

BIOLOGY

Overview

An Area of Concentration (AOC) in Biology begins with coursework in a three course, two-semester introductory sequence (Foundations of Biology I and II and Foundations of Biology Laboratory), which may be taken in any order. A well-rounded biologist will build on basic concepts with study in three core levels of organization: molecular/cellular biology, organismal biology, and ecology/evolution. Course offerings supplemented by tutorials allow students to accomplish this in seven contracts. Additional coursework in the other natural science disciplines is also required. Two additional biology elective courses will ensure students receive training in multiple areas to assist their thesis research and future goals.

In the current curriculum, molecular and cellular courses include Genetics, Developmental Biology, Microbiology, Neurobiology, and Cellular Biology. Organismal biology is represented by course offerings including Anatomy and Physiology, Botany, Entomology, Fish Biology, Invertebrate Zoology, Marine Mammal Biology, Plant Physiology, and the Biology of Sharks, Skates, and Rays. Ecology and evolution are represented by course offerings such as Animal Behavior, Biology of Urbanization, Conservation Biology, Coral Reef Ecology, Forest Ecology Laboratory, and Marine Ecology in addition to traditionally-titled courses in Ecology and Evolution. Advanced courses (often called “topics courses”), lab tutorials, internships, and seminars give students additional opportunities to explore their interests. Critical thinking, quantitative skill development, and writing skills are a part of all undertakings in the Biology concentration.

Faculty in Biology

Amy Bohan (<https://www.ncf.edu/directory/amy-bohan/>), Instructor of Biology

Amy Clore (<https://www.ncf.edu/directory/amy-clore/>), Professor of Biology

Erika Díaz Almeyda (<https://www.ncf.edu/directory/erika-diaz-almeyda/>), Assistant Professor of Biology and Environmental Studies (On Leave)
 Kristopher Fennie (<https://www.ncf.edu/directory/kristopher-fennie/>), Associate Professor of Epidemiology

Jayne M. Gardiner (<https://www.ncf.edu/directory/jayne-gardiner-loewy/>), Associate Professor of Biology (On Leave)

Sandra Gilchrist (<https://www.ncf.edu/directory/sandra-l-gilchrist/>), Professor of Biology and Marine Science/Natural Sciences Division Chair
 Emily Heffernan (<https://www.ncf.edu/directory/emily-v-heffernan/>), Associate Professor of Biology and Environmental Studies/Associate Provost

Elizabeth Leininger (<https://www.ncf.edu/directory/elizabeth-c-leininger/>), Associate Professor of Neurobiology (On Leave)

Tyrone Ryba (<https://www.ncf.edu/directory/tyrone-ryba/>), Associate Professor of Bioinformatics

Athena Rycyk (<https://www.ncf.edu/directory/athena-rycyk/>), Associate Professor of Biology and Marine Science

Jose R. Soto-Shoender (<https://www.ncf.edu/directory/jose-r-soto-shoender/>), Visiting Assistant Professor of Biology and Ecology

Lydia Wassink, Adjunct Assistant Professor of Biology and Ecology

Requirements for the AOC in Biology

A minimum of twenty-two (22) academic units.

Code	Title
Introductory Sequence ¹	
BIOL 2100	Foundations of Biology I*
BIOL 2200	Foundations of Biology II*
BIOL 2110	Foundations of Biology Laboratory
Intermediate Biology Lecture Coursework	
Select one lecture course from each category, for a total of three courses:	
Molecular/Cellular Scale Lectures	
BIOL 3200	Neurobiology
BIOL 3400	Introduction to Genetics
BIOL 3500	Cell Biology
BIOL 3550	Introduction to Microbiology
BIOL 3780	Developmental Biology ²
Organismic Scale Lectures	
BIOL 2460	Introduction to Entomology*
BIOL 3350	Introduction to Botany
BIOL 3370	Invertebrate Zoology
BIOL 3600	Fish Biology
BIOL 3660	Marine Mammal Biology
BIOL 3700	Biology of Sharks, Skates and Rays
BIOL 3780	Developmental Biology ²
BIOL 4400	Plant Physiology
Ecology/Evolution Scale Lectures	
BIOL 2360	Animal Behavior
BIOL 3100	Ecology*
BIOL 3120	Conservation Biology
BIOL 3140	Marine Ecology
BIOL 3300	Evolution
BIOL 3750	Coral Reef Ecology
BIOL 4100	Principles of Ecological Management
BIOL 4600	Biology of Urbanization
Intermediate Biology Lab Coursework	
Select three labs in at least two different categories:	
Molecular/Cellular Scale Labs	
BIOL 3210	Neurobiology Laboratory
BIOL 3410	Classical Genetics Techniques Laboratory
BIOL 3420	Fundamentals of Applied Genetics Laboratory
BIOL 3510	Cell Biology Laboratory
BIOL 3560	Introduction to Microbiology Laboratory
Organismic Scale Labs	
BIOL 2465	Introduction to Entomology Laboratory
BIOL 3355	Introduction to Botany Laboratory
BIOL 3375	Invertebrate Zoology Laboratory
BIOL 3610	Fish Biology Laboratory
BIOL 3650	Sensory Biology of Fishes Lecture/Lab

BIOL 3710	Biology of Sharks, Skates and Rays Laboratory
BIOL 4410	Plant Physiology Laboratory
Ecology/Evolution Scale Labs	
BIOL 2500	Coral Reef Issues*
BIOL 3110	Ecology Laboratory
BIOL 3130	Methods in Field Ecology
BIOL 3145	Marine Ecology Laboratory
BIOL 3360	Animal Behavior Laboratory
BIOL 4260	Tropical Disease Epidemiology

Additional Biology Course or Tutorial

Select, from these and other examples, **one** additional Biology course or tutorial that is beyond the introductory level and approved by Biology faculty:

BIOL 3135	Computational Methods in Biology
BIOL 3800	Principles of Bioinformatics
BIOL 4960	Research Methods in Biology
BIOL 3270	Social Epidemiology

Natural Sciences Coursework for the Biology AOC**Statistics Course**

BIOL 2150	Biostatistics
or STAN 2700	Dealing with Data I*

Additional Natural Sciences Courses

MATH 2311	Calculus I*
CHEM 2100	General Chemistry I*
CHEM 2150	General Chemistry II
CHEM 2160	General Chemistry Laboratory
CHEM 3100	Organic Chemistry I: Structure and Reactivity*
CHEM 3110	Organic Chemistry Inquiry Laboratory
PHYS 2500	Physics I (Algebra-based)*
or PHYS 2525	Physics I (Calculus-based)*
PHYS 2510	Physics I Laboratory*

Intermediate Courses in the Natural Sciences

Select **two** additional Natural Sciences courses, **one** lecture and **one** laboratory course or **two** laboratories:

CHEM 3600 & CHEM 3610	Organic Chemistry II: Structure and Reactivity* and Organic Chemistry II Laboratory*
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PHYS 2550 & PHYS 2555	Physics II and Physics II Laboratory*
CSCI 4230	Bio-Inspired Artificial Intelligence
Other upper level Chemistry, Computer Science, Math, Physics, or GIS courses	

Additional Requirements

One Independent Study Project (ISP) in Biology

Senior Thesis in Biology and Baccalaureate Exam

Highly Recommended**Writing Intensive Course**

WRTG 2140	Rhetoric and Writing: Writing about Writing for Students in the Sciences (or other relevant Writing Intensive Course)
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¹ May be taken in any order.

² Can be counted towards the Molecular/Cellular Scale course OR as an Organismic Scale course, but not both.

Note: Courses listed above are examples that satisfy requirements; unlisted courses or tutorials may satisfy requirements as determined by the baccalaureate exam committee. Students with plans to pursue graduate studies in biology or careers in various health fields should consult with their academic advisors about specific course selection.

Requirements for the Joint AOC in Biology

A minimum of seven (7) academic units.

Code	Title
Introductory Sequence ¹	
BIOL 2100	Foundations of Biology I*
BIOL 2200	Foundations of Biology II*
BIOL 2110	Foundations of Biology Laboratory

Intermediate Biology Lecture Coursework

Select **two** lecture courses from at least two categories, for a total of **two** courses:

Molecular/Cellular Scale Lectures

BIOL 3200	Neurobiology
BIOL 3400	Introduction to Genetics
BIOL 3500	Cell Biology
BIOL 3550	Introduction to Microbiology
BIOL 3780	Developmental Biology ²

Organismic Scale Lectures

BIOL 2460	Introduction to Entomology*
BIOL 3350	Introduction to Botany
BIOL 3600	Fish Biology
BIOL 3370	Invertebrate Zoology
BIOL 3660	Marine Mammal Biology
BIOL 3700	Biology of Sharks, Skates and Rays
BIOL 3780	Developmental Biology ²
BIOL 4400	Plant Physiology

Ecology/Evolution Scale Lectures

BIOL 2360	Animal Behavior
BIOL 3100	Ecology*
BIOL 3120	Conservation Biology
BIOL 3140	Marine Ecology
BIOL 3300	Evolution
BIOL 3750	Coral Reef Ecology
BIOL 4100	Principles of Ecological Management
BIOL 4260	Tropical Disease Epidemiology
BIOL 4600	Biology of Urbanization

Intermediate Biology Lab Coursework

Select **one** lab in any of the categories:

Molecular/Cellular Scale Labs

BIOL 3210	Neurobiology Laboratory
BIOL 3410	Classical Genetics Techniques Laboratory
BIOL 3420	Fundamentals of Applied Genetics Laboratory
BIOL 3510	Cell Biology Laboratory
BIOL 3560	Introduction to Microbiology Laboratory
Organismic Scale Labs	
BIOL 2465	Introduction to Entomology Laboratory
BIOL 3355	Introduction to Botany Laboratory
BIOL 3375	Invertebrate Zoology Laboratory
BIOL 3610	Fish Biology Laboratory
BIOL 3650	Sensory Biology of Fishes Lecture/Lab
BIOL 3710	Biology of Sharks, Skates and Rays Laboratory
BIOL 4410	Plant Physiology Laboratory
Ecology/Evolution Scale Labs	
BIOL 2500	Coral Reef Issues*
BIOL 3110	Ecology Laboratory
BIOL 3145	Marine Ecology Laboratory
BIOL 3130	Methods in Field Ecology
BIOL 3360	Animal Behavior Laboratory

Additional Requirements

One Independent Study Project (ISP), laboratory, field course, or lab or field tutorial in Biology

Senior Thesis related to Biology and Baccalaureate Exam (with one Biology faculty member on the committee)

Highly Recommended**Statistics Course**

BIOL 2150	Biostatistics
or STAN 2700	Dealing with Data I*

Writing Intensive Course

WRTG 2140	Rhetoric and Writing: Writing about Writing for Students in the Sciences (or other relevant Writing Intensive Course)
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¹ May be taken in any order.

² Can be counted towards the Molecular/Cellular Scale course OR as an Organismic Scale course, but not both.

Note: Students interested in graduate school should work closely with a Biology advisor as graduate programs have additional requirements beyond the courses listed above. These vary between biological disciplines.

Requirements for a Secondary Field in Biology

A minimum of six (6) academic units.

Code	Title
Introductory Sequence ¹	
BIOL 2100	Foundations of Biology I*

BIOL 2200	Foundations of Biology II*
BIOL 2110	Foundations of Biology Laboratory

Intermediate Biology Lecture Coursework

Select **two** lecture courses from at least two categories, for a total of **two** courses:

Molecular/Cellular Scale Lectures

BIOL 3200	Neurobiology
BIOL 3400	Introduction to Genetics
BIOL 3500	Cell Biology
BIOL 3550	Introduction to Microbiology
BIOL 3780	Developmental Biology ²

Organismic Scale Lectures

BIOL 2460	Introduction to Entomology*
BIOL 3350	Introduction to Botany
BIOL 3370	Invertebrate Zoology
BIOL 3600	Fish Biology
BIOL 3660	Marine Mammal Biology
BIOL 3700	Biology of Sharks, Skates and Rays
BIOL 3780	Developmental Biology ²
BIOL 4400	Plant Physiology

Ecology/Evolution Scale Lectures

BIOL 2360	Animal Behavior
BIOL 3100	Ecology*
BIOL 3120	Conservation Biology
BIOL 3140	Marine Ecology
BIOL 3300	Evolution
BIOL 3750	Coral Reef Ecology
BIOL 4100	Principles of Ecological Management
BIOL 4260	Tropical Disease Epidemiology
BIOL 4600	Biology of Urbanization

Intermediate Biology Lab Coursework

Select **one** lab in any of the categories:

Molecular/Cellular Scale Labs

BIOL 3210	Neurobiology Laboratory
BIOL 3410	Classical Genetics Techniques Laboratory
BIOL 3420	Fundamentals of Applied Genetics Laboratory
BIOL 3510	Cell Biology Laboratory
BIOL 3560	Introduction to Microbiology Laboratory

Organismic Scale Labs

BIOL 2465	Introduction to Entomology Laboratory
BIOL 3355	Introduction to Botany Laboratory
BIOL 3375	Invertebrate Zoology Laboratory
BIOL 3610	Fish Biology Laboratory
BIOL 3650	Sensory Biology of Fishes Lecture/Lab
BIOL 3710	Biology of Sharks, Skates and Rays Laboratory
BIOL 4410	Plant Physiology Laboratory

Ecology/Evolution Scale Labs	
BIOL 2500	Coral Reef Issues*
BIOL 3110	Ecology Laboratory
BIOL 3130	Methods in Field Ecology
BIOL 3145	Marine Ecology Laboratory
BIOL 3360	Animal Behavior Laboratory
Highly Recommended	
Statistics Course	
BIOL 2150 or STAN 2700	Biostatistics Dealing with Data I*
Writing Intensive Course	
WRTG 2140	Rhetoric and Writing: Writing about Writing for Students in the Sciences (or other relevant Writing Intensive Course)

¹ May be taken in any order.

² Can be counted towards the Molecular/Cellular Scale course OR as an Organismic Scale course, but not both.

Sample Two-Year Transfer Pathway

Note: The two-year pathway shows how a student with an Associate's degree could complete the area of concentration (AOC) requirements in 2 years. The pathway assumes a student is granted general education and AOC credit for 60 transferable credit hours (typically 18 courses) during AA or select AS degree work. For a Biology AOC, students should complete majors-focused Introductory Biology I and II with labs, General Chemistry I and II with labs, Physics I with lab (Physics II with lab recommended), Calculus I, and Statistics during their AA/AS. Developmental courses and prerequisite course requirements, credit loads, and/or course availability may affect a student's individual progress. Students should always consult with their academic advisor to determine individual program planning. Information about established transfer pathways for Biology AOCs can be found at: <https://www.ncf.edu/admissions/transfer-students/guaranteed-admission/>.

Third Year		
Fall Term	ISP	Spring Term
Statistics	Biology ISP (with Biology faculty)	Organismic Biology Scale Lecture
Ecology/Evolution Scale Lecture		Tutorial in Biology
Ecology/Evolution Scale Lab		
Biology Elective		
Fourth Year		
Fall Term	ISP	Spring Term
Organic Chemistry I	ISP of student's choice	Thesis Writing Tutorial
Organic Chemistry Inquiry Lab	Thesis Work	Non-intro level Natural Sciences Lecture
Cellular/Molecular Scale Lecture		Non-intro level Natural Sciences Lab
Cellular/Molecular Scale Lab		

Biology Facilities

The biology laboratories are equipped to offer an unusually rich undergraduate research experience. Housing a variety of microscopes including research-grade analytical light microscopes, a fluorescence microscope, and a scanning electron microscope, the labs also provide access to a photographic darkroom, controlled temperature chambers, digital imaging computers, incubators for culturing organisms and

testing animal behavior, and analytical instrumentation to carry out high-performance liquid chromatography (HPLC). A greenhouse and a herbarium of regional plants are available. Students interested in field ecology have access to a variety of sampling equipment including Secchi disks, DO meters, nephelometers, salinometer/conductivity meters, Nansen bottles and nets.

In both biology and biochemistry laboratories, extensive equipment is available for molecular biology projects. Equipment for analyzing DNA, RNA, and proteins includes vertical (large and small) and horizontal gel boxes for electrophoresis, high voltage power supplies, western transfer boxes, and automatic pipettors. Thermal cyclers for performing the polymerase chain reaction (PCR), as well as a laminar flow hood for eukaryotic cell culture, are also available and real-time PCR instrument for quantitative gene expression analysis and genetic variation detection was purchased with a grant from the National Science Foundation.

The Natural Sciences Division is housed in the Heiser Natural Sciences Complex. Two wings (34,000 square feet) were completed in 2000 and a third wing (22,000 square feet) was added in 2017. The Heiser Natural Sciences Complex consists of the William G. Selby and Marie Selby Building for Biology and Chemistry, the Paul H. Hanson Building for Mathematics and Physics, the Soo Bong Chae Memorial Auditorium, and the new wing. It contains 26 well-equipped research and teaching laboratories, including a 20-station computer laboratory and instrument rooms. Research and teaching laboratory spaces are in close proximity, and faculty offices in the laboratory sciences have windows with views into the laboratories, closely connecting faculty with student work at all times. In keeping with the New College mission of actively engaging students in research projects, research education is emphasized, and students learn to use instruments early in their program. Highly sophisticated equipment is available to research students in biology, chemistry, biochemistry, computer science, mathematics and physics.

New College is situated on Sarasota Bay and our students have the opportunity to study and conduct research at the Pritzker Marine Biology Research Center, located on our Bayfront Campus. The Center is home to more than 100 aquaria, anchored by a 15,000-gallon research and display tank. Each tank in the Living Ecosystem Teaching and Research Aquarium features different captive ecosystems, including a cold-water rocky shore and Sarasota Bay grass flats. Through a natural filtration system designed by students, the Center draws and recycles water from Sarasota Bay. Our research vessel, docked at the Caples Campus, facilitates research in the Sarasota Bay.

Representative Senior Theses in Biology

- Minilivestock: A Study in Insect Rearing and the Determination of Protein Contents of Two Insects
- Canavan Disease: A Clinical, Biochemical, and Genetic Perspective
- The Effect of Cortisol Administration on Learning and Memory in the Pinfish, *Lagodon rhomboides*
- Dot Spot and PCR Techniques Detect Tomato Mottle Geminivirus in Developing Tissue Following Localized Inoculations in Tomato Plants
- Evaluating the Effects of Cover Crops on Soil Organic Matter in Wheat-Fallow Rotation Schemes near Pendleton, Oregon
- Bioinformatic approaches to microsatellite discovery and primer design in the Dakota skipper (*Hesperia dacotae*) genome
- Bridging Academia and Management in Conservation Genetics: The Case of the Florida Duskywing Skipper (*Ephyriades brunnea*)
- A GIS Approach to Assessing the Impacts of Tropical Storm Fay (2008) on Photosynthetic Rates in the Middle St. John's River Basin

- The Interaction of Moringa (*Moringa oleifera* Lam.) Seed Extracts and Microbes
- Sex differences in GREB1 expression in the frog *Xenopus laevis*
- Cancer Immunosurveillance Evasion: its Comprehensive Historical Context and Correlations with Outcome
- The phenology of humpback (*Megaptera novaeangliae*), blue (*Balaenoptera musculus*), fin (*Balaenoptera physalus*), sperm (*Physeter macrocephalus*), and killer whales (*Orcinus orca*) determined by passive acoustic monitoring near Barkley Canyon
- Growth patterns and the effect of pH on the Florida manatee (*Trichechus manatus latirostris*) vibrissae