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.

The Biology A.B. Concentration Worksheet (https://bue.brown.edu/concentrations/biology-ab/) may be a useful tool for course planning.

Prerequisites: [1]		
CHEM 0330	Equilibrium, Rate, and Structure	
CHEM 0350	Organic Chemistry I	
MATH 0090	Single Variable Calculus, Part I (or placement. MATH 0050/MATH 0060 may be substituted for MATH 0090.)	
One of the following:		
MATH 0100	Single Variable Calculus, Part II (or placement)	
MATH 0170	Single Variable Calculus, Part II (Accelerated) (or equivalent placement)	
Or a statistics course, to be approved by the concentration advisor.		
Ten Core Courses: [2,3,4]		
BIOL 0200	The Foundation of Living Systems (Required course; AP credit or similar IB or A-levels accepted, placement test available.)	1
Area 1 (Cell/Molecular Biology)		**1**
BIOL 0280	Biochemistry	
BIOL 0470	Genetics	
BIOL 0500	Cell and Molecular Biology	
BIOL 0510	Introductory Microbiology	
BIOL 0530	Principles of Immunology	
BIOL 1050	Biology of the Eukaryotic Cell	
BIOL 1310	Developmental Biology	
BIOL 1515	Conservation in the Genomics Age	
BIOL 1810	21st Century Applications in Cell and Molecular Biology	
BIOL 1865	Toxicology	
NEUR 1020	Principles of Neurobiology	
Area 2 (Structure/Function)		**1**
BIOL 0410	Invertebrate Zoology	
BIOL 0440	Inquiry in Plant Biology: Analysis of Plant Growth, Reproduction and Adaptive Responses	
BIOL 0800	Principles of Physiology	
BIOL 1120	Biomaterials	
BIOL 1155	Hormones and Behavior	
BIOL 1310	Developmental Biology	
BIOL 1330	Biology of Reproduction	
BIOL 1505	Environmental Physiology	
BIOL 1865	Toxicology	
BIOL 1885	Human Anatomy and Biomechanics	
NEUR 0010	The Brain: An Introduction to Neuroscience	
Area 3 (Organismal Biology)		**1**
BIOL 0210	Diversity of Life	
BIOL 0380	The Ecology and Evolution of Infectious Disease	
BIOL 0410	Invertebrate Zoology	
BIOL 0420	Principles of Ecology	
BIOL 0430	The Evolution of Plant Diversity	
BIOL 0450	Evolutionary Behavioral Ecology	
BIOL 0480	Evolutionary Biology	
BIOL 1480	Terrestrial Biogeochemistry and the Functioning of Ecosystems	
BIOL 1515	Conservation in the Genomics Age	
ENVS 0490	Environmental Science in a Changing World	
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.		6
SENIOR CAPSTONE: *Only apples 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, 1140, 1150, 1250, 1330, 1515, 1525, 1535, 1555, 1575, 1600, 1820, 1970A.		
2. One semester of independent research/independent study (BIOL 1950 or BIOL 1960).		
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.

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 or one lab 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, a semester can count for one of the three lab course requirements.

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 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 all 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.

The Biology Sc.B. Concentration Worksheet (https://bue.brown.edu/concentrations/biology-scb/) may be a useful tool for course planning.

Prerequisites: [1]		
MATH 0090	Single Variable Calculus, Part I (or placement. MATH 0050/MATH 0060 may be substituted for MATH 0090)	
One of the following:		
MATH 0100	Single Variable Calculus, Part II (or placement)	
or MATH 0170	Single Variable Calculus, Part II (Accelerated)	
or a statistics course to be approved by the concentration advisor		
Each of the following:		
CHEM 0330	Equilibrium, Rate, and Structure (or IB credit)	
CHEM 0350	Organic Chemistry I	
CHEM 0360	Organic Chemistry II	
or BIOL 0280	Biochemistry	
PHYS 0030	Basic Physics A (or equivalent. PHYS 0050 PHYS 0070, or ENGN 0040 may be substituted for PHYS 0030.)	
PHYS 0040	Basic Physics B (or equivalent. PHYS 0060 or ENGN 0510 may be substituted for PHYS 0040.)	
Core Courses: [2,3,4]		
BIOL 0200	The Foundation of Living Systems (or placement)	1
Area 1 (Cell/Molecular Biology)		**1**
BIOL 0280	Biochemistry	
BIOL 0470	Genetics	
BIOL 0500	Cell and Molecular Biology	
BIOL 0510	Introductory Microbiology	
BIOL 0530	Principles of Immunology	
BIOL 1050	Biology of the Eukaryotic Cell	
BIOL 1310	Developmental Biology	
BIOL 1515	Conservation in the Genomics Age	
BIOL 1810	21st Century Applications in Cell and Molecular Biology	
BIOL 1865	Toxicology	
NEUR 1020	Principles of Neurobiology	
Area 2 (Structure/Function)		**1**
BIOL 0410	Invertebrate Zoology	
BIOL 0440	Inquiry in Plant Biology: Analysis of Plant Growth, Reproduction and Adaptive Responses	
BIOL 0800	Principles of Physiology	
BIOL 1120	Biomaterials	
BIOL 1155	Hormones and Behavior	
BIOL 1310	Developmental Biology	
BIOL 1330	Biology of Reproduction	
BIOL 1505	Environmental Physiology	
BIOL 1865	Toxicology	
BIOL 1885	Human Anatomy and Biomechanics	
NEUR 0010	The Brain: An Introduction to Neuroscience	
Area 3 (Organismal Biology)		**1**
BIOL 0210	Diversity of Life	
BIOL 0380	The Ecology and Evolution of Infectious Disease	
BIOL 0410	Invertebrate Zoology	
BIOL 0420	Principles of Ecology	
BIOL 0430	The Evolution of Plant Diversity	
BIOL 0450	Evolutionary Behavioral Ecology	
BIOL 0480	Evolutionary Biology	
BIOL 1480	Terrestrial Biogeochemistry and the Functioning of Ecosystems	
BIOL 1515	Conservation in the Genomics Age	
ENVS 0490	Environmental Science in a Changing World	
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 research. [4]		6
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:		
BIOL 1950	Directed Research/Independent Study	
BIOL 1960	Directed Research/Independent Study	
NEUR 1970	Independent Study	
Independent study course in a related discipline (i.e. STEM disciplines, ENVS, PHP, etc.) if the project is relevant to the student's learning goals and interests in 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 Achilli.		
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, Evolution and Organismal Biology; Physiology and Biotechnology; Neurobiology; Physical Sciences; 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 the concentration advisor.	3
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.

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/ BIOL 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.

Tracks

Biomedical Informatics - BIOL 1535 is required for this track along with 2 additional courses from the following (Additional advanced courses will be considered w/ advisor approval):

BIOL 1555	Methods in Informatics and Data Science for Health
BIOL 1575	Evaluation of Health Information Systems
BIOL 1595	Artificial Intelligence in Health Care

Cell and Molecular Biology

Three courses, for example:	
BIOL 1050	Biology of the Eukaryotic Cell
BIOL 1222A	Current Topics in Functional Genomics
BIOL 1270	Advanced Biochemistry
BIOL 1300	Biomolecular Interactions: Health, Disease and Drug Design
BIOL 1310	Developmental Biology
BIOL 1330	Biology of Reproduction
BIOL 1540	Molecular Genetics
BIOL 1545	Human Genetics and Genomics
BIOL 1580	Metabolism Across Biological Scales: Integrative Physiology and Pathobiology
BIOL 1810	21st Century Applications in Cell and Molecular Biology
BIOL 1820	Environmental Health and Disease
BIOL 1865	Toxicology
BIOL 1970A	Stem Cell Biology

Ecology, Evolution and Organismal Biology

Three courses, for example:	
BIOL 1430	Foundations of Population Genetics
BIOL 1435	Computational Methods for Studying Demographic History with Molecular Data
BIOL 1440	Marine Biology
BIOL 1465	Human Population Genomics
BIOL 1470	Conservation Biology
BIOL 1480	Terrestrial Biogeochemistry and the Functioning of Ecosystems
BIOL 1505	Environmental Physiology
BIOL 1515	Conservation in the Genomics Age
BIOL 1545	Human Genetics and Genomics
BIOL 1800	Animal Locomotion
BIOL 1885	Human Anatomy and Biomechanics
ENVS 1775	Biogeography

Immunobiology

Three courses, for example:	
BIOL 1250	Host-microbiome Interactions in Health and Disease
BIOL 1290	Cancer Biology
BIOL 1295	Fundamentals of Cancer Immunotherapy
BIOL 1520	Innate Immunity
BIOL 1525	Pathogenomics: Analysis, interpretation and applications of microbial genomes
BIOL 1550	Parasitism: Biology and Disease
BIOL 1560	Virology
BIOL 1600	Development of Vaccines to Infectious Diseases

Neurobiology

Three courses, for example:	
BIOL 1100	Cell Physiology and Biophysics
BIOL 1110	Topics in Signal Transduction
BIOL 1260	Physiological Pharmacology
BIOL 1650	Structure of the Nervous System
BIOL 1610	Experimental Neurobiology
NEUR listings 1000-level or above	

Physiology and Biotechnology

Three courses, for example:	
BIOL 1070	Biotechnology and Global Health
BIOL 1090	Polymer Science for Biomaterials
BIOL 1100	Cell Physiology and Biophysics
BIOL 1110	Topics in Signal Transduction
BIOL 1120	Biomaterials
BIOL 1140	Tissue Engineering
BIOL 1150	Stem Cell Engineering
BIOL 1160	Principles of Exercise Physiology
BIOL 1260	Physiological Pharmacology
BIOL 1300	Biomolecular Interactions: Health, Disease and Drug Design
BIOL 1505	Environmental Physiology
BIOL 1580	Metabolism Across Biological Scales: Integrative Physiology and Pathobiology
BIOL 1810	21st Century Applications in Cell and Molecular Biology
BIOL 1820	Environmental Health and Disease
BIOL 1865	Toxicology
BIOL 1885	Human Anatomy and Biomechanics

Physical Sciences

Must be a coherent set of three courses drawn from the Physical Sciences; courses must be above the introductory level and approved by advisor	

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/.

Stipulations for Biology Programs:

1. For double concentrations, no more than two courses may overlap (i.e., be used to meet requirements of both concentrations) with a few specific exceptions (https://college.brown.edu/sites/g/files/

dprerj916/files/2022-04/2-Course-Overlap-Exceptions-list-and-rule-for-web.docx).

2. No more than two semesters of directed research may be used as concentration credits. Each does count as an individual core course towards the program, but only carry one lab credit or one 1000-level credit towards the three required.
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, Toni-Marie Achilli.

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