DEPARTMENT OF BIOLOGICAL SCIENCES

Science and Technology Center (McNulty Hall)
(973) 761-9044
https://www.shu.edu/biology/

Faculty: Bitsaktsis *(Director of Graduate Studies);* Chang; Chu; Cottrell *(Chair)*; Hill; Klaus; Ko; Nichols *(Director of Health Professions)*; Snyder; Urso; Zhou
Faculty Associates: Ranasinghe; Tall
Lecturers: Pettit
Faculty Retired and Emeritus: Ahmad*; Blake; Glenn* Hsu*; Katz*; Krause*; Rabacchi; Moldow

The Department of Biological Sciences offers programs of study leading to the following degrees: Bachelor of Arts, Bachelor of Science, Master of Science in Biology, Master of Science in Biology with a Business Administration minor, Master of Science in Microbiology, and Doctor of Philosophy in Molecular Bioscience. The Department of Biological Sciences also offers three dual degree programs: Physical Therapy (B.S./D.P.T.), Physician Assistant (B.S./M.S.), and Athletic Training (B.S./M.S.A.T. and B.A./M.S.A.T.) with the School of Health and Medical Sciences. At the undergraduate level, the Department of Biological Sciences also offers an interdisciplinary minor program in Environmental Sciences.

Biology Honors Program

The Biology Honors Program offers the opportunity for students to work closely with faculty members on sustained research projects, leading to the presentation of their work at scientific forums and published papers. The Biology Honors Program is open to students with a minimum GPA of 3.0 in science courses. Students must complete at least 8 credits of biology research under the direction of a faculty member and present their work at two scientific forums:

Code	Title	Hours
BIOL 2181	Biology Honors I (optional)	1
BIOL 3191	Biology Research I	2
BIOL 3192	Biology Research II	2
BIOL 3193	Biology Research III	2
BIOL 3194	Biology Research IV (optional)	2
BIOL 4186	Bio Honors-Senior Thesis	1

From these credits in the Honors Program, up to four credits may be applied as biology electives toward the completion of the 14 *biology elective* credits needed for the major, the remaining credits will be counted as *general electives*. Honors students will also receive training in the responsible conduct of research and are encouraged to continue their research over the Summer.

Advanced Placement

Students with a score of 4 or higher in the Biology Advanced Placement Exam may waive the natural science requirement of the College of Arts and Sciences B.A. Core Curriculum. The credits may be assigned to BIOL 1101 Introduction to Biology. This course is not part of the requirements for biology majors.

Transfer Credits

The Department of Biological Sciences welcomes transfer students. The department may accept General Biology I/II, General Chemistry I/II, General Physics I/II and Calculus I/II or Statistics for science majors with a grade of C or better. Students are required to complete BIOL 2221 Genetics/BIOL 2222 Genetics Lab, BIOL 4199 Senior Biology Seminar , and at least two biology elective courses at Seton Hall University. In addition, B.S. students are required to take BIOL 2238 Cell Biology/BIOL 2239 Cell Biology Lab, and B.A. students are required to take either BIOL 3243 Ecology and Stewardship or (BIOL 3201 Ecology and Stewardship/BIOL 3202 Ecology and Stewardship lab) at Seton Hall University in order to graduate with the biology major from Seton Hall. All requirements for the major must be met.

Academic Requirements and Declaring the Biology Major

Prerequisites for all biology major elective courses:

Code	Title	Hours
BIOL 1211 & BIOL 1212	General Biology- Organisms and General Biology-Organisms Lab	4
BIOL 1222 & BIOL 1223	General Biology-Cell and General Biology-Cell Lab	4
BIOL 2221 & BIOL 2222	Genetics and Genetics Lab	4

Individual courses may have additional prerequisites as shown in the course descriptions. Students must check with biology department advisers to make sure courses are acceptable before registering.

Students entering as pre-science majors may declare the biology major after completing the following courses with a science GPA of 2.0 or better:

Code	Title	Hours
BIOL 1211 & BIOL 1212	General Biology- Organisms and General Biology-Organisms Lab	4
CHEM 1123 & CHEM 1125	General Chemistry I and General Chemistry Lab I	4
MATH 1015 or MATH 1401	Pre Calc Math Alg and Trig Calculus I	4
Total Hours		**12**

If students have completed additional courses toward the major, their science GPA must be 2.0 or above in order to declare the biology major.

To continue as a biology major after earning 30 or more credits, a student must have earned a minimum 2.0 GPA in the major requirements (biology, chemistry, math, and physics courses). Students whose GPA is less than 2.0 will be counseled about an alternate major. Students may continue to take biology courses for which they have satisfied the prerequisites, and may request reinstatement in the biology major at a later time. Note that the University requires a 2.0 GPA (minimum “C” average) in the major and overall in order to graduate.

Major Program

In addition to meeting the standards and requirements of the College of Arts and Sciences, a degree candidate must complete major requirements. Each major program is designed with sufficient flexibility

to ensure scheduling of arts and humanities courses for a broad liberal arts education. The undergraduate major in biology provides a strong background in the biological sciences in preparation for careers in any area of biology, medicine, dentistry and related professions. Through biology elective courses, the program gives students the opportunity to become familiar with different specialized areas of biology and to engage in independent library or laboratory research.

Each student in the major is assigned a faculty member who serves as academic adviser during the student's undergraduate years. The adviser provides continuity of information and guidance to help plan the student's academic program, evaluate progress, and explore career goals. While all students are required to take certain courses (see departmental requirements), each student selects courses and develops a specific program in consultation with the academic adviser. It is each student's responsibility to meet all program requirements.

Health Professions Programs

For information on Health Professions see the Health Professions/Pre-Medical and Pre-Dental Advisory Committee section of the catalogue.

Major

- Biology Major (B.A.) (http://catalogue.shu.edu/undergraduate/college-arts-sciences/department-biological-sciences/biology-major-ba/)
- Biology Major (B.S.) (http://catalogue.shu.edu/undergraduate/college-arts-sciences/department-biological-sciences/biology-major-bs/)
- Department of Biological Sciences (p. 1)

Accelerated and Dual Degrees

- Athletic Training Dual Degree B.A./M.S.A.T. (http://catalogue.shu.edu/undergraduate/college-arts-sciences/department-biological-sciences/athletic-training-dual-degree-ba-msat/)
- Athletic Training Dual Degree B.S./M.S.A.T. (http://catalogue.shu.edu/undergraduate/college-arts-sciences/department-biological-sciences/athletic-training-dual-degree-bs-msat/)
- Physical Therapy Major Dual Degree B.S./D.P.T. (http://catalogue.shu.edu/undergraduate/college-arts-sciences/department-biological-sciences/physical-therapy-major-dual-degree-program-bs-dpt/)
- Physician Assistant Major Dual Degree B.S./M.S. (http://catalogue.shu.edu/undergraduate/college-arts-sciences/department-biological-sciences/physician-assistant-major-dual-degree-bs-ms/)

Minor

- Environmental Sciences Minor (http://catalogue.shu.edu/undergraduate/college-arts-sciences/department-biological-sciences/environmental-sciences-minor/)

Note to Students: The following listing represents those courses that are in the active rotation for each department, i.e., have been offered in the past five years. Some departments have additional courses offered more rarely but still available – to find the complete list of all official courses for a department, please use the "Course Catalogue Search" function in Self-Service Banner

Course Descriptions

Equivalent courses taken elsewhere may be accepted as prerequisites. Students should check with their adviser to make sure courses are acceptable before registering.

BIOL 1211 General Biology- Organisms/BIOL 1212 General Biology-Organisms Lab, BIOL 1222 General Biology-Cell/BIOL 1223 General Biology-Cell Lab, and BIOL 2221 Genetics/BIOL 2222 Genetics Lab are prerequisites for all biology major elective courses. Individual courses may have additional prerequisites/corequisites as shown in the following course descriptions. Students must check with their adviser to make sure prerequisites/corequisites are met before registering for courses.

From the combined course groups of Biology Honors, Independent Study, Co-op, and Biology Research a maximum of 4 credits may be counted toward biology major credits for the B.S. and B.A. degrees. Any additional credits earned in those three course groups will be counted as general electives.

Core waivers will be considered for incoming students who transfer with an Associate's Degree in Biology. Please contact the department for more information.

BIOL 1101 Introduction to Biology (3 Credits)
Introduction to concepts that contribute to understanding the distinctive nature and characteristics of life, its cellular, physical and chemical bases. Emphasis on the function of tissues, organs and systems of the human body. Three-hour lecture per week. (For students not majoring in the sciences.)

BIOL 1104 Biology in the World Around Us (4 Credits)
Introduction to concepts that contribute to understanding the distinctive nature and characteristics of life, its chemical, informational, cellular, and ecological basis, with emphasis on the human and laboratory discovery. Lecture and Lab. (For students not majoring in the sciences).

BIOL 1105 Human Structure-Function I (4 Credits)
Biology of Homo sapiens, including discussions of human evolution, ecology, genetics and development; mammalian cellular, tissue, and organ structure and function; mammalian physiology emphasizing nervous and hormonal coordination necessary for homeostasis. Three-hour lecture, three-hour laboratory per week. (Primarily for psychology majors). Lab fee $25.

BIOL 1106 Human Structure-Function II (4 Credits)
Biology of Homo sapiens, including discussions of human evolution, ecology, genetics and development; mammalian cellular, tissue, and organ structure and function; mammalian physiology emphasizing nervous and hormonal coordination necessary for homeostasis. Three-hour lecture, three-hour laboratory per week. (Primarily for psychology majors).

BIOL 1115 Human Structure-Function I (3 Credits)
Same course content as BIOL 1105, but does not include lab. Three-hour lecture per week. (Primarily for non-science majors).

BIOL 1116 Human Structure-Function II (3 Credits)
Same course content as BIOL 1106, but does not include lab. Three-hour lecture per week. (Primarily for non-science majors).

BIOL 1122 Human Anatomy and Physiology I (3 Credits)
Introduction to the structure and function of the human body through the molecular, cellular, tissue, and organ system levels. Elements of structure as a basis for understanding function of major body systems, including: neural, endocrine, musculoskeletal, cardiovascular, digestive, renal, respiratory, reproductive, and more. Emphasis on the regulation of body processes to maintain homeostasis/wellbeing in the face of changing environment or disease challenge. Three-hour lecture, three-hour laboratory per week. Not for Biology majors.

BIOL 1123 Human Anatomy and Phys I Lab (1 Credit)
Introduction to the structure and function of the human body through the molecular, cellular, tissue, and organ system levels. Elements of structure as a basis for understanding function of major body systems, including: neural, endocrine, musculoskeletal, cardiovascular, digestive, renal, respiratory, reproductive, and more. Emphasis on the regulation of body processes to maintain homeostasis/wellbeing in the face of changing environment or disease challenge. Three-hour lecture, three-hour laboratory per week. Not for Biology majors.

BIOL 1133 Human Anatomy and Phys II (3 Credits)
Introduction to the structure and function of the human body through the molecular, cellular, tissue, and organ system levels. Elements of structure as a basis for understanding function of major body systems, including: neural, endocrine, musculoskeletal, cardiovascular, digestive, renal, respiratory, reproductive, and more. Emphasis on the regulation of body processes to maintain homeostasis/wellbeing in the face of changing environment or disease challenge. Three-hour lecture, three-hour laboratory per week. Not for Biology majors.

BIOL 1134 Human Anatomy and Phys II Lab (1 Credit)
Introduction to the structure and function of the human body through the molecular, cellular, tissue, and organ system levels. Elements of structure as a basis for understanding function of major body systems, including: neural, endocrine, musculoskeletal, cardiovascular, digestive, renal, respiratory, reproductive, and more. Emphasis on the regulation of body processes to maintain homeostasis/wellbeing in the face of changing environment or disease challenge. Three-hour lecture, three-hour laboratory per week. Not for Biology majors.

BIOL 1211 General Biology- Organisms (3 Credits)
Biology of various living organisms, introduction to taxonomy, phylogeny and evolution of organisms, as well as the structure and function of various organ systems in vertebrates.

BIOL 1212 General Biology-Organisms Lab (1 Credit)
Biology of various living organisms, introduction to taxonomy, phylogeny and evolution of organisms, as well as the structure and function of various organ systems in vertebrates.

BIOL 1222 General Biology-Cell (3 Credits)
Introduction to genetics, the cellular basis of life forms, the structures and functions of biologically important molecules. Covers cellular and molecular aspects of operation of bodily systems that are treated more descriptively in BIOL 1201 (e.g., kidney function, nerve cell function, muscle contraction, hormone action and cellular recognition in immunity). Includes microscopy, permeability, molecular modeling, enzyme studies, spectrophotometry, statistics and data analysis.

BIOL 1223 General Biology-Cell Lab (1 Credit)
Introduction to genetics, the cellular basis of life forms, the structures and functions of biologically important molecules. Covers cellular and molecular aspects of operation of bodily systems that are treated more descriptively in BIOL 1201 (e.g., kidney function, nerve cell function, muscle contraction, hormone action and cellular recognition in immunity). Includes microscopy, permeability, molecular modeling, enzyme studies, spectrophotometry, statistics and data analysis.

BIOL 2122 Introduction to Ecology (4 Credits)
Application of basic scientific laws, principles and concepts to environmental and resource problems. Scientific concepts such as matter and energy resources; soil, water and food resources; ecosystems, atmosphere and geologic processes; air and water pollution and pesticides will be studied. Problems such as deforestation, loss of biodiversity and global climate change will be examined. Three-hour lecture, three-hour laboratory per week. (Part of the environmental studies program; not a biology major elective course.) Lab fee TBA.

BIOL 2141 Introduction to Microbiology (3 Credits)
Integrated approach to the principles of bacteriology, mycology, virology and parasitology to provide a better understanding of the problems of health and disease (Not for science majors or pre-medical/pre-dental students). Students with a nursing major or tracking nursing must earn a "C+" or higher grade to fulfill the nursing program requirements.

BIOL 2142 Intro to Microbiology Lab (1 Credit)
Integrated approach to the principles of bacteriology, mycology, virology and parasitology to provide a better understanding of the problems of health and disease (Not for science majors or pre-medical/pre-dental students). Students with a nursing major or tracking nursing must earn a "C+" or higher grade to fulfill the nursing program requirements.

BIOL 2181 Biology Honors I (1 Credit)
Use of library resources to search the literature of the biological sciences and compile bibliographies. Principles of scientific inquiry and development of scientific theories explored through discussion with faculty. Review of various research areas and topics for laboratory investigation. Class assignments and term papers. One hour per week.

BIOL 2221 Genetics (3 Credits)
Fundamental principles of classic and molecular genetics. Simple inheritance patterns, cytogenetics, DNA replication, protein synthesis, regulatory mechanisms, genetic engineering and behavioral genetics. Problems of human genetics as related to genetic counseling and genetic engineering. Laboratory experiments illustrate principles of genetics using various organisms. Introduction to statistics and computers as applied to genetics.

BIOL 2222 Genetics Lab (1 Credit)
Fundamental principles of classic and molecular genetics. Simple inheritance patterns, cytogenetics, DNA replication, protein synthesis, regulatory mechanisms, genetic engineering and behavioral genetics. Problems of human genetics as related to genetic counseling and genetic engineering. Laboratory experiments illustrate principles of genetics using various organisms. Introduction to statistics and computers as applied to genetics.

BIOL 2238 Cell Biology (3 Credits)
Study of cell morphology and cell physiology, including diversity of cell types resulting from cell specialization, the intracellular and intercellular mechanisms by which cells communicate, reproduce, and develop. Experimental approaches and methodology are emphasized, as well as the cell's fundamental importance in medicine and disease. Laboratory exercises emphasize experimental design and execution, as well as data collection, analysis and presentation. Quantitative problem solving is emphasized throughout the lecture and laboratory components. Three-hour lecture, three-hour laboratory per week.
Prerequisites: (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D) or BIOL 2211 with a minimum grade of D

BIOL 2239 Cell Biology Lab (1 Credit)
Study of cell morphology and cell physiology, including diversity of cell types resulting from cell specialization, the intracellular and intercellular mechanisms by which cells communicate, reproduce, and develop. Experimental approaches and methodology are emphasized, as well as the cell's fundamental importance in medicine and disease. Laboratory exercises emphasize experimental design and execution, as well as data collection, analysis and presentation. Quantitative problem solving is emphasized throughout the lecture and laboratory components. Three-hour lecture, three-hour laboratory per week.

BIOL 3001 Selected Topics (3 Credits)

BIOL 3100 Bio Consequences of Racism (3 Credits)
This course is an in-depth exploration of the role racism plays in human biology and health. The mechanisms by which racism-related stress, stemming from structural, interpersonal, and intrapersonal racism, affect the physiology of human organ systems will be discussed. Disparities in pathologies such as kidney disease, cardiovascular disease, diabetes, maternal mortality and other adverse birth outcomes, obesity, COVID-19, cancer, diabetes, hypertension, and stroke will be considered. Racial/ethnic groups including Black or African American, Asian, Hispanic, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander will be considered. Prerequisites; Co-requisites: BIOL 2221
Prerequisites: BIOL 2221

BIOL 3191 Biology Research I (2 Credits)
Methods of original laboratory investigation and research projects. Hours by arrangement. Limited to juniors and seniors approved by the faculty. Permission must be obtained prior to registration. A maximum of 8 credits is permitted in BIOL 3191-3198. From the combined course groups of Biology Honors, Independent Study, and Biology Research, a maximum of four credits may be counted toward the biology major requirements. Any additional credits earned in those three course groups count as general electives.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3192 Biology Research II (2 Credits)
Methods of original laboratory investigation and research projects. Hours by arrangement. Limited to juniors and seniors approved by the faculty. Permission must be obtained prior to registration. A maximum of 8 credits is permitted in BIOL 3191-3198. From the combined course groups of Biology Honors, Independent Study, and Biology Research, a maximum of four credits may be counted toward the biology major requirements. Any additional credits earned in those three course groups count as general electives.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3193 Biology Research III (2 Credits)
Methods of original laboratory investigation and research projects. Hours by arrangement. Limited to juniors and seniors approved by the faculty. Permission must be obtained prior to registration. A maximum of 8 credits is permitted in BIOL 3191-3198. From the combined course groups of Biology Honors, Independent Study, and Biology Research, a maximum of four credits may be counted toward the biology major requirements. Any additional credits earned in those three course groups count as general electives.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3194 Biology Research IV (2 Credits)
Methods of original laboratory investigation and research projects. Hours by arrangement. Limited to juniors and seniors approved by the faculty. Permission must be obtained prior to registration. A maximum of 8 credits is permitted in BIOL 3191-3198. From the combined course groups of Biology Honors, Independent Study, and Biology Research, a maximum of four credits may be counted toward the biology major requirements. Any additional credits earned in those three course groups count as general electives.

BIOL 3195 Independent Study in Biology I (1 Credit)
Insight into current biological research and, with direct contact with the staff affords the opportunity to examine the biological sciences as a cultural subject and a professional field. Hours are by arrangement. (Limited to students selected by the faculty. Arrangements must be made and permission obtained prior to registration.) A maximum of 8 credits are permitted in BIOL 3191-3198. From the combined course groups of Biology Honors, Independent Study, and Biology Research a maximum of four credits may be counted toward the biology major requirements. Any additional credits earned in those three course groups count as general electives.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3196 Independent Study in Biology II (1 Credit)
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3197 Independent Study in Biology III (1 Credit)
Insight into current biological research and, with direct contact with the staff affords the opportunity to examine the biological sciences as a cultural subject and a professional field. Hours are by arrangement. (Limited to students selected by the faculty. Arrangements must be made and permission obtained prior to registration.) A maximum of 8 credits are permitted in BIOL 3191-3198. From the combined course groups of Biology Honors, Independent Study, and Biology Research a maximum of four credits may be counted toward the biology major requirements. Any additional credits earned in those three course groups count as general electives.

BIOL 3199 Histology (4 Credits)
Study of normal cells and tissues and how they are organized to form functional organ systems in humans. Laboratory involves analysis of prepared slides as well as some of the current microscopic techniques used to study cells and tissues. Lecture and labs are offered online. Face-to-face meetings with instructor each week for review of lecture and lab materials.
Prerequisites: BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D

BIOL 3200 Engaging the World: Sustainability in the Marine Environment (3 Credits)
Sustainability in the marine environment involves synchronizing human activities with the rhythms of nature. Students learn the theory of sustainability from the perspectives of marine biology and resource management, religious values, and socio-economic constraints, and study the application of these concepts in a particular geographic setting, Campobello Island, at the US-Canada border. This "travel and learn" course is offered in the summer term, and includes travel and residence for one week on Campobello Island, off the coast of Maine. The course fulfills the University Core Signature 3 requirement.

BIOL 3201 Ecology and Stewardship (3 Credits)
Students examine the inter-relationships of organisms with their environment, including the influences of human activities. Through reading, research, class discussion, computer simulations, field experiences, and contemplative exercises, students explore their roles within the Earth community in the context of both the natural sciences and the Catholic tradition of Saint Francis of Assisi and Bernard Lonergan.

BIOL 3202 Ecology and Stewardship lab (1 Credit)
Students examine the inter-relationships of organisms with their environment, including the influences of human activities. Through reading, research, class discussion, computer simulations, field experiences, and contemplative exercises, students explore their roles within the Earth community in the context of both the natural sciences and the Catholic tradition of Saint Francis of Assisi and Bernard Lonergan.

BIOL 3210 Human Genetics (3 Credits)
Inheritance of various traits from simple inheritance patterns to biochemical traits, to behavioral traits and Complex patterns of inheritance. Methods for detection of human traits will be discussed.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3212 Evolution (3 Credits)
Population genetics; Hardy-Weinberg equilibrium; genetic variation; kinds of selection; speciation mechanism; major phylogenetic patterns; evidence for organic evolution; and modern techniques (such as biochemical, morphometric, behavioral) in population genetics and taxonomy. Three-hour lecture per week. Offered in alternate years.
Prerequisites: BIOL 2211 (may be taken concurrently)

BIOL 3231 Molecular Biology (3 Credits)
Study of the chemical and physical structures of DNA molecules. Genetic code, transcription, translation, mutation and the regulatory mechanisms of DNA, RNA and proteins of prokaryotes and eukaryotes. Contemporary biotechnology topics are introduced, and recent scientific articles are also included.

BIOL 3233 Biochemistry of Metabolism (3 Credits)
Synthesis and degradation of organic molecules in living systems, especially humans. Dietary, medical and genetic aspects of metabolism. Integration and regulation of pathways. Includes metabolic activities restricted to plants and microorganisms; representative antibiotics, toxins, drugs. Three-hour lecture per week.
Prerequisites: BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D) and CHEM 2313 with a minimum grade of D or (CHEM 2315 with a minimum grade of D and CHEM 2321 with a minimum grade of D)
Enrollment limited to students with a semester level of Junior or Senior.

BIOL 3241 Introduction to Immunology (4 Credits)
Discussion of antigenicity, recognition and specificity. Development of the immune system: humoral and cell mediated responses. Cellular interactions, lymphokines and regulations. Structure and function of immunoglobulins, genetic basis of diversity, gammopathy and monoclonal antibody. Complement system, tolerance and immunosuppression. Autoimmunity and immunogenetics. Three-hour lecture and four-hour laboratory per week.
Prerequisites: BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D) and (CHEM 2321 with a minimum grade of D and CHEM 2315 with a minimum grade of D)

BIOL 3243 Ecology and Stewardship (4 Credits)
Students examine the inter-relationships of organisms with their environment, including the influences of human activities. Through reading, research, class discussion, computer simulations, field experiences, and contemplative exercises, students explore their roles within the Earth community in the context of both the natural sciences and the Catholic tradition of Saint Francis of Assisi and Bernard Lonergan.
Prerequisites: CORE 2101 with a minimum grade of D and BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3321 Vertebrate Physiology (4 Credits)
A comprehensive coverage of the physiology of cells, organs and organ systems with emphasis on the underlying biophysical and biochemical principles of function. Organ systems, including nerve, muscle, cardiovascular, respiratory and renal, are examined from the standpoint of their regulation and role in maintenance of homeostasis. Three-hour lecture, three-hour laboratory per week.
Prerequisites: (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D) or BIOL 2211 with a minimum grade of D

BIOL 3323 Neuroendocrinology (3 Credits)
Role of hormones in coordinating homeostasis. Emphasis on neuroendocrinology, including functional neuroanatomy and neuro-chemistry. Study of the mechanism of action of hormones at the cellular and molecular levels. Review and analysis of current literature. Three-hour lecture per week
Prerequisites: BIOL 2211 (may be taken concurrently)

BIOL 3324 Microbial Genetics (3 Credits)
Fundamental principles. Aspects of production and selection of microbial mutants. Classic mechanisms of microbial recombination, including transformation, transduction, and conjugation and recombinant DNA technology as related to microorganisms. Three-hour lecture per week.

BIOL 3333 Embryology (4 Credits)
Descriptive and experimental study of the development of vertebrates with emphasis on human development. Topics include gametogenesis, fertilization, cleavage, gastrulation, organogenesis and mechanisms involved in control of shaping, pattern formation and gene expression during development. Three-hour lecture, three-hour laboratory per week.

BIOL 3334 Anatomy and Physiology I (3 Credits)
Human Anatomy and Physiology I is part I of the two-part series that studies the structure and function of the human body extending from the microscopic components of cells and tissues to organs and organ systems. BIOL 3334 & 3335 includes the integumentary system, skeletal system, muscular system, cardiovascular system, respiratory system, and immune system. These courses are designed for BIOT (PT Track), BIOP (PA Track), BIOZ (AT Track) specifically. Biology majors who are not in a PT/PA/AT track need permission from the instructor to take these courses. For biology majors who have taken BIOL 3321, only BIOL 3334 & 3335, NOT BIOL 3336 & 3337, are accepted as biology elective, and BIOL 3336 & 3337 are accepted as a general elective only.
Prerequisites: BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3335 Anatomy and Physiology I lab (1 Credit)
Human Anatomy and Physiology I is part I of the two-part series that studies the structure and function of the human body extending from the microscopic components of cells and tissues to organs and organ systems. BIOL 3334 & 3335 includes the integumentary system, skeletal system, muscular system, cardiovascular system, respiratory system, and immune system. These courses are designed for BIOT (PT Track), BIOP (PA Track), BIOZ (AT Track) specifically. Biology majors who are not in a PT/PA/AT track need permission from the instructor to take these courses. For biology majors who have taken BIOL 3321, only BIOL 3334 & 3335, NOT BIOL 3336 & 3337, are accepted as biology elective, and BIOL 3336 & 3337 are accepted as a general elective only.
Prerequisites: BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3336 Human Anatomy and Physio II (3 Credits)
Human Anatomy and Physiology II is part II of the two-part series that studies the structure and function of the human bbody extending from the microscopic components of cells and tissues to organs and organ systems. BIOL 3336 & 3337 covers the organ systems such as the nervous system, endocrine system, gastrointestinal system, metabolism, urinary system, acid base balance, and reproductive system. These courses are designed for BIOT (PT Track), BIOP (PA Track), BIOZ (AT Track) specifically. Biology majors who are not in a PT/PA/AT track need permission from the instructor to take these courses. For biology majors who have taken BIOL 3321, only BIOL 3334 & 3335, NOT BIOL 3336 & 3337, are accepted as biology elective, and BIOL 3336 & 3337 are accepted as general elective only.
Prerequisites: BIOL 3338 with a minimum grade of D or (BIOL 3334 with a minimum grade of D and BIOL 3335 with a minimum grade of D) and BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3337 Human Anatomy and Phys II Lab (1 Credit)
Human Anatomy and Physiology II is part II of the two-part series that studies the structure and function of the human bbody extending from the microscopic components of cells and tissues to organs and organ systems. BIOL 3336 & 3337 covers the organ systems such as the nervous system, endocrine system, gastrointestinal system, metabolism, urinary system, acid base balance, and reproductive system. These courses are designed for BIOT (PT Track), BIOP (PA Track), BIOZ (AT Track) specifically. Biology majors who are not in a PT/PA/AT track need permission from the instructor to take these courses. For biology majors who have taken BIOL 3321, only BIOL 3334 & 3335, NOT BIOL 3336 & 3337, are accepted as biology elective, and BIOL 3336 & 3337 are accepted as general elective only.

BIOL 3338 Human Anatomy and Physiology I (4 Credits)
Prerequisites: BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3339 Human Anatomy and Physiology II (4 Credits)
Prerequisites: BIOL 3338 with a minimum grade of D and BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3340 ST: Intro to Pharmacology (3 Credits)

BIOL 3341 Environmental Toxicology (3 Credits)
Introduction to principles of ecotoxicology, including toxicity of petroleum and oil, solvents and pesticides, environmental ionizing radiation, air pollution, plant and animal toxins. Analytical and bioassay methods of detection will be studied as well as risk assessment. Three-hour lecture per week.
Prerequisites: (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D) and (CHEM 2315 with a minimum grade of D and CHEM 2321 with a minimum grade of D)

BIOL 3342 ST: Cell Signaling (3 Credits)

BIOL 3369 ST: Cancer Biology (3 Credits)

BIOL 3400 Biol and Applic of Stem Cells (3 Credits)
This course will familiarize students with the basic biology of stem cells and their use in regenerative medicine. Students will gain an understanding of the salient properties of stem cells and appreciate differences in embryonic versus adult stem cells. We will discuss the maintenance of stem cells, signals that promote their differentiation to specialized cell types, and the effects of disruption of this balance in cancers and degenerative diseases. Students will be exposed to primary research literature discussing different model systems used to study stem cell behavior and in the development of therapeutic approaches against diseases.
Prerequisites: BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D

BIOL 3411 Microbiology (4 Credits)
Microbiological theories, methods and techniques: comprehensive background in the structure, physiology and nomenclature of bacteria, yeast and fungi. Laboratory techniques used for the isolation, staining, culturing and identification of a variety of microorganisms. Three-hour lecture, four-hour laboratory per week. BIOL 3411 is required for B.S./M.S.P.A. and Secondary Education students. Those students will have priority to register for this course.
Prerequisites: BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3433 Forensic Biology (3 Credits)
This course provides a comprehensive review of biological principles applied to forensic science. Topics that will be discussed include, but are not limited to: crime scene, sample recovery and handling, analytical techniques, drug/alcohol use and abuse, serology, firearms, DNA, and hair and fiber analysis.
Prerequisites: BIOL 2211 with a minimum grade of D or (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 3434 Med Terminology-Physio App (3 Credits)
The course has been divided into two specific sections. The first section has been designed to meet the following objectives: word roots, combining forms, prefixes and suffixes, defining and understanding the specialties of medicine, building surgical and diagnostic terms. The course also covers the study of suffixes that pertain to medical diagnosis, the study of suffixes to understand medical procedures, diagnostic imagery- X-ray, CT, MRI, how, why and when to use them. Selected abbreviations that are standard in the medical community. Building terms about disease and disorder- suffixes and prefixes pertaining to specific pathologies will be studied in the first section of the course. Organization of the body- frames of reference, and the anatomical position. Sections of the body: coronal, frontal and transverse and their application to CT scans and MRI will be studied. General word parts about body fluids will be introduced and used to write medical terms. Classification of type of disease, such as organic diseases as opposed to functional disorders. Three-hour lecture.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3511 Advanced Imaging (3 Credits)
Students will gain an understanding of (1) the physical design of the compound light microscope and its relationship to image formation; (2) the physics of image formation; and (3) selected biological microscopic imaging techniques. Students will gain mastery of (1) the hands-on use of the compound light microscope, (2) basic sample preparation, (3) quantitative image analysis, and (4) the production of publication-quality images. Students will gain experience in the use of specific biological imaging techniques including wide-field fluorescence and confocal imaging, time-lapse imaging, and three-dimensional volume reconstruction. Three-hour lecture/lab.

BIOL 3593 Permaculture Design (3 Credits)
The ethics, principles and practices of permaculture (permanent agriculture and permanent culture) are introduced with real life examples of urban, suburban and rural landscape regeneration projects. Using whole systems thinking, students will design human habitats that yield perennial abundance and enduring value. Focus on habitats that are adaptive, resilient and secure places, in a future of peak oil, climate instability, and deepening economic insolvency. The course is accompanied by Permaculture Design Lab (1 credit). Together, the course and the lab lead to a professional certificate in Permaculture Design.

BIOL 3688 Slct Topic - Emerging Diseases (3 Credits)
This course is designed to give students insights how microbes cause infectious diseases. Specific topics will be discussed to demonstrate the importance of emerging diseases and how these diseases are affected by the religion, culture, environment, human development, health and social issues. Topics will include studies of bacterial, viral, protozoan and prion diseases that cause epidemics or pandemics.
Prerequisites: BIOL 3411 with a minimum grade of D

BIOL 3699 Spec Top: Metabolic Diseases (3 Credits)
Prerequisites: BIOL 3233 with a minimum grade of D

BIOL 3894 Biology Co-Op I (3 Credits)
See Co-op Adviser.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3895 Biology Co-Op II (3 Credits)
See Co-op Adviser.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3896 Biology Co-Op III (3 Credits)
See Co-op Adviser.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 3999 Junior Biology Seminar (1 Credit)
Students are introduced to recent research developments in different biological fields and integrate what they learned in the classroom setting with what is conducted in the laboratory setting. Students will learn experimental design, communication skills, and how to discuss and evaluate biological research.

BIOL 4186 Bio Honors-Senior Thesis (1 Credit)
Laboratory research carried out previously are the basis for an extensive written report. The thesis must be completed in order for any biology honors credits to be included in the 32 biology credits required in the major.
Prerequisites: BIOL 2211 with a minimum grade of D

BIOL 4199 Senior Biology Seminar (3 Credits)
Seminars and discussions designed to integrate readings of the current biology literature with both written and oral presentation. Specific goals include: acquiring skills in gathering and analysis of biological information, developing confidence and expertise in presenting biology through writing and speaking, formulating a critical method of evaluating and discussing biology. In addition, this seminar will be coordinated with the department's outcome assessment.
Prerequisites: (BIOL 2221 with a minimum grade of D and BIOL 2222 with a minimum grade of D)

BIOL 4412 Molecular Virology (3 Credits)
The goal of this course is to introduce students to the basic principles of virology including genome organization, virus structure, gene expression and replication strategies, virus-host cell interactions and the molecular basis of pathogenesis. All important human viruses will be discussed, including papilloma, herpes, smallpox, polio, measles, West Nile, HIV, influenza, SARS, and hepatitis viruses. Three-hour lecture.

BIOL 4431 Microbial Genetics (3 Credits)
Fundamental principles. Aspects of production and selection of microbial mutants. Classic mechanisms of microbial recombination including transformation, transduction, and conjugation and recombinant DNA technology as it relates to microorganisms. Three-hour lecture. Prerequisite: BIOL 3411.
Prerequisites: BIOL 3411 (may be taken concurrently)