BIOLOGICAL SCIENCES

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Biology explores the structure, function, and evolution of diverse living systems. It addresses some of the most important issues of our time—genetic engineering, stem cell research, obesity, cancer, and the effects of global warming. Majoring in Biology prepares students to pursue a career in research, teaching, or the allied health sciences. It is also relevant to careers as diverse as environmental policy, law, public health, creative writing, and textbook development.

Mission

The mission of the Biology major is to provide students with a broad education in biology. To this end, students are offered a range of lecture courses that span the molecular, physiological, and ecological levels of organization. Students also complete laboratory courses that help them learn how to design and test hypotheses, use modern scientific equipment, and interpret data. Finally, students learn scientific communication skills by critiquing research articles, writing laboratory reports and research papers, and participating in oral presentations and debates. The department encourages students to become involved in a research project under the guidance of a faculty member at Barnard or elsewhere in New York City.

Student Learning Outcomes

Students graduating with a major in Biology should be able to attain the following outcomes:

- Demonstrate an appreciation of the many different life forms on planet Earth.
- Have the ability to discuss a biological phenomenon from many different levels of organization (e.g., discuss HIV from the perspective of structure to host immune response to evolutionary and epidemiological issues).
- Describe the basic features of Mendelian genetics and the central dogma of molecular biology; understand the basic physiological processes of at least one organism; and demonstrate an understanding of population-level processes.
- Make an oral presentation on either an original research project or a published primary research paper.
- Generate a testable hypothesis and develop and execute a controlled experimental design.
- Write an original scientific paper and/or a review article.

Research

Students are strongly encouraged to engage in research at Barnard. Either or both year-long courses, BIOL BC3591 Guided Research and Seminar-BIOL BC3592 Guided Research and Seminar or BIOL BC3593 Senior Thesis Research & Seminar-BIOL BC3594 Senior Thesis Research & Seminar, may be used to fulfill major requirements while the variable-credit semester-long course, BIOL BC3597 Guided Research, may be used for degree credit.

In addition to conducting research during the academic year, students are encouraged to pursue summer research internships. Barnard faculty engage many students in paid research projects during the summer through the Summer Research Institute (SRI) (https://barnard.edu/summer-research-institute/) at Barnard. The departmental office also has information about summer internships outside of Barnard. In addition, the department awards funds on a competitive basis to support summer research not otherwise funded by internships.

Introductory Course Selection

The Biology Department offers several options at the introductory level; students should select courses on the basis of their preparation and background in biology.

Students who took advanced biology in high school should enroll in the 1500-level sequence. This sequence can be started either in the fall (BIOL BC1500 Introduction to Organismal and Evolutionary Biology & BIOL BC1501 Introductory Lab in Organismal and Evolutionary Biology) or the spring (BIOL BC1502 Introduction to Cell and Molecular Biology & BIOL BC1503 Introductory Lab in Cell and Molecular Biology) and fulfills the science lecture and laboratory portion of the General Education Requirements, as well as the premedical requirement in biology. Please note that the Foundations distributional requirements for the sciences includes two science lecture courses, one of which must include a laboratory, but both of which do not necessarily need to be taken from the same scientific discipline.

Students with little or no experience in biology should enroll in the 1000-level sequence, which provides an appropriate introduction to important concepts in the field. Offered in the fall, BIOL BC1002 Global Health and Ecology includes a laboratory component, while BIOL BC1001 Revolutionary Concepts in Biology, offered in the spring, consists only of a lecture component. Taken together, these two lectures and laboratory fulfill the science General Education Requirement.

Students who wish to move on to the 1500-level courses are eligible to do so upon completion of BIOL BC1002 Global Health and Ecology with lab in the fall. Students must complete the entire 1500-level sequence (BIOL BC1500 Introduction to Organismal and Evolutionary Biology, BIOL BC1501 Introductory Lab in Organismal and Evolutionary Biology, BIOL BC1502 Introduction to Cell and Molecular Biology, and BIOL BC1503 Introductory Lab in Cell and Molecular Biology) for the Biology major or minor and for the biology premedical requirements.

AP Course Credit

Students who have passed the Advanced Placement examination in biology with a grade of 4 or 5 receive 3 points of credit toward their degree. However, AP credit neither goes toward fulfillment of the science GER nor does it exempt a student from any introductory course.

AP degree credit is granted regardless of which introductory courses are completed at Barnard.

Chair: Hilary Callahan
Professor Emeritus: Philip Ammirato
Professors: Hilary Callahan, John Glendinning, Paul Hertz, Jennifer Mansfield, and Brian Morton
Requirements for the Major

There are four ways to complete a major in Biology. A student can obtain a general Biology Major or may complete one of the three majors that concentrate on a specific level of biological organization: Cellular and Molecular; Physiology and Organismal; or Ecology and Evolutionary.

**Introductory Biology**

You may begin the introductory sequence with BIOL BC1002 Global Health and Ecology and the co-requisite lab BIOL BC1012 in the fall of your freshman year, but for the major you must then complete the entire 1500-level sequence the subsequent spring and fall. Please note that starting in Fall 2020, in order to enroll in BIOL BC1500 or BIOL BC1502, you will need to sign up for a co-requisite discussion section. With the exception of AY20-21, you will also need to enroll in a co-requisite recitation section in order to enroll in either BIOL BC1501 or BIOL BC1503 lab.

<table>
<thead>
<tr>
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**Genetics**

BIOL BC2100 Molecular and Mendelian Genetics 3

It is recommended, but not required, that this be taken immediately following the completion of the 1500-level courses.

**Five Upper Level Lecture Courses**

All Biology majors must complete five upper-level courses, with category distribution requirements, and the courses that fulfill each category listed below. To complete the Biology Major without a concentration, the five courses must include at least one course from each of the three categories. To complete one of the three concentrations, at least four courses must be from the appropriate category and at least one must be from another category. Although some courses are listed in multiple categories, a student can only use a course towards one of the categories. Additional Columbia courses that can be used to fulfill the major requirements are provided on the Biology website (biology.barnard.edu). If a student completes courses that make them eligible for more than one of the four majors, they may select which one is reflected on their transcript.

1. **Cellular & Molecular Biology**

<table>
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<tr>
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<tr>
<td>BIOL BC2490</td>
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<td>Topics in Molecular Genetics</td>
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<tr>
<td>BIOL BC3308</td>
<td>Genomics and Bioinformatics</td>
<td>3</td>
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<tr>
<td>BIOL BC3310</td>
<td>Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL BC3320</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL BC3352</td>
<td>Development</td>
<td>3</td>
</tr>
<tr>
<td>BIOL BC3362</td>
<td>Molecular and Cellular Neuroscience</td>
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2. **Physiology & Organismal Biology**

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<tr>
<td>BIOL BC2280</td>
<td>Animal Behavior</td>
<td>3</td>
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<td>Statistics and Research Design</td>
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<td>Neurobiology II: Development &amp; Systems</td>
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<td>EEEB UN3011</td>
<td>Behavioral Biology of the Living Primates</td>
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<td>EEEB UN3208</td>
<td>Explorations in Primate Anatomy</td>
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<tr>
<td>EEEB W4112</td>
<td>Ichthyology</td>
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3. **Ecology & Evolutionary Biology**

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<td>BIOL BC2262</td>
<td>Vertebrate Biology</td>
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<td>BIOL BC2272</td>
<td>Ecology</td>
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<td>Statistics and Research Design</td>
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<tr>
<td>BIOL BC2851</td>
<td>Plants and Profits: The Global Power of Botany</td>
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<td>BIOL BC3320</td>
<td>Microbiology</td>
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<td>Applied Ecology and Evolution</td>
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<td>Conservation Biology</td>
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<td>EEEB W4110</td>
<td>Coastal and Estuarine Ecology</td>
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**Three Upper Level Laboratory Courses**

Students must complete at least three Biology laboratories beyond the 1500 level. Laboratories may require a lecture course as a co-requisite or prerequisite; such requirements are specified in the Barnard catalogue. A year-long research-seminar course (BIOL BC3591 followed by BIOL BC3592) may substitute for lab courses. Students may also take lab courses at Columbia (or other institutions) to satisfy the lab requirement, with permission from the Chair.

**Research Option**

A student may count two consecutive semesters of Guided Research and Seminar (BIOL BC3591 followed by BIOL BC3592) as a laboratory course for the major. Guided Research (BIOL BC3597) counts for degree credit but does not count toward the major. A student may not receive credit for research that is paid.

**Senior Capstone Experience**

Students must enroll in one section of Senior Seminar (BIOL BC3590) or complete two semesters of Senior Thesis Research Seminar (BIOL BC3593 followed by BIOL BC3594). A student cannot take both Senior Thesis Research and Guided Research and Seminar at the same time.

**Chemistry Requirement**

One semester of General Chemistry (with laboratory) and one semester of Organic Chemistry (with laboratory) are required.

**Requirement for the Minor**

A minor in biology includes:

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<td>CHEM BC3282</td>
<td>Biological Chemistry</td>
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<td>BIOL UN3034</td>
<td>Biotechnology</td>
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<td>BIOL UN3073</td>
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<tr>
<td>BIOL UN3310</td>
<td>Virology</td>
<td>3</td>
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**Listed below are the courses that fulfill each category.**
Biology

**HSPP BC1002 Research Apprenticeship Seminar. 3 points.**
This year-long course is 3 pts (1.5/semester)

Prerequisites: This course is open to 16 first-year students who are also enrolled in an introductory lab science sequence; applications will be made available via the first-year class blog through the Dean of Studies Office.

The course will meet in a seminar format, and will discuss how research problems are defined, how scientists immerse themselves in the existing literature on a topic, how researchers craft experimental protocols and collect data, and how data can be used to test hypotheses. Students will also consider science stories in the New York Times and lead formal debates about ethical and social issues. Occasionally, the seminar period will be devoted to tours of faculty science labs to learn about the research that Barnard professors conduct and the research opportunities available on campus.

Additionally, students will participate in a month-long laboratory rotation each semester. During the rotation period, each student will spend 3 hours per week shadowing a Barnard junior or senior Research Intern who is conducting a year-long research project. In addition to this exposure to research at Barnard, students will discuss how to obtain summer science internships in laboratories off campus. Seminar assignments will include readings about the research process, as well as short library-based research projects about scientific claims in textbooks. In the fall, students will develop their presentation skills in a session with Barnard’s Speaking Fellows. In the spring, each student will deliver an oral presentation about the research career of a scientist of her choosing.

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**BIOI BC1008 HEALTHIER LIFE. 3.00 points.**
This is an introductory biology survey course which explores fundamentals of physiology in humans and other organisms, both in the context of global health and global ecological issues. It emphasizes reciprocal interactions between individual healthy humans and healthy societies, and the function of ecosystems in supporting humans and other biodiversity

Fall 2020: BIOI BC1008

<table>
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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<td>Callahan</td>
<td>3.00</td>
<td>22/60</td>
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**BIOI BC1002 Global Health and Ecology. 4.5 points.**
Prerequisites: BIOI BC1012 lab enrollment is required. This lecture & lab course does not fulfill biology major nor pre-health requirements, but is recommended for prospective biology majors who lack a high-school level background in biology. For students fulfilling a Nine Ways of Knowing lab science requirement, this course may be taken with AP/IB credit OR with BIOI BC1502 & BIOI BC1503 in the spring. Students fulfilling a Foundations requirement may take BIOI BC1002/BIOI BC1012 as a one-semester course in addition to another science lecture, such as BIOI BC1001 Revolutionary Concepts in Biology, to fulfill the lab science requirement.

What disease is the number one killer worldwide? What will be the next pandemic? Fundamentals of human physiology and microbiology are explored in the context of major global health issues. Principles of ecology are outlined, with an emphasis on the bidirectional impact of the interactions of humans with the global environment. Lab exercises introduce biological techniques for studying these topics. **Enrollment in BIOI BC1012 (BC1002 lab) is required**, and limited to 16 students per section.
BIOL BC1012 BIOL BC1002 Lab. 0 points.
Prerequisites: BIOL BC1002 Global Health & Ecology is a co-requisite.
This lab course does not fulfill biology major nor pre-health requirements.
Enrollment in each lab section is limited to 16 students per section.
Students must attend the first lab to hold their place.
Fundamentals of human physiology and microbiology are explored in the context of major global health issues. Principles of ecology are outlined, with an emphasis on the bidirectional impact of the interactions of humans with the global environment. Lab exercises introduce biological techniques for studying these topics.

BIOL BC1001 Revolutionary Concepts in Biology. 3 points.
Prerequisites: This lecture course does not fulfill Biology major nor premedical requirements, but does count toward the Science Lecture GER requirement for students fulfilling a Foundations requirement.
Exploration of the major discoveries and ideas that have revolutionized the way we view organisms and understand life. This is an introductory survey course that explores basic concepts of molecular and cellular biology, genetics and evolution. Students will focus on biological concepts, biotechnology and bioethics, which inundate contemporary society.

BIOL BC1500 Introduction to Organismal and Evolutionary Biology. 3 points.
Prerequisites: This course is suitable for majors & fulfillment of pre-health requirements. A high school biology background or equivalent preparation is highly recommended. For those without this background seeking to major in biology, BIOL BC1002 & BIOL BC1012 are recommended in the fall of their freshmen year, followed by the year-long 1500-level lecture & lab sequence. BIOL BC1500 & BIOL BC1502 do not have to be taken in a fall to spring sequence.
Detailed introduction to biological phenomena above the cellular level; development, anatomy, and physiology of plants and animals; physiological, population, behavioral, and community ecology; evolutionary theory; analysis of micro-evolutionary events; and systematics.

BIOL BC1510 BIOL BC1500 DISCUSSION SECTION. 0.00 points.
The goals of these discussion sections include providing a space to build community during remote learning and promoting opportunities for active engagement with the lecture material. These discussion sections will also serve as a space for students to consider science from multiple perspectives beyond discipline-specific content in the lecture and text (e.g. hearing guest lectures from BIPOC scientists, considering racial disparities in health outcomes, etc.). Participation will include posting on discussion boards between sessions, delivering short presentations during discussion, working well with partners, and making thoughtful comments during the discussion period.

Fall 2020: BIOL BC1500

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Fall 2020: BIOL BC1510

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<td>003/00828</td>
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<td>BIOL 1510</td>
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BIOL BC1501 Introductory Lab in Organismal and Evolutionary Biology. 2 points.
Prerequisites: BIOL BC1500 lecture is a pre- or co-requisite (preferred). Students must also enroll for a section of BIOL BC1511 recitation. A high school biology background or equivalent preparation is highly recommended. This course is suitable for fulfillment of biology major and pre-health requirements. Enrollment is limited to 16 students per section. A laboratory-based introduction to the major groups of living organisms; anatomy, physiology, evolution, and systematics; and laboratory techniques for studying and comparing functional adaptations.

Fall 2020: BIOL BC1501

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BIOL BC1511 BIOL BC1501 Recitation. 0 points.
Prerequisites: BIOL BC1500 lecture is a pre- or co-requisite (preferred). This recitation (BIOL BC1511) is a co-requisite course for enrollment in BIOL BC1501 Introductory Lab in Organismal & Evolutionary Biology. Each individual lab section is limited to 16 students per section, however all students must enroll in one of the two recitation sections offered. A laboratory-based introduction to the major groups of living organisms; anatomy, physiology, evolution, and systematics; and laboratory techniques for studying and comparing functional adaptations.

BIOL BC1502 Introduction to Cell and Molecular Biology. 3 points.
Prerequisites: BIOL BC1002 or equivalent preparation. Course suitable for fulfillment of premedical requirements. Together with BIOL BC1500 this course is part of a yearlong introductory sequence. BIOL BC1500 and BIOL BC1502 do not need to be taken in sequence. Detailed introduction to cellular and subcellular biology: cell structures and functions, energy metabolism, biogenesis of cell components, biology of inheritance, molecular genetics, regulation of gene expression, and genes in development.

BIOL BC1503 Introductory Lab in Cell and Molecular Biology. 2 points.
Prerequisites: BIOL BC1502 lecture is a pre- or co-requisite (preferred). Students must also enroll for a section of BIOL BC1513 recitation. A high school biology background or equivalent preparation (such as BIOL BC1002 & BIOL BC1012) is highly recommended. This course is suitable for fulfillment of biology major and pre-health requirements. Enrollment is limited to 16 students per section; must attend first lab to hold place. A laboratory-based introduction to cell and molecular biology. Both classic and modern approaches are used to investigate principles of heredity as well as the structure and function of cells and their molecular components. Lab exercises introduce practical techniques and data analysis.

BIOL BC1513 BIOL BC1503 Recitation. 0 points.
Prerequisites: BIOL BC1502 lecture is a pre- or co-requisite (preferred). This recitation (BIOL BC1513) is a co-requisite course for enrollment in BIOL BC1503 Introductory Lab in Cell & Molecular Biology. Each individual lab section is limited to 16 students per section, however all students must enroll in one of the two recitation sections offered. A laboratory-based introduction to cell and molecular biology. Both classic and modern approaches are used to investigate principles of heredity as well as the structure and function of cells and their molecular components. Lab exercises introduce practical techniques and data analysis.
BIOL BC1599 Science Journal Club. 1 point.
Prerequisites: ) Limited to 16 students who are participating in the Science Pathways Scholars Program.
Students in this seminar course will be introduced to the scientific literature by reading a mix of classic papers and papers that describe significant new developments in the field. Seminar periods will be devoted to oral reports, discussion of assigned reading, and student responses.

, Section 1: Limited to students in the Science Pathways Scholars Program.
,Section 2: Limited to first-year students who received a 4 or 5 on the AP and are currently enrolled in BIOL BC1500.

Fall 2020: BIOL BC1599
Course Number Section/Call Times/Location Instructor Points Enrollment
BIOL 1599 001/00090 T 3:00pm - 4:00pm, Room TBA Sedelia 1 15/16

BIOL BC2100 Molecular and Mendelian Genetics. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or the equivalent. This course is a pre-requisite for most 3000-level courses. Mendelian and molecular genetics of both eukaryotes and prokaryotes, with an emphasis on human genetics. Topics include segregation, recombination and linkage maps, cytogenetics, gene structure and function, mutation, molecular aspects of gene expression and regulation, genetic components of cancer, and genome studies.

Fall 2020: BIOL BC2100
Course Number Section/Call Times/Location Instructor Points Enrollment
BIOL 2100 001/00091 T 10:10am - 11:25am, Room TBA Brian Morton 3 49/50

BIOL BC2240 Plant Evolution and Diversity. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or the equivalent.
Survey of plant biology emphasizing evolutionary and ecological perspectives on mating and reproduction, physiology, anatomy, and morphology.

BIOL BC2262 Vertebrate Biology. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, and BIOL BC1503 or the equivalent.
Systematic survey of the Phylum Chordata: fossil history, biogeography, systematics, natural history, body architecture, energetics, locomotion, feeding, and behavior.

BIOL BC2272 Ecology. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or the equivalent. This course is a pre- or co-requisite for BIOL BC2873 Laboratory in Ecology.
Introduction to evolutionary ecology; life history strategies, population growth, competition, predator-prey interactions, population regulation, species diversity, community organization, and biogeography. Lectures integrate theory with empirical studies.

BIOL BC2278 Evolution. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or the equivalent.
Study of the process of evolution with an emphasis on the mechanisms underlying evolutionary change. Topics include the origins of life, rates of evolutionary change, phylogenetics, molecular evolution, adaptive significance of traits, sexual selection, and human evolution.

BIOL BC2280 Animal Behavior. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, and BIOL BC1503 or the equivalent. This course is a pre-requisite for BIOL BC2281 Laboratory in Animal Behavior.
This introduction to animal behavior takes an integrative approach to understand the physiological and genetic basis of behavior, the ecological context of behavior, and the evolutionary consequences of behavior. This course focuses on the process of scientific research, including current research approaches in animal behavior and practical applications of these findings.

BIOL BC2281 Laboratory in Animal Behavior. 3 points.
standard for lab courses in Biology
Prerequisites: (BIOL BC1500) and (BIOL BC1502) and (BIOL BC2280) and (BIOL BC1501) and (BIOL BC1503)
This lab provides an introduction to animal behavior research, including current research approaches and practical applications of these findings. Students will complete two main projects. The first is a group project using the fruit fly Drosophila melanogaster, which will involve observing, recording, and analyzing reproductive behaviors. The second is an independent project that will be designed, conducted, and analyzed by students using publicly available animal behavior resources and/or data. Both projects will incorporate critical thinking, problem solving and experimental design, with an emphasize on scientific writing and oral presentation skills.

BIOL BC2286 Statistics and Research Design. 3 points.
Not offered during 2020-21 academic year.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or the equivalent, college-level algebra or the equivalent. General Educational Requirement: Quantitative and Deductive Reasoning (QUA)
Introduction to basic principles of statistics and experimental design. Topics include common statistical procedure, analysis of data, sampling populations, power analysis, and the design of experiments. This course differs from traditional statistics courses by explicitly integrating statistics into research process.

BIOL BC2490 Coding in Biology. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503, BIOL BC2100
An introduction to the basics of Python and R coding in the context of solving basic problems in molecular biology. Python will be used to write programs that analyze various features of DNA sequence data and R will be used to analyze output from RNA-seq experiments. No prior programming experience is necessary. The work will involve modifying existing code as well as developing simple programs from the ground up.
BIOL BC2500 MATLAB for Scientists. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1502, and MATH UN1101
Introduction to MATLAB programming and numerical methods applied to the analysis of biological data. Topics range from foundational programming concepts and algorithms and an introduction to MATLAB, to more advanced concepts such as data visualization, curve fitting and data interpolation, basic statistical methods, modeling biological systems of ordinary differential equations, and image analysis.

BIOL BC2801 Laboratory in Genetics. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503; and pre or corequisite, BIOL BC2100 and Enrollment limited to 16 students per section.
Exercises in genetics at both the Mendelian and molecular levels. Basic principles of genetic analysis will be studied using Drosophila and bacteria. A project in molecular genetics, involving such techniques as PCR, gel electrophoresis, and cloning, will be undertaken using plant genes.

BIOL BC2841 Laboratory in Plant Evolution and Diversity. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or equivalent. Enrollment is limited to 16; must attend first lab to hold place. Through field observations, experiments, statistical analyses and data synthesis, gain coding skills and insights into key tools and techniques for studying, managing, and conserving botanical biodiversity. Digital projects are integrated with studies of structure, ecology, biogeography, and evolution. Emphasis on plants in NYC's local environment.

BIOL BC2851 Plants and Profits: The Global Power of Botany. 4 points.
The course is part of the Barnard Teaches program. It will have a lab that will teach science and digital skills and on Thursdays two consecutive times are scheduled to allow lecture and lab to accommodate trips to NYBG. Not offered during 2020-21 academic year.
Prerequisites: Strongly recommend prior enrollment in BIOL BC1001 or 1002, or in BIOL BC 1501 and 1502, or the equivalent. Students need to understand genetics and must be prepared to read professional science literature. Science students must be prepared for lengthy reading assignments.
Sustaining complex human systems requires plants, which in turn depend on soils, geology, and climate. With that reality in the forefront, this course will foster fluency and expertise in classical and cutting edge botanical science: genetics, genomics, biogeography, conservation biology, economic and ethno-botany. At the center of its investigations will be the ongoing digital revolution, recognizing that natural history has been and will continue to be essential to all of the plant sciences. The course will encourage interdisciplinary perspectives, pushing students outside of their intellectual comfort zones and aiming to comprehend plant biodiversity from a multiplicity of human perspectives.

BIOL BC2873 Laboratory in Ecology. 3 points.
Not offered during 2020-21 academic year.
Prerequisites: BIOL BC2272 (which can be taken as a pre- or co-requisite). Enrollment is limited to 16; must attend first lab to hold place. The definition of ecological problems in experimentally tractable ways; the design of experiments and analysis of ecological data; class projects on population ecology. Students conduct individual projects during last month of term.

BIOL BC3303 Laboratory in Molecular Biology. 3 points.
Prerequisites: BIOL BC2100 (which can be taken as a pre- or co-requisite). Enrollment is limited to 16; must attend first lab to hold place. Introduction to the use of molecular techniques to answer questions about subcellular biological phenomena. Techniques include isolation of genomic and plasmid DNAs, restriction enzyme analysis, DNA and protein electrophoresis, bacterial transformation, and plasmid subcloning.

BIOL BC3304 Topics in Molecular Genetics. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503, BIOL BC2100 or equivalent Selected topics in molecular genetics and gene regulation, with a focus on examples from human evolution, physiology, and disease. The course will be organized into four modules with combined lecture and journal club-style discussion. Module topics include molecular regulation of transcription, epigenetic regulation of the genome, gene regulatory networks, and genome architecture and evolution. We will draw from examples in the current literature and explore current experimental approaches in molecular genetics of humans and model organisms.

BIOL BC3305 PROJECT LAB IN MOLECULAR GENETICS. 3.00 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503, and BIOL BC2100 or permission of instructor. Enrollment limited to 16. Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503, and BIOL BC2100 or permission of instructor. Enrollment limited to 16. Laboratory course in which students conduct original research projects in molecular genetics. Students will participate in experimental design, conduct and data analysis, and work with key techniques for studying gene structure, expression and function such as nucleic acid extraction and synthesis, cloning, bioinformatics analysis, PCR and qPCR. Students will present their results orally and in writing. Enrollment in both semesters (BIOL BC3305 and BIOL BC3306) of this full-year course is required, and fulfills two upper-level lab courses for the Barnard Biology major. Must be taken in sequence, beginning in the fall. -B. Morton - J. Mansfield
BIOL BC3306 Project Laboratory in Molecular Genetics. 3 points.
Prerequisites: BIOL BC2100 or permission of the instructors. Enrollment is limited to 16; must attend first lab to hold place.
Laboratory course in which students conduct original research projects in molecular genetics. Students will participate in experimental design, conduct data analysis, and work with key techniques for studying gene structure, expression, and function including nucleic acid extraction and synthesis, cloning, bioinformatics analysis, PCR, and qPCR. Students will present their results orally and in writing. Enrollment in both semesters (BIOL BC3305 and BIOL BC3306) of this full-year course is required, and fulfills two upper-level lab courses for the Barnard Biology major. Must be taken in sequence, beginning in the fall.

BIOL BC3308 Genomics and Bioinformatics. 3 points.
Not offered during 2020-21 academic year.
Prerequisites: (BIOL BC1500)(BIOL BC1501)(BIOL BC1502)(BIOL BC1503) and BIOL BC2100 or the equivalent. This course is an upper-level laboratory. Advanced topics in genetics focusing on genome-level features and methods of sequence analysis. The primary emphasis of the course will be on microbial genomic and metagenomic applications, but many of the techniques will be applicable to eukaryotic genomics and medical genomics as well. Through this course students will become comfortable with the command line interface, learn basic programming skills, be exposed to a variety of online tools, and become proficient in a number of genomic software packages.

BIOL BC3310 Cell Biology. 3 points.
Prerequisites: (BIOL BC1500)(BIOL BC1501)(BIOL BC1502)(BIOL BC1503) and BIOL BC2100 or the equivalent. This course explores the components, systems, and regulatory mechanisms involved in eukaryotic cellular function. Topics include: signal transduction, translational and protein quality control, organellar and cytoskeletal dynamics, and some coordinated responses such as proliferation and programmed cell death. Throughout the course we will see how general cell biology can be specialized to achieve specific cellular functions through regulation of the basic machinery. We will also explore the cellular and molecular bases for a variety of human pathologies, with an emphasis on cancer. In addition to lecture, we will spend some time discussing the material, including selected articles from the primary literature, and learning through group presentations.

BIOL BC3311 Laboratory in Cell Biology. 3 points.
Prerequisites: BIOL BC3310 (which can be taken as a pre- or co-requisite). Enrollment is limited to 16; must attend first lab to hold place. Introduction to cell biological techniques used to investigate structural, molecular, and physiological aspects of eukaryotic cells and their organization into tissues. Techniques include light and electron microscopy, cell culture, isolation of cellular organelles, protein electrophoresis, and Western Blot analysis.

BIOL BC3320 Microbiology. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503, and BIOL BC2100 or the equivalent. This course is a pre-requisite for BIOL BC3321 Laboratory in Microbiology. Survey of the diversity, cellular organization, physiology, and genetics of the major microbial groups. Also includes aspects of applied microbiology and biotechnology, the function of microorganisms in the environment, and the role of microbes in human diseases.

BIOL BC3321 Laboratory in Microbiology. 3 points.
Prerequisites: BIOL BC3320 (which can be taken as a pre- or co-requisite). Enrollment is limited to 16; must attend first lab to hold place. Provides experience in the isolation, cultivation, and analysis of pure cultures of microorganisms. Methods used for the study of cell structure, growth, physiology, and genetics of microbes will be incorporated into laboratory exercises.

BIOL BC3352 Development. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503, and BIOL BC2100 or the equivalent. This course is a pre-requisite for BIOL BC3354 Laboratory in Embryology. Introduction to animal developmental biology and its applications. This course will examine the basic mechanisms through which animal bodies organize themselves, from an integrative perspective at the levels of genes and gene networks, cell properties and behaviors, coordinated interactions of cells in developing tissues, organs and organ systems, and the role of developmental processes in morphological evolution. Topics include: fertilization, cleavage and gastrulation, establishment of body axes, neural development, organ formation, tissue and organ regeneration, stem cells and medical applications, evolution of developmental programs, and teratogenesis.

BIOL BC3354 LABORATORY IN EMBRYOLOGY. 3 points.
This lab course will explore the foundational methods of vertebrate embryology. Using both classical and modern experimental approaches, we will identify and manipulate developmental processes such as gastrulation, neurulation, and organogenesis. Students will investigate molecular regulation of patterning and the importance of tissue-tissue interactions during early development. Utilizing modern genetic tools and imaging techniques, such as digital microscopy, students will have the opportunity to visualize embryogenesis in real-time.
Prerequisite: Two terms of introductory biology (BIOL BC1500,BC1502 or equivalent) AND one term of Genetics (BIOL BC2100 or equivalent) AND at least one upper level lab course at the cell and molecular level. OR permission from the instructor.
BIOL BC3360 Physiology. 3 points.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, and BIOL BC1503 or the equivalent.
This course examines how mammals carry out basic functions like manipulating objects, sensing the external world, oxygenating tissues, and processing food. Emphasis is placed on (a) how the body regulates itself through the integrated action of multiple organ systems and (b) what goes awry in disease.

Fall 2020: BIOL BC3360
Course Number: BIOL 3360
Section/Call Number: 001/00097
Times/Location: M T W Th 11:40am - 12:55pm
Room: TBA
Instructor: John Glendinning
Points: 3
Enrollment: 56

BIOL BC3361 Laboratory in Physiology. 3 points.
Prerequisites: BIOL BC3360 (or equivalent, which can be taken as a pre- or co-requisite). Enrollment is limited to 16; must attend first lab to hold place.
Provides a hands-on introduction to the different physiological systems in vertebrates and invertebrates. Emphasizes the operation of a variety of physiological monitoring devices and the collection and analysis of physiological data.

BIOL BC3362 Molecular and Cellular Neuroscience. 3 points.
Prerequisites: (BIOL BC1500)(BIOL BC1501)(BIOL BC1502)(BIOL BC1503) and CHEM BC3230 or the equivalent.
Structure and function of neural membranes; ionic basis of membrane potential and action potential; synaptic transmission and neurochemistry; sensory transduction and processing; reflexes and spinal cord physiology; muscle structure and function; neuronal circuitry; and nervous system development.

Fall 2020: BIOL BC3362
Course Number: BIOL 3362
Section/Call Number: 001/00098
Times/Location: M T W Th F 12:00pm - 1:00pm
Room: TBA
Instructor: Elizabeth Bauer
Points: 3
Enrollment: 74/80

BIOL BC3363 Laboratory in Molecular and Cell Neuroscience. 3 points.
Prerequisites: BIOL BC3362 (which can be taken as a pre- or co-requisite). Enrollment is limited to 16; must attend first lab to hold place.
Introduction to techniques commonly used in current neurological research, including intracellular and extracellular recording of action potentials, neuroanatomical methods, and computer simulation of the action potential.

BIOL BC3367 Ecophysiology. 3 points.
Not offered during 2020-21 academic year.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, and BIOL BC1503, or the equivalent. BIOL BC2280 is recommended.
Individuals, communities and ecosystems are composed of complex organism-environment interactions. We will examine these dynamic relationships in animals at the physiological level, covering basic concepts as they specifically relate to animal fitness. Course focus: how changes in stress and reproductive endocrinology and ecoimmunology relate to individual and population dynamics.

BIOL BC3380 Applied Ecology and Evolution. 3 points.
Not offered during 2020-21 academic year.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or the equivalent.
Ecological and evolutionary models of populations (exponential and density-dependent growth; species interactions; genetic differentiation resulting from mating, random drift, and selection) applied to problems resulting from human-induced environmental change (endangered species; use of pesticides and antibiotics; escaping transgenic organisms; global climate change; emerging pathogens; other invaders; etc.)

BIOL BC3388 Tropical Ecology. 3 points.
Not offered during 2020-21 academic year.
Prerequisites: BIOL BC1500, BIOL BC1501, BIOL BC1502, BIOL BC1503 or the equivalent.
Focusing on tropical rain forests, the course explores the contemporary and historical ecological processes that generate and maintain species diversity in the tropics. Topics include biogeography and the latitudinal gradient of diversity, tropical climate and soils, origins of tropical ecosystems, causes and consequences of tropical deforestation, as well as unique ecological patterns and processes in specific tropical regions (Neotropics, African, and Asian tropics).
BIOL BC3591 Guided Research and Seminar. 4 points.
Per Semester

An independent research project in Biology under the guidance of a faculty member and suitting the needs of the individual student. A Barnard research mentor (if your lab is at Barnard) or internal adviser in the Biology Department (if your lab is elsewhere) must approve your planned research before you enroll in this year-long course. A Project Approval Form (https://forms.gle/mDNyT5CaEJkMMMWCt5/) must be submitted to the department in the fall.

Attendance at a weekly seminar is required. By the end of the year, students enrolled in BIOL BC3591-BIOL BC3592 will write a scientific paper and give a poster presentation of their work at the Barnard Biology Research Symposium. Completion of this year-long course fulfills two upper-level laboratory requirements for the major. Must be taken in sequence, beginning in the fall.

Fall 2020: BIOL BC3591

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BIOL BC3592 Guided Research and Seminar. 4 points.
Per Semester

An independent research project in Biology under the guidance of a faculty member and suitting the needs of the individual student. A Barnard research mentor (if your lab is at Barnard) or internal adviser in the Biology Department (if your lab is elsewhere) must approve your planned research before you enroll in this year-long course. A Project Approval Form (https://forms.gle/mDNyT5CaEJkMMMWCt5/) must be submitted to the department in the fall.

Attendance at a weekly seminar is required. By the end of the year, students enrolled in BIOL BC3591-BIOL BC3592 will write a scientific paper and give a poster presentation of their work at the Barnard Biology Research Symposium. Completion of this year-long course fulfills two upper-level laboratory requirements for the major. Must be taken in sequence, beginning in the fall.

Fall 2020: BIOL BC3593

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BIOL BC3593 Senior Thesis Research & Seminar. 4 points.
Per Semester

Prerequisites: Permission of a faculty sponsor and the department. Cannot be taken concurrently with BIOL BC3591 or BIOL BC3592. Same as BIOL BC3591-BIOL BC3592, including attendance at a weekly seminar. By the end of the year, students enrolled in BIOL BC3593-BIOL BC3594 will write a scientific paper and orally present their work at the Barnard Biology Research Symposium.

A Barnard research mentor (if your lab is at Barnard) or internal adviser in the Biology Department (if your lab is elsewhere) must approve your planned research before you enroll in this year-long course. A Project Approval Form (https://forms.gle/mDNyT5CaEJkMMMWCt5/) must be submitted to the department in the fall. Completion of this year-long course fulfills the senior capstone requirement for the major; it cannot be taken at the same time as BIOL BC3591-BIOL BC3592. Must be taken in sequence, beginning in the fall.

Fall 2020: BIOL BC3594

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BIOL BC3597 Guided Research. 4 points.
Prerequisites: Permission of a faculty sponsor. Similar to BIOL BC3591-BIOL BC3592, this is a one-semester course that provides students with degree credit for unpaid research without a seminar component. You may enroll in BIOL BC3597 for between 1-4 credits per semester. As a rule of thumb, you should be spending approximately 3 hours per week per credit on your research project.

This course does not fulfill any Biology major requirements. It is open to students beginning in their first year.

Cross-Listed Courses

Anatomy (Barnard)
ANAT BC2573 Human Anatomy and Movement. 3 points.
Corequisites: ANAT BC2574
Dancers and other movers will acquire concrete, scientific information about anatomy and integrate this knowledge into their senser experience of movement. Through readings, lecture/discussions and movement practice, students will explore: (1) structure and function of bones and joints, (2) muscles, neuromuscular function and coordination, (3) motor cognition and learning.

ANAT BC2574 Laboratory in Human Anatomy. 3 points.
Corequisites: ANAT BC2573
This new interdisciplinary laboratory course will introduce students to the practices of creative and scientific research in anatomy. The laboratory course will offer students “hands-on” opportunities to view cadaveric specimens, to collect, analyze and communicate scientific information/data related to anatomy and to explore the use of anatomical information to generate creative movement and choreography.

Chemistry (Barnard)
CHEM BC2900 Research Methods Seminar. 1 point.
Instructor’s Permission Required
Prerequisites: Students must be sophomores with a strong interest in pursuing research in the biological or chemical sciences
Skills to facilitate into biology and chemistry research. Students will learn to think and work like scientists and to identify, apply for and gain entry to research lab groups. Focus on writing and oral presentation skills.

Additional readings and discussions on laboratory safety, women in science, and scientific ethics.

CHEM BC3282 Biological Chemistry. 3 points.
Prerequisites: (CHEM BC3230) and (CHEM BC3231) BIOL BC1502.
Lecture: MWF 9:00-9:50.

Fall 2020: BIOL BC3597

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Chemistry (Barnard)
CHEM BC3282 Biological Chemistry Laboratory Techniques. 5 points.
Prerequisites: Organic II lab (CHEM BC3333, BC3335, or equivalent); Quantitative analysis lab (BC3338, BC3340, or equivalent); Biochemistry (CHEM BC3282y, CHEM C3501, or equivalent). Lecture: T 1:10-12:50; Laboratory two afternoons: T 2:10-6:00 / TH 1:10-5:00.
Theory and application of fundamental techniques for the isolation, synthesis and characterization of biological macromolecules including proteins, lipids, nucleotides and carbohydrates. Techniques include spectroscopic analysis, gel electrophoresis, chromatography, enzyme kinetics, immunoblotting, PCR, molecular cloning and cell culture, as well as modern laboratory instrumentation, such as UV-Vis, GC-MS and HPLC.

CHEM BC3357 Biochemistry Laboratory Techniques. 3 points.
Fee: $45.
Prerequisites: four terms of chemistry and biology laboratory.
Corequisites: BIOC C3501 or BCHM G4021.
Lecture and lab. Same course as BC3355, but only one section of lab hours required.

Neuroscience and Behavior (Barnard)
NSBV BC2002 Statistics and Experimental Design. 4 points.
This course is for students interested in learning how to conduct scientific research. They will learn how to (i) design well-controlled experiments and identify “quack” science; (ii) organize, summarize and illustrate data, (iii) analyze different types of data; and (iv) interpret the results of statistical tests.