

Biology

Faculty: Pecor, *Chair:* Butler, Clement, Dickinson, Elderkin, Elliott, Erickson, Kress, Lovett, Morrison, Nayak, Norvell, O'Connell, Peel, Reinert, Sarwar, Shevlin, Thornton, Woldemariam, Wund.

The Department of Biology at The College of New Jersey provides undergraduate students with a comprehensive modern education in biology, with subject matter ranging in biological complexity from molecular and cell biology, through organismal biology, and on to ecology and evolutionary biology. The general objectives of the department are: 1) to develop in students an understanding of the biological principles that underlie all living things; 2) to instill in students a sense of inquiry; and 3) to sharpen the analytical thinking skills of students. The major is a liberal arts-based program that prepares students for a variety of opportunities after graduation, including entry into biology-related professional occupations, pursuit of advanced graduate study in biology, enrollment at medical and allied health professional schools, and teaching at the primary and secondary levels.

Students in the Department of Biology learn firsthand about the work of a biological scientist. They learn about both classic experiments and cutting edge research in biology from the classic literature, the finest textbooks, and current primary scientific literature. In the classroom, in the field, and in laboratories, scientific inquiry is the basis for learning, enhanced and encouraged by experienced, dedicated professors and the shared experiences of the class. Students construct hypotheses, develop research proposals, and hone their investigative and analytical skills through their work in course laboratories, research with faculty members, and mentored research at other institutions. Biology students discuss each other's work, write research papers, and submit their findings via scientific poster presentations. This rich set of experiences allows each student to realize the concept goals of the biology program noted below.

The biology program has been designed to give all majors in the department exposure to the complete range of disciplines within biology. The biology core courses, which are required of all biology students, provide a solid foundation within biology from the molecular to the ecosystem level. Students then supplement this core curriculum through the selection of upper-level biology option courses in their particular areas of interest.

Program Concept Goals

The study of biology is increasingly complex and multi-disciplinary. However, there are central concepts which are fundamental to all biological systems. These concepts constitute the biology program's Concept Goals, which are instilled in each student.

- Within biological systems, structure and function are interdependent.
- Energy transformations underlie all biological processes.
- Expression of a unique subset of genes from an organism's inherited DNA genome determines a cell's particular characteristics.
- Biological diversity is the result of a continuous process of evolution in an ecological context.

Programs within Biology

There are multiple programs within the biology major: liberal arts (BS or BA), secondary education (BS or BA), seven-year BS/MD, and seven-year BS/OD. There also are dual majors with early childhood education, elementary education, special education, urban education, and deaf and hard of hearing education. There also is a biology specialization within the iSTEM dual major with these education majors. For program requirements, consult “Biology Programs” found on the Department of Biology web page: <https://biology.tcnj.edu/academics/program-summary-sheets/>

BIOLOGY: LIBERAL ARTS, BACHELOR OF SCIENCE**Major Courses**

| | |
|---|----------------|
| BIO 099/Orientation to Biology | 0 course units |
| BIO 201/Foundations of Biological Inquiry | 1 course unit |
| BIO 211/Biology of the Eukaryotic Cell | 1 course unit |
| BIO 221/Ecology and Field Biology | 1 course unit |
| BIO 231/Genetics | 1 course unit |
| BIO 498/Biological Seminar | 1 course unit |
| (Qualified students may use BIO 495/496 to serve as the capstone experience—see Biology course descriptions.) | |
| Biology option courses | 5 course units |
| Five biology option courses (by advisement), of which one must be in ‘organisms and evolution’ and no more than two may be transfer credits from another institution. | |

Total major courses **10 course units**

Correlate Courses

| | |
|--|----------------|
| CHE 201, 202/General Chemistry I, II | 2 course units |
| CHE 331, 332/Organic Chemistry I, II | 2 course units |
| MAT 127/Calculus A | 1 course unit |
| One of the following courses (by advisement) | 1 course unit |
| MAT 128/Calculus B | |
| MAT 200/Discrete Mathematics | |
| STA 215/Statistical Inference | |
| PHY 201/Physics I | 1 course unit |

Total required correlate courses **7 course units**

BIOLOGY: LIBERAL ARTS, BACHELOR OF ARTS**Major Courses**

| | |
|---|----------------|
| BIO 099/Orientation to Biology | 0 course units |
| BIO 201/Foundations of Biological Inquiry | 1 course unit |
| BIO 211/Biology of the Eukaryotic Cell | 1 course unit |
| BIO 221/Ecology and Field Biology | 1 course unit |
| BIO 231/Genetics | 1 course unit |
| BIO 498/Biological Seminar | 1 course unit |
| (Qualified students may use BIO 495/496 to serve as the capstone experience—see Biology course descriptions.) | |
| Biology option courses | 4 course units |
| Four biology option courses (by advisement), of which | |

one must be in 'organisms and evolution' and no more than two may be transfer credits from another institution.

Total major courses**9 course units****Correlate Courses**

CHE 201, 202/General Chemistry I, II

2 course units

MAT 127/Calculus A

1 course unit

Total required correlate courses**3 course units****BIOLOGY: SECONDARY EDUCATION**

An overview of the entire secondary-level teacher preparation sequence for students can be found in the section of this bulletin for the Department of Education Administration and Secondary Education. Students planning to teach middle or high school biology should consult with advisors in both biology and secondary education in planning their academic program. These plans should take into account requirements for the major, liberal learning, professional courses, and state certification. Students are considered "pre-candidates" in the program until they engage in their first major clinical field experience (Clinical Experience I, typically in the Spring of Junior year), at which point they advance to candidacy. Students typically begin taking education courses in the first or second year. In the sophomore year, prior to applying for Clinical Experience I, students must either have passed the Praxis Core certification exam or have achieved a State mandated threshold score on the SAT or ACT exam. In addition, their cumulative GPA (CGPA) must be 3.0 or higher (or between 2.75 and 2.99 with permission), and by the time they engage in Clinical Experience I, they must have earned a B- or better in SED 224, EFN 299, and SPE 103. To be allowed to student teach (Clinical Experience II, BIO 490), the student must establish a CGPA of 3.0 or higher (or between 2.75 and 2.99 with permission), must have completed the biology core, must have taken the Praxis II certification examinations (Biology and General Science content tests), and must have earned a B- or better in SED 399 and PHY 390.

Candidates for a teacher-education certificate must have a CGPA of 3.0 or higher to successfully complete their teacher education program with certification from TCNJ (students graduating with a GPA < 3.0 but > 2.75 and who meet certain Praxis exam score thresholds can appeal to the State for certification). They also must meet the state hygiene/physiology requirement, the harassment-intimidation-bullying requirement, and pass the appropriate Praxis II examination before the New Jersey State Department of Education will issue the appropriate certificate. Teacher-education candidates will receive a "certificate of eligibility with advanced standing" which requires a candidate to be provisionally certified for his or her first year of teaching. After one year of successful teaching, the candidate is eligible for a permanent certificate.

BACHELOR OF SCIENCE**Major Courses**

BIO 099/Orientation to Biology

0 course units

BIO 201/Foundations of Biological Inquiry

1 course unit

BIO 211/Biology of the Eukaryotic Cell

1 course unit

BIO 221/Ecology and Field Biology

1 course unit

BIO 231/Genetics

1 course unit

BIO 498/Biological Seminar

1 course unit

(Qualified students may use BIO 495/496 to serve as the

| | |
|---|----------------|
| capstone experience—see Biology course descriptions.) | |
| Biology option courses | 4 course units |
| Four biology option courses (by advisement), of which one must be in ‘organisms and evolution’ and no more than two may be transfer credits from another institution. | |

Total major courses **9 course units**

Correlate Courses

| | |
|--|----------------|
| CHE 201, 202/General Chemistry I, II | 2 course units |
| CHE 331, 332/Organic Chemistry I, II | 2 course units |
| MAT 127/Calculus A | 1 course unit |
| One of the following courses (by advisement) | 1 course unit |
| MAT 128/Calculus B | |
| MAT 200/Discrete Mathematics | |
| STA 215/Statistical Inference | |
| (preferably the section designed for biology majors) | |
| PHY 201 Physics I | 1 course units |

Total required correlate courses **7 course units**

Professional Education Sequence Courses

| | |
|---|------------------|
| SED 099/College Seminar | 0 course units |
| SED 224/Adolescent Learning and Development | 1 course unit |
| EFN 299/Schools, Communities and Culture | 1 course unit |
| SPE 103/Social and Legal Foundations of Special Education | 1 course unit |
| SED 399/Pedagogy in Secondary Schools | 1.5 course units |
| RAL 328/Reading in Secondary Education | 0.5 course units |
| PHY 390/Methods of Teaching Science | 1 course unit |
| BIO 490/Student Teaching | 2 course units |
| SED 498/Collaborative Capstone for Professional Inquiry | 1 course unit |

Total required professional education sequence courses **9 course units**

BACHELOR OF ARTS

Major Courses

| | |
|---|----------------|
| BIO 099/Orientation to Biology | 0 course units |
| BIO 201/Foundations of Biological Inquiry | 1 course unit |
| BIO 211/Biology of the Eukaryotic Cell | 1 course unit |
| BIO 221/Ecology and Field Biology | 1 course unit |
| BIO 231/Genetics | 1 course unit |
| BIO 498/Biological Seminar | 1 course unit |
| (Qualified students may use BIO 495/496 to serve as the capstone experience—see Biology course descriptions.) | |
| Biology option courses | 4 course units |
| Four biology option courses (by advisement), of which one must be in ‘organisms and evolution’ and no more than two may be transfer credits from another institution. | |

Total major courses **9 course units**

Correlate Courses

| | |
|--------------------------------------|----------------|
| CHE 201, 202/General Chemistry I, II | 2 course units |
| MAT 127/Calculus A | 1 course unit |

Total required correlate courses **3 course units**

Professional Education Sequence Courses

| | |
|---|------------------|
| SED 099/College Seminar | 0 course units |
| SED 224/Adolescent Learning and Development | 1 course unit |
| EFN 299/Schools, Communities and Culture | 1 course unit |
| SPE 103/Social and Legal Foundations of Special Education | 1 course unit |
| SED 399/Pedagogy in Secondary Schools | 1.5 course units |
| RAL 328/Reading in Secondary Education | 0.5 course units |
| PHY 390/Methods of Teaching Science | 1 course unit |
| BIO 490/Student Teaching | 2 course units |
| SED 498/Collaborative Capstone for Professional Inquiry | 1 course unit |

Total required professional education sequence courses **9 course units**

BIOLOGY: SEVEN-YEAR BS/MD (MEDICAL) PROGRAM

This accelerated program with Rutgers New Jersey Medical School in Newark is available to entering first-year students only. More information on the program and the application process is available from Dr. Dennis Shevlin (shevlin@tcnj.edu), Dr. Sudhir Nayak (nayak@tcnj.edu), and at the following website: <https://biology.tcnj.edu/academics/medical-careers/7-year-medical-program/>

Major Courses

| | |
|--|----------------|
| BIO 099/Orientation to Biology | 0 course unit |
| BIO 201/Foundations of Biological Inquiry | 1 course unit |
| BIO 211/Biology of the Eukaryotic Cell | 1 course unit |
| BIO 221/Ecology and Field Biology | 1 course unit |
| BIO 231/Genetics | 1 course unit |
| Two additional 300- or 400-level biology option courses (by advisement), one of which must have a lab and no more than one may be transfer credit from another institution. (BIO 393, 394, 399, 493, 494, 495, and 496 do not qualify to meet this requirement.) | 2 course units |
| BIO 498/Biological Seminar (Qualified students may use BIO 495/496 to serve as the capstone experience—see Biology course descriptions.) | 1 course unit |

Total major courses **7 course units**

Correlate Courses

| | |
|--|----------------|
| CHE 201, 202/General Chemistry I, II | 2 course units |
| CHE 331, 332/Organic Chemistry I, II | 2 course units |
| MAT 127/Calculus A | 1 course unit |
| One of the following courses (by advisement) | 1 course unit |
| MAT 128/Calculus B | |
| MAT 200/Discrete Mathematics | |
| STA 215/Statistical Inference | |
| PHY 201, 202/Physics I, II | 2 course units |

Total required correlate courses**8 course units**

The remainder of requirements for the major will be taken at Rutgers-NJ Medical School. Please note: Rutgers-NJMS also requires that students in the program participate in an independent research project (with or without academic credit) prior to starting coursework at Rutgers-NJMS.

BIOLOGY: SEVEN-YEAR BS/OD (OPTOMETRY) PROGRAM

This accelerated program works in conjunction with the State University of New York's State College of Optometry in Manhattan and is available to entering first-year students and to enrolled biology first-year students and first-semester sophomores. To be considered, entering first-year applicants must have an SAT score of at least 1300 (Verbal + Math, with at least 670 in Math) and must be in the top 10 percent of their graduating class. An interview at SUNY is required before acceptance into the program. Seven-Year BS/OD majors must maintain an overall GPA of 3.3 or higher and a GPA of 3.3 or higher in all required science and mathematics courses, with no grade in the required courses below a C. Students are required to take the Optometry Aptitude Test (OAT) and score 320 or higher on all sections. More information about the program is available from Dr. Sudhir Nayak (nayak@tcnj.edu) and at the following web site: <https://biology.tcnj.edu/academics/medical-careers/7-year-optometry-program/>

Major Courses

| | |
|---|----------------|
| BIO 099/Orientation to Biology | 0 course units |
| BIO 201/Foundations of Biological Inquiry (formerly BIO 185) | 1 course unit |
| BIO 211/Biology of the Eukaryotic Cell | 1 course unit |
| BIO 221/Ecology and Field Biology | 1 course unit |
| BIO 231/Genetics | 1 course unit |
| BIO 332/Biology of the Vertebrates | 1 course unit |
| BIO 498/Biological Seminar (Qualified students may use BIO 495/496 to serve as the capstone experience—see Biology course descriptions.) | 1 course unit |
| Biology option course (by advisement) | 1 course unit |

Total major courses**7 course units****Correlate Courses**

| | |
|--------------------------------------|----------------|
| CHE 201, 202/General Chemistry I, II | 2 course units |
| CHE 331, 332/Organic Chemistry I, II | 2 course units |
| MAT 127/Calculus A | 1 course unit |
| PHY 201, 202/Physics I, II | 2 course units |
| PSY 101/Introduction to Psychology | 1 course unit |
| STA 215/Statistics | 1 course unit |

Total required correlate courses**9 course units**

The remainder of the requirements for the major will be taken at SUNY College of Optometry.

'Organisms and Evolution' Biology Option Courses

The Biology-Liberal Arts and Biology-Secondary Education major will need to enroll in at least one biology option course that addresses organisms and evolution. The courses that fulfill this requirement include the following:

- BIO 332/Biology of the Vertebrates
- BIO 341/Biology of Seed Plants
- BIO 342/Biology of the Invertebrates
- BIO 343/General Entomology
- BIO 344/Avian Biology
- BIO 365-366/Natural History of the Galapagos Islands and Ecuador
- BIO 411/Animal Physiology

Course Registration

It is the responsibility of the student to ensure that all pre-requisites or co-requisites for enrolling in a particular course have been met. Students found not to have met prerequisites or co-requisites will be dis-enrolled. Furthermore, registering in a course section in order to hold a seat for another student is considered to be a violation of Department of Biology policy for both the student holding the seat and the student taking the held seat. Seat-holding will be monitored through PAWS.

Program Entrance, Retention, and Exit Standards

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program.

The following are the standards for **Biology-Liberal Arts** and **Biology-Secondary Education Programs**:

- Retention in the program is based on the following performance standards: 1) at the end of the fourth semester (or second semester for transfer students) at TCNJ, the student must have a minimum cumulative TCNJ GPA of 2.0 in all math and science courses (excluding any biology courses numbered below 185), and 2) must have completed at least three math and science courses at TCNJ required by the major.
- Applicants for internal transfer to Biology should have at minimum a C- in both BIO 201 and CHE 201. That said, this major has very limited capacity, and simply meeting the minimum requirements is not likely to result in admission. Preference will be given to applicants based on math and science GPA, the number of biology, other science, and math courses completed, and demonstrated enthusiasm for the field of biology. Consult the Department of Biology web page for complete application details: <http://biology.tcnj.edu/internal-transfers-to-biology/>
- Graduation requires: 1) an overall GPA of 2.0 in all TCNJ courses, 2) a cumulative GPA of 2.0 in all math and science courses taken at TCNJ, and 3) a cumulative GPA of C- (1.67) or higher in the following core courses: BIO 185/201, BIO 211, BIO 221, and BIO 231.

The following are the standards for the **Biology-Seven-Year Medical Program**:

- Retention in the program is based on the following performance standards in these “critical content courses”: 1) overall 3.5 GPA each semester, and 2) a B or higher in BIO 185/201, BIO 211, CHE 201, 202, 331, 332, and PHY 201, 202.

- Internal transfer into the program is not allowed by the articulation agreement.
- Graduation includes credits earned during the first year at Rutgers New Jersey Medical School.

The following are the standards for the **Biology-Optometry Program**:

- Retention in the program is based on the following performance standards: a GPA of 3.3 in the biology curriculum and a GPA of 3.3 in the optometry science and mathematics prerequisites, with no grade below a C. For further details consult the optometry advisor regarding the articulation agreement.
- Transfer into the program can only be achieved from the Biology-Liberal Arts program. Students must have a GPA of 3.3 or higher in the required optometry courses and an overall GPA of 3.3 or higher. For further details consult the optometry advisor regarding the articulation agreement.
- Graduation includes credits earned at SUNY College of Optometry. For further requirements and modifications consult the optometry advisor regarding the articulation agreement.

Biology Minor

The minor consists of five course units:

BIO 201/Foundations of Biological Inquiry

Two of the following:

BIO 211/Biology of the Eukaryotic Cell

BIO 221/Ecology and Field Biology

BIO 231/Genetics (*Please note that BIO 211 is a prerequisite for BIO 231.*)

Two additional biology option courses, of which no more than one may be transfer credit from another institution.

The minimum GPA for retention in and completion of the minor is the same as for the major.

A minimum of three of the biology courses for the minor must be taken at TCNJ.

Departmental Honors

The Departmental Honors Program provides advanced research experience and recognition of outstanding achievement. To be eligible to request Departmental Honors, the biology major must have at least eight course units earned at The College of New Jersey, including three course units in biology. The student should have an overall GPA of 3.3 or higher, and a science GPA of 3.5 or higher. The candidate must apply by submitting a written request to the Biology Departmental Honors Advisor. To receive Departmental Honors, the candidate must complete the biology major with an overall GPA of 3.3 and a science GPA of 3.5 or higher. In addition, at least five course units in biology must be completed at TCNJ, and the student must complete the equivalent of three course units of Independent Research in Biology with the same faculty member. The research will culminate with an oral presentation and a written thesis presented in a format acceptable to a scientific journal. For completion of Departmental Honors, the student's Honors Review Committee must judge the initial proposal and the final thesis as being of "Honors Quality." Students who successfully complete the program will be

certified by the Department of Biology to graduate “With Departmental Honors in Biology.”

New Jersey Sea Grant Consortium

The College of New Jersey is a member of the New Jersey Sea Grant Consortium (NJS GC), a group of universities and colleges interested in education and research in the marine sciences. Extensive summer programs conducted at field stations along the New Jersey coastline are available to interested students. In addition, students may take summer courses at the Consortium’s field station at Sandy Hook, one of which (Introduction to Marine Biology, BIO 363) can be used to fulfill a biology option course requirement. The descriptions of courses offered at Sandy Hook are at the end of the course description list below. Students must register for these courses via PAWS, and fill out an application available via the NJS GC web site (<http://www.njseagrant.org/education/college-programs>).

Coursework at Other Institutions

All students interested in enrolling in a biology course at another institution (where the course is not listed in njtransfer.org) must receive approval from the chair of the Department of Biology before enrolling in order for any course to be eligible for biology credit. For students currently enrolled at TCNJ, transfer credit will not be awarded for any on-line (distance learning) course offered to fulfill a biology major or minor degree requirement with a laboratory or field component. The course may, however, be transferable as free elective credit. (Please note: For each biology program, there is a maximum number of biology option course units that may be transfer credits from another institution; refer to descriptions of individual programs for specific details.)

Study Abroad

One of the opportunities available to students pursuing a degree in biology is to study abroad for a semester or a year. Students interested in studying abroad should meet with their faculty advisor early in their college career to plan a curriculum so that they may complete their studies in four years. Students will also need to meet with the College’s Center for Global Engagement, and receive approval from the chair of Biology in order for courses taken abroad to count toward requirements within the major (please note: for each biology program, there is a maximum number of biology option course units that may be transfer credits from another institution; refer to descriptions of individual programs for specific details). For those not able to spend a full semester abroad, BIO 365/366/Natural History of the Galapagos Islands and Ecuador offers a short-term abroad immersion experience.

Pre-Professional Advising

A large number of students whose career goal is in medicine, dentistry, or other allied health fields seek to satisfy pre-professional course requirements and prepare for the Medical College Admissions Test, Dental Admission Test, or other entrance exam while enrolled as a biology major. Careful advisement within the department and through the Medical Careers Advisory Committee (MCAC) is provided to both Biology majors and students in other fields. Interested students should visit the MCAC website: <https://mcac.pages.tcnj.edu>

First Year Suggested Sequence for all biology majors**Fall**

FSP First Seminar
BIO 099/Orientation to Biology
BIO 201/Foundations of Biological Inquiry (formerly BIO 185)
CHE 201/General Chemistry I
MAT 127/Calculus A*

Spring

BIO 211/Biology of the Eukaryotic Cell **or** BIO 221/Ecology and Field Biology
CHE 202/General Chemistry II
WRI 102/Academic Writing (if not exempted)*
Foreign Language (if not exempted)**/or math/or liberal learning

**It is recommended that students exempted from this course take other liberal learning courses.*

*** Arabic 151 and 152, Chinese 151 and 152, Japanese 151 and 152, and Russian 151 and 152 (offered annually); and Persian 151 and 152 (offered occasionally) are intensive courses and carry two course units of credit each. Students should take this into account when planning a normal four-course semester.*

Within the first four semesters (two years), most students should complete BIO 201/Foundations of Biological Inquiry (formerly BIO 185), BIO 211/Biology of the Eukaryotic Cell, BIO 221/Ecology and Field Biology, and BIO 231/Genetics, as well as the four-semester chemistry sequence. Note that students must have earned a C- or higher in BIO 185/201 in order to enroll in biology courses numbered 200 or above, and BIO 211 is a prerequisite for BIO 231. Students may also have the opportunity during the first two years to complete a biology option course. Students must have completed BIO 211, 221, *and* 231 or have completed two of those courses and be co-enrolled in the third before they can enroll in any 400-level course in biology; students must have *completed* all three of these core courses before they can enroll in BIO 498/Biological Seminar, BIO 495/Independent Research in Biology Capstone, or BIO 496/Honors Independent Research in Biology Capstone. The capstone course (either senior seminar or capstone research) is taken during the final year (for 4-year students) or final semester of on-campus study (for students graduating in less than 4 years and for students in the 7-year articulated programs). A student wishing to take Senior Seminar at another time must have the approval of the Chairperson of the Department of Biology.