.) if the project is relevant to the student’s learning goals and interests in the concentration.
The following COEX courses: BIOL 0190R, BIOL 0190S, BIOL 0285, BIOL 0440, BIOL 0600, BIOL 0940G, BIOL 1515, BIOL 1555; NEUR 1630, CLPS 1195. New COEX courses will be considered as they are developed and offered at Brown, and as relevant to the concentration.

A summer research experience equivalent in scope and scale to work the student would pursue in a Biology independent study course. Examples include UTRAs, LINK awards, approved research programs at other institutions, etc. These experiences do not count as a course in the 10 course core requirement, but they can be used to satisfy the one semester of the research requirement. Advisors will work with students to review these experiences - drawing on a range of potential materials including a written summary of the experience, formal work plans, materials produced (i.e. presentations/papers), and in some cases a letter from the supporting advisor.

Other equivalent opportunities not listed - with approval from the concentration advisor and Dean Smith

Students are encouraged to pursue research related to their track

**TRACK:**

The advanced thematic track consists of three additional biological sciences courses (not including BIOL 1950/1960 research) that form a Track. Tracks include: Immuno/Pathobiology; Ecology and Evolutionary Biology; Physiology and Biotechnology; Neurobiology; Physical Sciences; Marine Biology; Cell and Molecular Biology; Biomedical Informatics. At least two track courses, and preferably all three, must be above 1000-level. Track courses should form a cohesive grouping approved by an advisor and/or Associate Dean of Biology, Katherine Smith

**Biomedical Informatics - BIOL 1565 is required for this track along with 2 additional courses from the following:**

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<tr>
<td>BIOL 1555</td>
<td>Methods in Informatics and Data Science for Health</td>
</tr>
<tr>
<td>BIOL 1575</td>
<td>Evaluation of Health Information Systems</td>
</tr>
<tr>
<td>BIOL 1595</td>
<td>Artificial Intelligence in Biomedicine</td>
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**Cell and Molecular Biology**

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<td>Biology of the Eukaryotic Cell</td>
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<tr>
<td>BIOL 1270</td>
<td>Advanced Biochemistry</td>
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<td>BIOL 1300</td>
<td>Biomolecular Interactions: Health, Disease and Drug Design</td>
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<td>BIOL 1545</td>
<td>Human Genetics and Genomics</td>
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<tr>
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<tr>
<td>BIOL 1970A</td>
<td>Stem Cell Biology</td>
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**Ecology and Evolutionary Biology**

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<tbody>
<tr>
<td>BIOL 1420</td>
<td>Experimental Design in Ecology</td>
</tr>
<tr>
<td>BIOL 1430</td>
<td>Foundations of Population Genetics</td>
</tr>
<tr>
<td>BIOL 1435</td>
<td>Computational Methods for Studying Demographic History with Molecular Data</td>
</tr>
<tr>
<td>BIOL 1440</td>
<td>Marine Biology</td>
</tr>
<tr>
<td>BIOL 1450</td>
<td>Community Ecology</td>
</tr>
<tr>
<td>BIOL 1465</td>
<td>Human Population Genomics</td>
</tr>
<tr>
<td>BIOL 1470</td>
<td>Conservation Biology</td>
</tr>
<tr>
<td>BIOL 1475</td>
<td>Biogeography</td>
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<td>BIOL 1480</td>
<td>Terrestrial Biogeochemistry and the Functioning of Ecosystems</td>
</tr>
<tr>
<td>BIOL 1495</td>
<td>500 Million Years of Land Plants</td>
</tr>
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<td>BIOL 1515</td>
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**Immunobiology**

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<tbody>
<tr>
<td>BIOL 1250</td>
<td>Host-microbe Interactions in Health and Disease</td>
</tr>
<tr>
<td>BIOL 1290</td>
<td>Cancer Biology</td>
</tr>
<tr>
<td>BIOL 1520</td>
<td>Innate Immunity</td>
</tr>
<tr>
<td>BIOL 1550</td>
<td>Biology of Emerging Microbial Diseases</td>
</tr>
<tr>
<td>BIOL 1560</td>
<td>Virology</td>
</tr>
<tr>
<td>BIOL 1600</td>
<td>Development of Vaccines to Infectious Diseases</td>
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</table>

**Marine Biology**

<table>
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<tr>
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<tbody>
<tr>
<td>BIOL 1440</td>
<td>Marine Biology</td>
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</table>
| GEOL (EEPS) listings 1000 level or above. Must be a coherent set of courses that are above the introductory level and approved by advisor

**Neurobiology**

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<tr>
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<tbody>
<tr>
<td>BIOL 1100</td>
<td>Cell Physiology and Biophysics</td>
</tr>
<tr>
<td>BIOL 1110</td>
<td>Topics in Signal Transduction</td>
</tr>
<tr>
<td>BIOL 1190</td>
<td>Synaptic Transmission and Plasticity</td>
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<tr>
<td>BIOL 1260</td>
<td>Physiological Pharmacology</td>
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**Physiological Pharmacology**

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| NEUR listings 1000 level or above

**Physical Sciences**

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<td>Polymer Science for Biomaterials</td>
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<td>BIOL 1120</td>
<td>Biomaterials</td>
</tr>
<tr>
<td>BIOL 1140</td>
<td>Tissue Engineering</td>
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<td>BIOL 1300</td>
<td>Biomolecular Interactions: Health, Disease and Drug Design</td>
</tr>
</tbody>
</table>

**Total Credits**: 13

1. AP scores of 4 or 5 may substitute Math courses.
2. Biology courses for concentration credit include those numbered between 0100-2999. Exclusions: BIOL 1070, 1920 series courses, and BIOL 1980 can only be used as related sciences with advisor approval and do not fulfill advanced course requirements.
3. At least two biology and/or neuroscience courses must be at the advanced level (between 1000-2999). At least three of the biology and/or neuroscience courses must include laboratory or fieldwork. BIOL 1950/1960 can count for one of the three lab course requirements and one advanced course.
4. No substitutions per above Area list. If a course is listed in more than one area, it may be used to fulfill one area only; the other area must be fulfilled by a different course.

**Stipulations for Biology Programs:**

1. For double concentrations, no more than two courses may overlap (i.e., be used to meet requirements of both programs). This includes prerequisite courses.
2. No more than two semesters of directed research may be used as concentration credits. Each does count as an individual core towards the program, but only carry one lab credit towards the three required.

**Honors:** Honors in biology requires a thesis and presentation based on a research project (usually conducted via BIOL 1950/BIOL 1960), and quality grades in the concentration. Guidelines and information on faculty research are available in the Office of Biology Undergraduate Education or at [http://www.brown.edu/academics/biology/undergraduate-education/](http://www.brown.edu/academics/biology/undergraduate-education/).
3. A limited number of transfer or study abroad courses may be used within the program, subject to approval of advisor, and Associate Dean of Biology, Katherine Smith.