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).
Prerequisites: BIO 101
Attributes: Science Course w/Lab (Sci Maj), Undergraduate

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

BIO 109 General Biology I (3 credits)

BIO 119 General Biology II (3 credits)

BIO 119L General Biology II Laboratory (1 credit)

BIO 119R General Biology II Recitation (0 credits)

BIO 132 Introductory Biology I (3 credits)

BIO 132L Introductory Biology I Lab (1 credit)

BIO 133 Introductory Biology II (3 credits)

BIO 133L Introductory Biology II Lab (1 credit)

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.
Prerequisites: BIO 151L
Attributes: First-Year Seminar, GEP Natural Science, Undergraduate

BIO 151 Bio I: Cells Lab Phage (0 credits)
A research-based laboratory for freshman accompanying BIO 101
including 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.
Prerequisites: BIO 151L
Attributes: First-Year Seminar, GEP Natural Science, Undergraduate

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.
Prerequisites: BIO 151L
Attributes: First-Year Seminar, GEP Natural Science, Undergraduate

BIO 151L Phage Lab (0 credits)
A research-based laboratory for freshman accompanying BIO 101.
Students work "in silico" (using computers) to annotate bacteriophage
genomes isolated the previous year by students in BIO 150L. Complete
annotated genomes will be submitted to GenBank. Open to first year
students majoring in Biology, Chemical-Biology, or Environmental
Science. Admission by application. Successful completion of BIO101
and 151L fulfills the first year seminar GEP requirement. Students are
expected to continue with BIO 151L in the spring. Two 75- minute lab
periods.
Attributes: First-Year Seminar, 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. Open to all students
except those who have credit for BIO 102.
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. 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. Open to all students. 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: GEP Natural Science, Undergraduate

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

BIO 165L Exp. Living World Lab (0 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 202 Human Structure and Function I (3 credits)
BIO 202L Human Structure & Function I Lab (1 credit)
BIO 203 Human Structure & Function II (3 credits)
BIO 203L Hum Structure & Function II Lab (1 credit)
BIO 203R Human Struct & Func II Recitat (0 credits)
BIO 204 Biological Sciences Colloquium (1 credit)
BIO 205 Introduction to Neuroscience (3 credits)
BIO 218 Hematology (3 credits)
BIO 218L Hematology Lab (1 credit)
BIO 219 Basic Nutrition (3 credits)
BIO 220 Plant Diversity and Morphology (3 credits)
BIO 230 Basic Concepts and Procedures (4 credits)
BIO 243 Microbial Science (3 credits)
BIO 243L Microbial Science Lab (1 credit)
BIO 243R Microbial Science Recitation (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, or 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 Hlth (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 276 Introduction to Environmental (3 credits)
BIO 276L Intro to Environmental Lab (1 credit)
BIO 280 Comparative Animal Physiology (3 credits)
BIO 290 Career Development Seminar (0 credits)
This seminar course is designed to enhance students' professional development, knowledge about careers, and practical career skills. By the end of the seminar, students will be able to identify career paths of interest and have the necessary tools to pursue them.
Attributes: Undergraduate

BIO 306 Human Molecular & Cellular Bio (3 credits)
BIO 310 Anatomy and Physiology I (3 credits)
BIO 311 Anatomy and Physiology II (3 credits)
BIO 311R Anatomy& Physiology II Recitat (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 K-12 children. Time commitment is 3 hrs per week.
Attributes: Undergraduate

BIO 336 Pharmacognosy (4 credits)
BIO 343 Microbial Genetics (4 credits)
BIO 348 Clinical Microbiology (4 credits)
BIO 348L Clinical Microbiology Lab (0 credits)
Attributes: Undergraduate

BIO 350 Clinical Immunology (3 credits)
BIO 358 Principals &App of Immunology (3 credits)
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 does not fulfill requirements for a Biology major or minor.
Prerequisites: (THE 154 or THE 221) and PHL 154
Attributes: Faith-Reason Course, Undergraduate

BIO 372 Aquatic Biology (4 credits)
BIO 377 Ecology (4 credits)
BIO 377L Field Ecology Lab (0 credits)
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.
Restrictions: Enrollment is limited to students with a major in Biology.
Attributes: Undergraduate
BIO 400 Developmental Genetics (3 credits)
Students will learn about the principles governing plant and animal development and the underlying cellular and genetic mechanisms. This includes: gametogenesis and fertilization, sex determination, embryogenesis and early development, ectoderm development (nervous systems, skin and appendages), mesoderm development (muscle, bone, blood and cardiovascular), endoderm development (organogenesis, tube formation and reproduction) and an introduction to common developmental disorders. Students will read primary literature and learn about the techniques employed in developmental genetics research using model systems.
Prerequisites: BIO 201 and CHM 125
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 201 and (CHM 125 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 201 and (CHM 125 or CHM 126)
Attributes: Undergraduate

BIO 402L Advanced Cell Biology Lab (0 credits)

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 201 and CHM 215 (may be taken concurrently) and (CHM 125 or CHM 126)
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 201 and CHM 125 and (PHY 101 or PHY 105)
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 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 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 201 and (CHM 125 or CHM 126) and ENG 101
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 neuronal function, sensory and motor systems, behavior, and higher mental processes. 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, and two 2-hour laboratory periods.
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 201 and (CHM 125 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 201 and (CHM 125 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 or CHM 126)
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 201 and (CHM 125 or CHM 126)
Attributes: Undergraduate

BIO 417L Systemic Physiology 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.
Prerequisites: BIO 201 and (CHM 125 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 and (CHM 125 or CHM 126) and (PHY 101 or PHY 105)
Attributes: Undergraduate

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

BIO 422 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 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 201 and (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 or CHM 126)
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 and (CHM 125 or CHM 126)
Attributes: Undergraduate

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 counteracting 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 426 Fermentation Science (4 credits)
This course will provide students with an overview of various fermentation processes and their use in producing fermented foods and beverages. Fermentation will be considered from biochemical, microbiological, food science, historical and cultural points of view. This course will run either with an associated lab or, periodically, as a study tour. Two 75-minute lecture periods and one three-hour lab, or, if running as a study tour, one three-hour meeting per week plus one week abroad. When this course is run as a lecture-only course, it is worth 3 credits, whereas when it is run as a study-tour course, it is worth 4 credits and is considered a lab-based course.

Prerequisites: (BIO 201 and CHM 125)
Attributes: Undergraduate

BIO 426L Fermentation Science 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 429 Environmental Science (4 credits)
An overview of the relationship between humans, their activities, and the environment around them. Though focused on the biological impacts from pollution, overpopulation, climate change, and resource exploitation, this course will also address the chemical and physical mechanisms that drive those changes and possible solutions to the challenges they present. Three, 50-minute lecture periods, one three-hour laboratory period.

Prerequisites: (BIO 201 and CHM 125)
Attributes: Undergraduate

BIO 429L Environmental Science Lab (0 credits)

BIO 430 Neurological Disorders (4 credits)
Students will learn about the molecular and cellular mechanisms underlying various human nervous system disorders, such as autism, addiction, trauma, and neurodegenerative disorders. There will be a focus on the reading of primary literature and writing. Laboratory work will include a semester-long investigative research project. Two 50-minute lecture periods, and two 2-hour laboratory periods.

Prerequisites: BIO 201 and CHM 125 and ENG 101
Attributes: Undergraduate, Writing Intensive Course- GEP

BIO 430L Neurological Disorders Lab (0 credits)

BIO 432 Genes and Brains (3 credits)

BIO 433 Parasitology (3 credits)

BIO 433L Parasitology Lab (1 credit)

BIO 434 Biology of Aging (3 credits)

BIO 436 Virology (3 credits)

BIO 440 Human Physiology (4 credits)

BIO 453 Microbial Physiology (4 credits)

BIO 455 Molecular Basis Neuro Disorder (3 credits)
Students will explore the molecular underpinnings of different neurological disorders and diseases, such as neurodegenerative disorders (Alzheimer’s, Parkinson’s Disease, etc.), addiction, and epilepsy. Through primary literature, discussion, and inquiry-based learning, students will also learn about the research methodology and model systems used to make advances in the investigation of these diseases and disorders.

Attributes: Undergraduate

BIO 460 Neurobiology (3 credits)

BIO 462 Genetics (4 credits)

BIO 462L Genetics Lab (0 credits)

BIO 466 Genetics (4 credits)

BIO 466L Genetics 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.

Prerequisites: BIO 201 and CHM 125
Attributes: Undergraduate

BIO 473 Biological Sciences Seminar I (1 credit)

BIO 474 Emerging Biological Threats (3 credits)

BIO 475 Biological Sciences Seminar II (1 credit)

BIO 476 Molecular Biology (3 credits)

BIO 476L Molecular Biology Lab (2 credits)

BIO 477 Seminar in Neuroscience (1 credit)

BIO 491 Biology Internship (1-3 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. Permission of the Chair of Biology required.

Prerequisites: BIO 201 and (CHM 125 or CHM 126)
Attributes: Undergraduate

BIO 492 Biology Internship II (1-3 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. Permission of the Chair of Biology required.

Prerequisites: BIO 201 and (CHM 125 or CHM 126)
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 201 and (CHM 125 or CHM 126)
Attributes: Undergraduate

BIO 494 Undergraduate Research in Bio (1-6 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 201 and (CHM 125 or CHM 126)
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.
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 600 Developmental Genetics (3 credits)
Students will learn about the principles governing plant and animal development and the underlying cellular and genetic mechanisms. This includes: gametogenesis and fertilization, sex determination, embryogenesis and early development, ectoderm development (nervous systems, skin and appendages), mesoderm development (muscle, bone, blood and cardiovascular), endoderm development (organogenesis, tube formation and reproduction) and an introduction to common developmental disorders. Students will read primary literature and learn about the techniques employed in developmental genetics research using model systems.
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 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 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 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 period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 611L Molecular Genetics Lab (0 credits)

BIO 612 Neurobiology (4 credits)
Introduction to the structure and function of the vertebrate nervous system. Major topics will include neuronal function, sensory and motor systems, behavior, and higher mental processes. 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, and two 2-hour laboratory periods.
Restrictions: Enrollment is limited to Graduate level students.

BIO 612L Neurobiology Lab (0 credits)

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 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 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 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 period.
Restrictions: Enrollment is limited to Graduate level students.

BIO 611L Molecular Genetics Lab (0 credits)

BIO 612 Neurobiology (4 credits)
Introduction to the structure and function of the vertebrate nervous system. Major topics will include neuronal function, sensory and motor systems, behavior, and higher mental processes. 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, and two 2-hour laboratory periods.
Restrictions: Enrollment is limited to Graduate level students.

BIO 612L Neurobiology Lab (0 credits)
**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 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 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 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.

*Restrictions:* Enrollment is limited to Graduate level students.

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

**BIO 622 Applied & Environ Microbiology Lab (0 credits)**

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

**BIO 623 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.

*Restrictions:* Enrollment is limited to Graduate level students.

**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 Lab (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 Fermentation Science (4 credits)
This course will provide students with an overview of various fermentation processes and their use in producing fermented foods and beverages. Fermentation will be considered from biochemical, microbiological, food science, historical and cultural points of view. This course will run either with an associated lab or, periodically, as a study tour. Two 75-minute lecture periods and one three-hour lab, or, if running as a study tour, one three-hour meeting per week plus one week abroad.
*Restrictions: Enrollment is limited to Graduate level students.*

BIO 626L Fermentation Science Lab (0 credits)

BIO 628 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 628L Histopathology Lab (0 credits)

BIO 629 Environmental Science (4 credits)
An overview of the relationship between humans, their activities, and the environment around them. Though focused on the biological impacts from pollution, overpopulation, climate change, and resource exploitation, this course will also address the chemical and physical mechanisms that drive those changes and possible solutions to the challenges they present. Three, 50-minute lecture periods, one three-hour laboratory period.

BIO 629L Environmental Science Lab (0 credits)

BIO 630 Neurological Disorders (4 credits)
Students will learn about the molecular and cellular mechanisms underlying various human nervous system disorders, such as autism, addiction, trauma, and neurodegenerative disorders. There will be a focus on the reading of primary literature and writing. Laboratory work will include a semester-long investigative research project. Two 50-minute lecture periods, and two 2-hour laboratory periods.

BIO 630L Neurological Disorders Lab (0 credits)

BIO 701 Fundamentals of Brewing Science (3 credits)
BIO 711 Brewery Engineering (3 credits)
BIO 712 Microbiology of Beer (2 credits)
BIO 713 Quality Control Lab (2 credits)
BIO 714 Project in Brewing Science (3 credits)
BIO 715 Brewing Science Internship (3 credits)
BIO 720 Science Communication & Outreach (1 credit)
BIO 767 Cell Biology Methods Lab (2 credits)
BIO 770 Advanced Topics in Biology (4 credits)
Topics, course format, and instructors may vary each semester.
*Restrictions: Enrollment is limited to Graduate level students.*

BIO 785 Introduction to Research (1-2 credits)
BIO 786 Research Ethics (1 credit)
BIO 790 Independent Study (3 credits)
BIO 791 Graduate Internship (1-4 credits)
BIO 792 Project in Cell Bio & Biotech (1-3 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 (1-6 credits)
Research credit during preparation of thesis. Times to be arranged.
*Restrictions: Enrollment is limited to Graduate level students.*

BIO 799 Master's Research (1-9 credits)
BIO 801 Scientific Discourse (1 credit)
BIO 861 Cell and Molecular Biology (3 credits)
BIO 887 PhD Colloquium (1 credit)
BIO 897 Scientific Proposals (2 credits)
BIO 899 Doctoral Research (1-9 credits)