**BIOLOGY**

**Department Mission**

The Biology program has as its aim the education of broadly trained biologists who are well grounded in chemistry, physics, and mathematics, and have command of the written and spoken word. Emphasis is placed on understanding basic principles and concepts in biology, and the application of those principles through analysis of data and synthesis of information learned in the classroom and the research laboratory. The Biology program has always been known as a training ground for individuals pursuing professional careers in the life sciences. Many graduates from the Biology program have gone on to professional schools, pursued graduate studies, or entered the work force directly in academic, government, and industrial labs. This requires that our students be prepared to face the challenges of a competitive world. To help them meet these challenges the Department of Biology has established a strong advising program. Faculty commitment to academic advising and accessibility of faculty advisors to students exemplifies the institutional mission of cura personalis.

**Professor:** Dr. Christina King Smith; Eileen D. Grogan, Ph.D.; Jonathan Fingerut, Ph.D.; Karen Snetseelaar, Ph.D.; Michael P. McCann, Ph.D.; Scott McRobert, Ph.D.

**Associate:** Clint J. Springer, Ph.D.; Edwin Li, Ph.D.; John M. Braverman, S.J., Ph.D.; Julia Lee-Soety, Ph.D.

**Assistant:** Catalina Arango Pinedo, Ph.D.; Jennifer C. Tudor, Ph.D.; Matthew D. Nelson, Ph.D.; Shantanu Bhatt, Ph.D.

**Lab Coordinator:** Brian M. Forster, Ph.D.

**Chair:** Dr. Christina King Smith

**Biology in the GEP (See Curricula)**

The GEP requires that all students take EITHER one semester of a lab-based natural science course (6 contact hours) OR two semesters of lecture-only natural science courses. Students who wish to satisfy the natural science GEP by completing courses in Biology may do so by taking the first semester of the Biology majors, lab-based course sequence, BIO 101, or one of the lab-based, one-semester courses for non-science majors, as they become available. Alternatively, students may fulfill one or both semesters of the natural science GEP by completing one or two of the special one-semester lecture-only Biology courses designed for non-science majors listed below.

**Code** | **Title** | **Hours**
--- | --- | ---
BIO 160 | Heredity and Evolution | 3
BIO 161 | Human Organism | 3
BIO 162 | Plants and Civilization | 3

**Undergraduate**

- Biology Major ([https://academiccatalog.sju.edu/arts-sciences/biology/bs-biology](https://academiccatalog.sju.edu/arts-sciences/biology/bs-biology))

**Undergraduate Minors**

- Biology ([https://academiccatalog.sju.edu/arts-sciences/biology/minor-biology](https://academiccatalog.sju.edu/arts-sciences/biology/minor-biology))

**Graduate**

- Master of Science In Biology ([https://academiccatalog.sju.edu/arts-sciences/biology/ms-biology](https://academiccatalog.sju.edu/arts-sciences/biology/ms-biology))
- Master of Arts in Biology ([https://academiccatalog.sju.edu/arts-sciences/biology/ma-biology](https://academiccatalog.sju.edu/arts-sciences/biology/ma-biology))

**BIO 101 Bio I: Cells (4 credits)**

The study of the structure and function of representative prokaryotic and eukaryotic cells. Chemical makeup, organelle interactions, energy producing and biosynthetic reactions will be stressed. Three lecture periods, one three-hour laboratory period (BIO 101L or 150L). First of three courses in the core program.

**Attributes:** GEP Natural Science, Science Course w/Lab (Sci Maj), Undergraduate

**BIO 101L Bio I: Cells Lab (0 credits)**

Students who register for BIO 101 must also register for a BIO 101 laboratory. For example, if you register for BIO 101 you must, at the same time, register for BIO 101L.

**Attributes:** GEP Natural Science, Undergraduate

**BIO 102 Bio II: Genetics (4 credits)**

The study of heredity and the mechanism of transmission of genetic information in biological systems. The course material is approached from the population, organismic, and biochemical perspectives. Three lecture periods, one three-hour laboratory period (BIO 102L or 151L). Prerequisite: BIO 101.

**Prerequisites:** BIO 101

**Attributes:** GEP Natural Science, Undergraduate

**BIO 102L Bio II: Genetics Lab (0 credits)**

**BIO 150 Science of Learning Science (3 credits)**

A first year seminar focusing on the science that underlies how we learn and application of that to teaching and learning science, with a focus on biology. Students will read literature on learning that ranges from how the brain works to current evidenced-based studies of effective ways to teach and learn science. Students will put this new knowledge to work immediately by analyzing their own learning and by designing and teaching hands-on science units to children. Co-requisite: BIO 101.

**Attributes:** First-Year Seminar

**BIO 150L Bio I: Cells Lab Phage (0 credits)**

A research-based laboratory for freshman accompanying BIO 101 involving isolation, purification, and preliminary genomic characterization of bacteriophages, viruses that infect bacteria. Open to first year students majoring in Biology, Chemical-Biology, or Environmental Science. Admission by application. Successful completion of BIO101 and 150L fulfills the first year seminar GEP requirement. Students are expected to continue with BIO 151L in the spring. Two 120-minute lab periods.

**Attributes:** First-Year Seminar, GEP Natural Science, Undergraduate

**BIO 151L Bio II: Genetics Lab Phage (0 credits)**

A continuation of BIO 150L, this laboratory is conducted in silico to annotate bacteriophage genomes isolated during the fall semester. Complete annotated genomes will be submitted to GenBank. Open to first year students majoring in Biology, Chemical Biology, or Environmental Science. Admission by application. Two 75- minute lab periods.

**Prerequisites:** BIO 101L or BIO 150L

**Attributes:** Undergraduate
BIO 160 Heredity and Evolution (3 credits)
A study of human genetics at three levels: human heredity and the inheritance of disease, genes and DNA, and human evolution. Includes discussion of how a cell uses its genetic information and how scientists study genes using genetic engineering techniques. Successful completion of this course satisfies one of the Natural Science requirements in the GER/GEP. Open to all students except those who have credit for BIO 102. Three lecture periods.
Attributes: GEP Natural Science, Undergraduate

BIO 161 Human Organism (3 credits)
A study of the basic principles of human anatomy, physiology, and genetics. The organization and function of the human body will be described with an appreciation of underlying genetic and evolutionary concepts. Successful completion of this course satisfies one of the Natural Science requirements in the GER/GEP. Open to all students except those who have credit for BIO 201 or 260. Three lecture periods.
Attributes: GEP Natural Science, Undergraduate

BIO 162 Plants and Civilization (3 credits)
This course will examine plants in the context of their importance to people. Plants used for food, fiber, medicine, and recreation will be included. Successful completion of this course satisfies one of the Natural Science requirements in the GER/GEP. Open to all students except biology majors. Biology majors need permission of the Biology Chair to take this course.
Restrictions: Students cannot enroll who have a major in Biology, Chemistry, Chemical Biology or Physics.
Attributes: Undergraduate

BIO 163 Unseen Life on Earth (4 credits)
BIO 163L Unseen Life on Earth Lab (0 credits)

BIO 165 Exploring the Living World (4 credits)
Students in this course will learn about the scientific world view and experience the methods of science in the context of the life sciences. This course is designed for students not planning to major in science. The course includes a survey of plant and animal life, an overview of bioenergetics, and selected topics in genetics and evolutionary biology. Successful completion of this course fully satisfies the GEP Natural Science requirement. Three lecture periods and one three-hour laboratory.
Attributes: GEP Natural Science, Science Course w/Lab (Sci Maj), Undergraduate

BIO 165L Exp. Living World Lab (0 credits)

BIO 170 Special Topics (3 credits)

BIO 201 Bio III: Organismic Biology (4 credits)
A survey of all living things followed by more detailed study of plants and animals. Topics include development, nutrition, locomotion, transport, and homeostatic controls. Three lecture periods, one three-hour laboratory period.
Prerequisites: BIO 102
Attributes: Undergraduate

BIO 201L Bio III: Organismic Biol Lab (0 credits)

BIO 260 Anat&Physiol Nurs/Al Hlth I (4 credits)
This course is designed for students needing preparation in human anatomy and physiology as required for nursing and some allied health programs. BIO 260/L alone does not fulfill a requirement for a Biology major or minor, nor does it fulfill general education requirements. Students may count either BIO 260 plus BIO 261, or BIO 417 toward graduation, but not both. Three 50-minute lecture periods and one three-hour lab period.
Prerequisites: BIO 101 or BIO 165
Attributes: Undergraduate

BIO 260L Anat&Physiol Lab I (0 credits)

BIO 261 Anat&Physiol Nurs/Al Hlth II (4 credits)
Continuation of BIO 260. This course is designed for students needing preparation in human anatomy and physiology as required for nursing and some allied health programs. For biology majors and minors, completion of BIO 261 may count for one, 400-level Biology elective. It does not satisfy the requirement for a course from groups A, B, C. nor does it fulfill general education requirements. Students may count either BIO 260 plus BIO 261, or BIO 417 toward graduation, but not both. Three 50-minute lecture periods and one three-hour lab period.
Prerequisites: BIO 260 (may be taken concurrently)
Attributes: Undergraduate

BIO 261L Anat&Physiol Lab II (0 credits)

BIO 270 Microbio Nurse/Allied Health (4 credits)
This course is designed for students needing preparation in microbiology as required for nursing and some allied health programs. It does not fulfill a requirement for the Biology major or minor, nor does it fulfill general education requirements. Not open to students who have taken BIO 416 or BIO 422. Three 50-minute lecture periods and one three-hour lab period.
Prerequisites: BIO 101 or BIO 165
Attributes: Undergraduate

BIO 270L Microbio Nurse/Allied Hlth Lab (0 credits)

BIO 320 Science Communication&Outreach (1 credit)
Optional Service Learning course can be taken in conjunction with any Biology course. Guided experience in preparing and presenting hands-on science lessons to K12 children. Time commitment is 3 hrs per week.
Attributes: Undergraduate

BIO 360 God and Evolution (3 credits)
This course considers a major topic in academic discourse and society at large, the relationship between religion/theology and biological evolution. This course explores the thesis that the two can be compatible — including from an informed scientific point of view. Students in this course learn evolutionary biology, theological account of creation, and how they can be compatible. This course fulfills the "Faith and Reason" requirement of the GEP. It does not fulfill requirements for a Biology major or minor.
Prerequisites: (THE 154 or THE 221) and PHL 154
Attributes: Faith-Reason Course (New GEP), Undergraduate

BIO 390 Biology Seminar (0 credits)
Attendance at three seminars is required each semester during sophomore, junior, and senior years. Approved seminars are posted in the Department. Graded on a P/NP basis.
Restrictions: Enrollment is limited to students with a major in Biology or Chemical Biology.
Attributes: Undergraduate
BIO 401 Animal Behavior (4 credits)
The study of animals and their behaviors, with a strong emphasis on evolutionary relationships and ecology. Live animals will be studied in the classroom, laboratory, and field. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1025 or CHM 125 or CHM 1023) or CHM 126
Attributes: Undergraduate

BIO 401L Animal Behavior Lab (0 credits)

BIO 402 Advanced Cell Biology (4 credits)
An in-depth analysis of eukaryotic cell structure and function, including membrane structure and transport, cellular organelles, the cytoskeleton, and cell communication. Emphasis will be on experimental approaches to understanding concepts in cell biology. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1025 or CHM 125 or CHM 126 or CHM 1023
Attributes: Undergraduate

BIO 402L Advanced Cell Biology Lab (0 credits)

BIO 403 Biometrics and Modeling (4 credits)
Computer simulation of life science phenomena from the subcellular to population levels. Appropriate statistics are included along with exposure to simulation software. Three 50-minute lecture periods, one three-hour laboratory period.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 404 Biochemistry (3 credits)
An introduction to the chemistry of living systems. The study of important molecules, metabolic pathways, and control systems will be emphasized.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 2321 (may be taken concurrently) or CHM 215 (may be taken concurrently)) and (CHM 125 or CHM 126 or CHM 1021 or CHM 1025 or CHM 1023
Attributes: Undergraduate

BIO 405 Biomechanics (4 credits)
The role of physics in biological systems and the organismal and super-organismal level. Lectures will cover a range of biomechanics disciplines, presenting underlying physical principles and their biological ramifications. Laboratories will provide experience with the experimental techniques available to measure forces relevant to biological systems. Two 75-minute lecture periods, one three-hour laboratory period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1023 or CHM 125 or CHM 1025) and (PHY 1031 or PHY 101 or PHY 105 or PHY 1051)
Attributes: Undergraduate

BIO 405L Biomechanics Lab (0 credits)

BIO 406 Comparative Anatomy (4 credits)
An integrated comparative study of vertebrate structure and development. A synthesis of the embryological development, the gross anatomy, and the histology of selected forms. Two 75-minute lecture periods, one three-hour laboratory period.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 406L Comparative Anatomy Lab (0 credits)

BIO 407 Developmental Biology (4 credits)
A study of the molecular and cellular aspects of development. Emphasis will be on induction, regeneration, and genetic control of differentiation. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1025 or CHM 125 or CHM 126 or CHM 1023
Attributes: Undergraduate

BIO 407L Developmental Biology Lab (0 credits)

BIO 408 Histology (4 credits)
An in depth study of the microscopic structure and function of normal cells, tissues and organs as found in the vertebrates. Students will make extensive use of computer imaging, CD-ROM presentations and biological specimens for study in the laboratory. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1025 or CHM 125 or CHM 126 or CHM 1023
Attributes: Undergraduate

BIO 408L Histology Lab (0 credits)

BIO 409 Ecology (4 credits)
A study of the complex interrelationship between organisms and their environment. The course will include discussions on fundamental themes in ecology such as food webs and population growth, as well as topics of current interest such as oil spills and the destruction of the rain forest. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 409L Ecology Lab (0 credits)

BIO 410 Light and Electron Microscopy (4 credits)
A course in techniques of light and electron microscopy, including aspects of technique, theory, and operation through lecture, demonstration, and student exercises. Time for individual use of the confocal and electron microscopes will be provided. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 410L Light & Electrn Microscopy Lab (0 credits)

BIO 411 Molecular Genetics (4 credits)
Study of the molecular biology of the genetic material, its structure, expression, regulation, and its dynamic nature. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1025 or CHM 125 or CHM 1023) or CHM 126
Attributes: Undergraduate

BIO 411L Molecular Genetics Lab (0 credits)

BIO 412 Neurobiology (4 credits)
Introduction to the structure and function of the vertebrate nervous system. Major topics will include the molecular and cellular basis of neuronal activities, sensory and motor systems, behavior, and higher mental processes. The neurobiology of disease and neuroethics will also be discussed. Laboratory work will include hands-on experience of several neurobiological techniques to measure molecular and biochemical changes in a mouse brain. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate
BIO 412L Neurobiology Lab (0 credits)

BIO 413 Plant Physiological Ecology (4 credits)
This course will focus on the physiological mechanisms plants use to respond to their environment. Major topic areas include the basic environmental physiology of carbon, water, and mineral nutrient exchange, and the adaptive mechanisms plants use to survive the variety of global environments. Labs will cover common physiological research methods ranging from cellular to whole organism level measurements and will involve both laboratory and field work. Two 75-minute lecture periods, two 90-min laboratory periods.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1025 or CHM 125 or CHM 1023 or CHM 126)
Attributes: Undergraduate

BIO 413L Plant Physiological Eco Lab (0 credits)

BIO 414 Plant Systematics (4 credits)
Students will learn to recognize vascular plant families and understand how taxonomists study evolutionary relationships among plant groups. Economic, medical, and ecological importance of various seed plants will be emphasized. Two 75-minute lecture periods, two 90-minute laboratory periods.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1025 or CHM 125 or CHM 1023 or CHM 126)
Attributes: Undergraduate

BIO 414L Plant Systematics Lab (0 credits)

BIO 415 Immunology (4 credits)
An introductory course providing students with an overview of how the immune system works, including molecules, cells and organs of the immune system and their functions and interactions. Discussion of the experimental techniques used to understand the cell-cell interactions that occur in immunity as well as the differentiation and activation of the immune response will be included. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 415L Immunology Lab (0 credits)

BIO 416 Microbiology (4 credits)
The structural, cultural, and physiological characteristics of microorganisms and their role in the economy of nature. The principles of immunity, serology, and virology are also considered. Three 50-minute lecture periods, one three-hour laboratory period.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 416L Microbiology Lab (0 credits)

BIO 417 Systemic Physiology (4 credits)
A study of the fundamental mechanisms of vertebrate physiology. The basis for the function of the various organ systems and the biological controls that result in the integration of these systems will be discussed. Two 50-minute lecture periods, one four-hour laboratory period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1023 or CHM 125 or CHM 1025 or CHM 126)
Attributes: Undergraduate

BIO 417L Systemic Physiology Lab (0 credits)

BIO 418 Field Research Techniques (4 credits)

BIO 418L Field Research Techniques Lab (0 credits)

BIO 419 Invertebrate Zoology (4 credits)
A study of the morphology, physiology, behavior, and phylogenetic relationships of the major groups of invertebrates. Participants will compare and contrast the physical and biological challenges facing the invertebrates that live on land, in water, and inside other organisms. The laboratory will include observations and experiments on live and preserved animals. Two 50-minute lecture periods, and two 2-hour lab periods.
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 419L Invertebrate Zoology Lab (0 credits)

BIO 420 Bioinformatics (4 credits)
Introduction to the use of computers in biology. Students learn about important scientific questions and the contemporary tools used to answer them. Topics include genome sequence assembly and annotation, database mining, genome organization, phylogenetics and genetics of human disease. Two 50-minute lecture periods, one four-hour lab period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 125 or CHM 1025 or CHM 1023 or CHM 126)
Attributes: Undergraduate

BIO 420L Bioinformatics Lab (0 credits)

BIO 421 Molecular&Cellular Biophysics (4 credits)
The course is designed to show students how the integration of physics, chemistry and molecular biology are used to explain and predict molecular and cellular processes such as protein-protein interactions, protein folding, diffusion, and signaling. The course will also provide students with a basic understanding and hands-on experience of several biophysical and biochemical laboratory techniques. Two 50-minute lecture periods, one four-hour lab period.
Prerequisites: (BIO 201 or BIO 1031) and (CHM 125 or CHM 1021 or CHM 1023 or CHM 1025 or CHM 126) and (PHY 101 or PHY 105)
Attributes: Undergraduate

BIO 421L Mol & Cell Biophysics Lab (0 credits)

BIO 422 Applied&Environ Microbio (4 credits)
The course will introduce us to the complex relationships between microbes and their environment, including other organisms. In the frame of these relationships, we will explore how microbial activities are key to geochemical cycles and to human-engineered processes that are essential part of our lives. Two 50-minute lecture periods, one four-hour lab period.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 1023 or CHM 1025 or CHM 125 or CHM 126)
Attributes: Undergraduate
BIO 422L Applied & Environ Micro Lab (0 credits)

BIO 423 Evolution (4 credits)
This course covers the major concepts of evolutionary biology, including natural selection, adaptation, genetic drift, and phylogenetic trees. The course trains students to know how to generate and test evolutionary hypotheses using data and inference. The lab portion of the course encourages hands-on learning through computer simulation and problem-solving. Two 50-minute lecture periods, one four-hour lab period. 
Prerequisites: BIO 201 and CHM 125.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 125 or CHM 126 or CHM 1023 or CHM 1025 or CHM 1021)
Attributes: Undergraduate

BIO 423L Evolution Lab (0 credits)

BIO 424 Biotechnology (4 credits)
A course in which students will learn how basic cell and molecular biology are used to develop products for biomedical, agricultural and industrial applications. The course will also cover fundamental and emerging techniques in the biotechnology field. The lab section will focus on the steps involved in the production and purification of recombinant proteins expressed in bacterial cells. Two 50-minute lecture periods, one four-hour laboratory period. 
Prerequisites: (BIO 201 or BIO 1031) and (CHM 125 or CHM 126 or CHM 1023 or CHM 1025 or CHM 1021)

BIO 424L Biotechnology Lab (0 credits)

BIO 425 Bacterial Pathogenesis (4 credits)
A study of the physiological, genetic, and biochemical basis underlying some of the commonly encountered bacterial diseases. The course also addresses the roles of antimicrobial compounds and the host immune system in countering disease. Finally, in the lab module for the course, students perform discovery-oriented research as they identify novel genes in enteropathogenic Escherichia coli (EPEC) that affect bacterial virulence in a C. elegans (roundworm) model of disease. Two 75-minute lecture periods, one three-hour laboratory period. 
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 425L Bacterial Pathogenesis Lab (0 credits)

BIO 428 Histopathology (4 credits)
A study of the microscopic structure and function of normal and diseased cells, tissues and organs, focusing on vertebrates, with a special emphasis on humans. Using prepared slides and computer images, students will learn to identify and differentiate healthy and pathological samples and relate this to abnormal or disrupted organ function. Two 50-minute lecture periods, two, two-hour lab periods. 
Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 428L Histopathology Lab (0 credits)

BIO 470 Special Topics (3 credits)
Advanced study on a topic or problem to be arranged with any of the Departmental faculty members. Open to juniors and seniors, with permission of the chair.
Prerequisites: (BIO 1031 or BIO 201) and (CHM 125 or CHM 1021)
Attributes: Undergraduate

BIO 491 Biology Internship (3 credits)
Internships enable the student to gain first-hand experience working in some field of biology. Interns should work a minimum of 10 hours weekly for 12 weeks to earn credit for a single course. Permission to take an internship for course credit must be obtained prior to beginning the internship. Open to juniors and seniors, with permission of the chair of Biology. 
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 125 or CHM 126 or CHM 1023 or CHM 1025)
Attributes: Undergraduate

BIO 492 Biology Internship II (3 credits)
Internships enable the student to gain first-hand experience working in some field of biology. Interns should work a minimum of 10 hours weekly for 12 weeks to earn credit for a single course. Permission to take an internship for course credit must be obtained prior to beginning the internship. Open to juniors and seniors, with permission of the chair of Biology. 
Prerequisites: (BIO 1031 or BIO 201) and (CHM 125 or CHM 126 or CHM 1021)
Attributes: Undergraduate

BIO 493 Undergraduate Research in Bio (3,6 credits)
Laboratory or field work on a specific biological problem in cooperation with a faculty member of the department. Normally requires three hours of work per week for each unit of credit. This course may be taken for credit multiple semesters but only one semester counts as a biology elective. In subsequent semesters this course will count as a general elective. Students need to complete the application form for independent study and have the approval of the department chair and Associate Dean. 
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 125 or CHM 126 or CHM 1023)
Attributes: Undergraduate

BIO 494 Undergraduate Research in Bio (3,6 credits)
Laboratory or field work on a specific biological problem in cooperation with a faculty member of the department. Normally requires three hours of work per week for each unit of credit. This course may be taken for credit multiple semesters but only one semester counts as a biology elective. In subsequent semesters this course will count as a general elective. Students need to complete the application form for independent study and have the approval of the department chair and Associate Dean. 
Prerequisites: (BIO 1031 or BIO 201) and (CHM 1021 or CHM 125 or CHM 126 or CHM 1023)
Attributes: Undergraduate

BIO 550 Research Techniques (3 credits)
An introduction to techniques commonly used in life science research laboratories. Weekly meetings by different faculty members on their area of specialty. One lecture period. 
Restrictions: Enrollment is limited to Graduate level students.

BIO 550L Research Techniques Lab (1 credit)
This course is designed to expose students to the research activity within the department. Students will be rotated through 2-3 faculty research laboratories, working in each lab for a four-week period. Students will select the labs to work in based on their interest. This experience is designed to allow students the opportunity to learn the practical side of laboratory techniques and to help students select a research area for study. Times to be arranged. 
Restrictions: Enrollment is limited to Graduate level students.
BIO 552 Graduate Seminar (1 credit)
Presentations and discussions of primary literature articles. Topic varies by semester. One period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 601 Animal Behavior (4 credits)
Study of animals and their behaviors with strong emphasis on evolutionary relationships and ecology. Two lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 601L Animal Behavior Lab (0 credits)

BIO 602 Advanced Cell Biology (4 credits)
In depth analysis of eukaryotic cell structure and function. Emphasis is on experimental approaches to understanding concepts in cell biology. Two lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 602L Advanced Cell Biology Lab (0 credits)

BIO 603 Biometrics and Modeling (4 credits)
Computer simulation of life science phenomena from the subcellular to population levels. Appropriate statistics are included along with exposure to simulation software. Two lecture periods, one four-hour laboratory.
Restrictions: Enrollment is limited to Graduate level students.

BIO 604 Biochemistry (3 credits)
An introduction to the study of the chemistry of living systems. The study of important macromolecules, metabolic pathways, and control systems will be emphasized. Two lecture periods.
Restrictions: Enrollment is limited to Graduate level students.

BIO 605 Biomechanics (4 credits)
Students are introduced to the ways in which the behavior, morphology and material composition of plants and animals are affected by and take advantage of physical forces. This course will include lectures given by the members of the Biology and Physics Department, as well as an integrated laboratory section where students will observe and measure the effect of physical forces on organisms in both aquatic and terrestrial systems. Two 75-minute lecture periods, one three-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 605L Biomechanics Lab (0 credits)

BIO 606 Comparative Anatomy (4 credits)
An integrated comparative study of vertebrate structure and development. A synthesis of the embryological development, the gross anatomy, and the histology of selected forms. Two lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 606L Comparative Anatomy Lab (0 credits)

BIO 607 Developmental Biology (4 credits)
A study of the molecular and cellular aspects of development. Emphasis will be on induction, regeneration, and genetic control of differentiation. Two lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 607L Developmental Biology Lab (0 credits)

BIO 608 Histology (4 credits)
A study in depth of the microscopic structure and function of normal cells, tissues and organs as found in the vertebrates. Students will make extensive use of computer imaging, CD-ROM presentations and biological specimens for study in the laboratory. Two three-hour sessions per week.
Restrictions: Enrollment is limited to Graduate level students.

BIO 608L Histology Lab (0 credits)

BIO 609 Ecology (4 credits)
Study of complex interrelationship between organisms and their environment. Two lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 609L Ecology Lab (0 credits)

BIO 610 Light & Electron Microscopy (4 credits)
The techniques of light and electron microscopy, including aspects of technique, theory, and operation. Two lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 610L Light & Elec Microscopy Lab (0 credits)

BIO 611 Molecular Genetics (4 credits)
Study of the molecular biology of the genetic material, its structure, expression, regulation, and its dynamic nature. Two lecture periods, one four-hour laboratory.
Restrictions: Enrollment is limited to Graduate level students.

BIO 611L Molecular Genetics Lab (0 credits)

BIO 612 Neurobiology (4 credits)
A study of neural activity using examples from invertebrate and vertebrate model systems. The emphasis will be at the cellular and tissue levels with appropriate neurochemistry and pharmacology included. Laboratory work will focus on computer simulation of neural processes including simple nerve nets. Two lecture periods, one four-hour laboratory.
Restrictions: Enrollment is limited to Graduate level students.

BIO 612L Neurobiology Lab (0 credits)

BIO 613 Plant Physiological Ecology (4 credits)
This course will focus on the physiological mechanisms plants use to respond to their environment. Major topic areas include the basic environmental physiology of carbon, water, and mineral nutrient exchange, and the adaptive mechanisms plants use to survive the variety of global environments. Labs will cover common physiological research methods ranging from cellular to whole organism level measurements and will involve both laboratory and field work. Two 75-minute lecture periods, two 90 minute lab periods.
Restrictions: Enrollment is limited to Graduate level students.

BIO 613L Plant Physiological Eco Lab (0 credits)

BIO 614 Plant Systematics (4 credits)
Students will learn to recognize vascular plant families and understand how taxonomists study evolutionary relationships among plant groups. Economic, medical, and ecological importance of various seed plants will be emphasized. Two 75-minute lecture periods, two 90-minute laboratory periods.
Restrictions: Enrollment is limited to Graduate level students.

BIO 614L Plant Systematics Lab (0 credits)

BIO 615 Immunology (4 credits)
An introductory course providing students with an overview of how the immune system works, including molecules, cells and organs of the immune system and their functions and interactions. Discussion of the experimental techniques used to understand the cell-cell interactions that occur in immunity as well as the differentiation and activation of the immune response will be included. Two 50-minute lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.
BIO 615L Immunology Lab (0 credits)

BIO 616 Microbiology (4 credits)
The structural, cultural, and physiological characteristics of microorganisms and their role in the economy of nature. Three 50-minute lecture periods, one three-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 616L Microbiology Lab (0 credits)

BIO 617 Systemic Physiology (4 credits)
A study of the fundamental mechanisms of vertebrate physiology. The basis for the function of the various organ systems and the biological controls that result in the integration of these systems will be discussed.
Two lecture periods, one four-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 617L Systemic Physiology Lab (0 credits)

BIO 618 Field Research Techniques (4 credits)

BIO 618L Field Research Techniques Lab (0 credits)

BIO 619 Invertebrate Zoology (4 credits)
A study of the morphology, physiology, behavior, and phylogenetic relationships of the major groups of invertebrates. Participants will compare and contrast the physical and biological challenges facing the invertebrates that live on land, in water, and inside other organisms. The laboratory will include observations and experiments on live and preserved animals. Two 50-minute lecture periods; two two-hour lab periods.
Restrictions: Enrollment is limited to Graduate level students.

BIO 619L Invertebrate Zoology Lab (0 credits)

BIO 620 Bioinformatics (4 credits)
Introduction to the use of computers in biology. Students learn about important scientific questions and the contemporary tools used to answer them. Topics include genome sequence assembly and annotation, database mining, genome organization, phylogenetics and genetics of human disease. Two 50-minute lecture periods, one four-hour lab period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 620L Bioinformatics Lab (0 credits)

BIO 621 Molecular&Cellular Biophysics (4 credits)
The course is designed to show students how the integration of physics, chemistry and molecular biology are used to explain and predict molecular and cellular processes such as protein-protein interactions, protein folding, diffusion, and signaling. The course will also provide students with a basic understanding and hands-on experience of several biophysical and biochemical laboratory techniques. Two 50-minute lecture periods, one four-hour lab period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 621L Mol & Cel Biophysics Lab (0 credits)

BIO 622 Applied & Environ Microbiology (4 credits)
The course will introduce us to the complex relationships between microbes and their environment, including other organisms. In the frame of these relationships, we will explore how microbial activities are key togeochemical cycles and to human-engineered processes that are essential part of our lives. Two 50-minute lecture periods, one four-hour lab period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 622L Applied & Environ Micro Lab (0 credits)

BIO 623L Evolution Lab (0 credits)

BIO 624 Biotechnology (4 credits)
A course in which students will learn how basic cell and molecular biology are used to develop products for biomedical, agricultural and industrial applications. The course will also cover fundamental and emerging techniques in the biotechnology field. The lab section will focus on the steps involved in the production and purification of recombinant proteins expressed in bacterial cells. Two 50-minute lecture periods, one four-hour lab period
Restrictions: Enrollment is limited to Graduate level students.

BIO 624L Biotechnology (0 credits)

BIO 625 Bacterial Pathogenesis (4 credits)
A study of the physiological, genetic, and biochemical basis underlying some of the commonly encountered bacterial diseases. The course also addresses the roles of antimicrobial compounds and the host immune system in counteracting disease. In the lab module for the course, students perform discovery-oriented research as they identify novel genes in enteropathogenic Escherichia coli (EPEC) that affect bacterial virulence in a C. elegans (roundworm) model of disease. Two 75-minute lecture periods, one three-hour laboratory period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 625L Bacterial Pathogenesis Lab (0 credits)

BIO 626 Histopathology (4 credits)
A study of the microscopic structure and function of normal and diseased cells, tissues and organs, focusing on vertebrates, with a special emphasis on humans. Using prepared slides and computer images, students will learn to identify and differentiate healthy and pathological samples and relate this to abnormal or disrupted organ function. Two 50-minute lecture periods, two, two-hour lab periods.
Restrictions: Enrollment is limited to Graduate level students.

BIO 626L Histopathology Lab (0 credits)

BIO 720 Science Communication&Outreach (1 credit)

BIO 770 Advanced Topics in Biology (3-4 credits)
Topics, course format, and instructors may vary each semester.

BIO 790 Independent Study (3 credits)

BIO 791 Graduate Internship (1-4 credits)

BIO 793 Research (1-6 credits)
Research project undertaken in the laboratory of a member of the graduate faculty. Meeting times arranged.
Restrictions: Enrollment is limited to Graduate level students.
BIO 794 Thesis Research (3.6 credits)
Research credit during preparation of thesis. Times to be arranged.
Restrictions: Enrollment is limited to Graduate level students.