

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*.

Faculty

The biology department's faculty and staff members are scientists, scholars, educators, mentors and advisers who are eager to engage in research and support students throughout their journey in the ever-evolving field of life sciences.

Department of Biology Faculty & Staff (<https://www.sju.edu/departments/biology/faculty-staff/>)

Biology in the GEP

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, like BIO 165. 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
Non-science majors Biology GEP lecture-only courses		
BIO 160	Heredity and Evolution	3
BIO 161	Human Organism	3
BIO 162	Plants and Civilization	3
Non-science majors Biology GEP lab-based courses		
BIO 165	Exploring the Living World	4

Programs

Undergraduate Majors

- Biology (<https://academiccatalog.sju.edu/arts-sciences/biology/bs-biology/>)
- Biological Studies (<https://academiccatalog.sju.edu/arts-sciences/biology/biological-studies-ba/>)

- Biology Secondary Education (<https://academiccatalog.sju.edu/arts-sciences/biology/bs-biology/#biologysecondaryeducationtextcontainer>)
- Biomedical Sciences (<https://academiccatalog.sju.edu/arts-sciences/biology/biomedical-science-major/>)
- Medical Laboratory Science (<https://academiccatalog.sju.edu/arts-sciences/biology/medical-lab-sci-major/>)

Undergraduate Minors

- Biology (<https://academiccatalog.sju.edu/arts-sciences/biology/minor-biology/>)

Graduate

- Biology (MS) (<https://academiccatalog.sju.edu/arts-sciences/biology/ms-biology/>)
- Biology (MA) (<https://academiccatalog.sju.edu/arts-sciences/biology/ma-biology/>)
- Genomics (<https://academiccatalog.sju.edu/arts-sciences/biology/genomics-ms/>)

Graduate Certificates

- Brewing Science (<https://academiccatalog.sju.edu/arts-sciences/biology/brewing-science-gct/>)
- Genomics (<https://academiccatalog.sju.edu/arts-sciences/biology/genomics-gct/>)

Courses

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 BIO 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 a section of 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 BIO 151L).

Prerequisites: BIO 101

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

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

Students who register for BIO 102 must also register for a BIO 102 laboratory. For example, if you register for BIO 102 you must, at the same time, register for a section of BIO 102L.

Attributes: Undergraduate

BIO 109 General Biology I (3 credits)

Basic principles of biology with emphasis on the scientific method, cellular structure and function, cellular respiration, cellular division, protein synthesis, metabolism, and genetics. Three lecture periods, one recitation period, one three-hour laboratory period (BIO 109L). This course will not be offered after the '23 - '24 academic year.

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 109L General Biology I Lab (1 credit)

This is a laboratory-based course to be taken with General Biology I. This laboratory allows students to participate in the scientific method through various experiments. Students will perform hypothesis-based experiments on a variety of topics, which may include macromolecule composition, microscopy, osmolarity, enzyme activity, fermentation, and biotechnology. Students who register for BIO 109 must also register for a BIO 109 laboratory. For example, if you register for BIO 109 you must, at the same time, register for a section of BIO 109L. This course will not be offered after the '23 - '24 academic year.

Attributes: Undergraduate

BIO 119 General Biology II (3 credits)

A continuation of basic principles of biology with emphasis on evolution, morphology, and diversity of organisms within the three domains in life, ecology, animal behavior, and environmental biology. Three lecture periods, one recitation period, one three-hour laboratory period (BIO 119L). This course will not be offered after the '23 - '24 academic year.

Prerequisites: BIO 109 or BS 109

Attributes: Undergraduate

BIO 119L General Biology II Laboratory (1 credit)

This is a laboratory-based course to be taken with General Biology II. Students will engage in experiments that focus on Mendelian and population genetics and microbiology. Additionally, students will observe live and preserved specimens to investigate plant and animal diversity. Students who register for BIO 119 must also register for a BIO 119 laboratory. For example, if you register for BIO 119 you must, at the same time, register for a section of BIO 119L. This course will not be offered after the '23 - '24 academic year.

BIO 132 Introductory Biology I (3 credits)

An introduction to basic biological principles with an emphasis on cellular and molecular biology. Major topics include molecular makeup of a cell, cell structure, cellular respiration, cell to cell communication, cell division, gene expression, and gene regulation. Three lecture periods, one recitation period, one three-hour laboratory period (BIO 132L). This course will not be offered after the '23 - '24 academic year.

Attributes: Undergraduate

BIO 132L Introductory Biology I Lab (1 credit)

This is a laboratory-based course to be taken with Introductory Biology I. This laboratory allows students to participate in the scientific method through various experiments. Students will perform hypothesis-based experiments on a variety of topics, which may include macromolecule composition, microscopy, osmolarity, enzyme activity, fermentation, and biotechnology. Students who register for BIO 132 must also register for a BIO 132 laboratory. For example, if you register for BIO 132 you must, at the same time, register for a section of BIO 132L. This course will not be offered after the '23 - '24 academic year.

BIO 133 Introductory Biology II (3 credits)

This course is a continuation of BS 132; it is a study of basic biological systems emphasizing evolution, biodiversity, and physiological and morphological differences between organisms. Three lecture periods, one recitation period, one three-hour laboratory period (BIO 133L). This course will not be offered after the '23 - '24 academic year.

Prerequisites: BIO 132

Attributes: Undergraduate

BIO 133L Introductory Biology II Lab (1 credit)

This is a laboratory-based course to be taken along with Introductory Biology II. Students will engage in experiments that focus on Mendelian and population genetics and microbiology. Additionally, students will observe live and preserved specimens to investigate plant and animal diversity. Students who register for BIO 133 must also register for a BIO 133 laboratory. For example, if you register for BIO 133 you must, at the same time, register for a section of BIO 133L. This course will not be offered after the '23 - '24 academic year.

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, Biomedical Science, Biochemistry, Chemical Biology, Environmental Science, or Medical Laboratory 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 Phage Lab (0 credits)

A research-based laboratory for freshman accompanying BIO 102. 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, Biomedical Science, Biochemistry, Chemical Biology, Environmental Science, or Medical Laboratory Science. Admission by application. Successful completion of BIO102 and 151L fulfills the first year seminar GEP requirement. Students are expected to continue with BIO 150L in the spring. Two 75- minute lab periods.

Prerequisites: BIO 150L

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 or BIO 462 or BS 462.

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 BIO 202 or BIO 260 or BIO 310 or BS 201 or BS 310.

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 Biochemistry, Biology, Biomedical Sciences, Chemistry, Chemical Biology, Environmental Science, Medical Laboratory Science 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. Three lecture periods, one three-hour laboratory period (BIO 165).

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

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

Students who register for BIO 165 must also register for a BIO 165 laboratory. For example, if you register for BIO 165 you must, at the same time, register for a section of BIO 165L.

Attributes: GEP Natural Science, Undergraduate

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 (BIO 201L). This course is NOT required for legacy University of the Sciences students.

Prerequisites: BIO 102

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

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

Students who register for BIO 201 must also register for a BIO 201 laboratory. For example, if you register for BIO 201 you must, at the same time, register for a section of BIO 201L.

Attributes: Undergraduate

BIO 202 Human Structure and Function I (3 credits)

Organization of the human body and histology. Students will examine the histology, gross anatomy and function of the integumentary, skeletal, muscular and nervous systems. Three hours of lecture and one hour of recitation. Students may count either BIO 202 plus BIO 203, or BIO 260 plus BIO 261, or BIO 310 plus 311, or BIO 417 toward graduation, but not more than one such combination.

Prerequisites: BIO 119 or BIO 102 or BS 119 or BIO 133 or BS 133

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 202L Human Structure&Function I Lab (1 credit)

Organization of the human body and histology, microscopic examination of tissues and organs, followed by a study of the gross anatomy of the muscular and skeletal systems. One, three-hour lab period. Students who register for BIO 202L must also register for a BIO 202 OR a BIO 310 lecture section. For example, if you register for BIO 202L you must, at the same time, register for a section of BIO 202 OR BIO 310.

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 203 Human Structure & Function II (3 credits)

Continuation of BS 205 - Human Structure and Function I. Organization of the human body and histology. Students will examine the histology, gross anatomy, and function of organs of the circulatory, digestive, respiratory, and excretory systems. Three hours of lecture and one hour of recitation. Students may count either BIO 202 plus BIO 203, or BIO 260 plus BIO 261, or BIO 310 plus BIO 311, or BIO 417 toward graduation, but not more than one such combination.

Prerequisites: BIO 202

Attributes: Undergraduate

BIO 203L Hum Structure& Function II Lab (1 credit)

Continuation of BIO 202L - Human Structure and Function I Laboratory. A study of the organization and histology of the human circulatory, digestive, respiratory, and excretory systems. One, three-hour lab period. Students who register for BIO 203L must also register for a BIO 203 OR a BIO 311 lecture section. For example, if you register for BIO 203L you must, at the same time, register for a section of BIO 203 or BIO 311.

Attributes: Undergraduate

BIO 204 Biological Sciences Colloquium (1 credit)

Preparation for careers in biology, microbiology, environmental science, and the health professions; introduction to faculty research. Required for all second-year University of the Sciences legacy students in biological sciences.

Restrictions: Enrollment limited to students with the University Sciences Legacy attribute.

Attributes: Undergraduate

BIO 205 Introduction to Neuroscience (3 credits)

Introduction to neuron structure and function, synaptic transmission, organization of the nervous system, brain-behavior relationships, and current neuroscience methods.

Prerequisites: BIO 102 or BIO 119 or BIO 133 or BS 119 or BS 133

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 206 Animal Diversity (3 credits)

An introduction to the natural history, diversity, and functional anatomy of animals, stressing the theme of evolution.

Prerequisites: BS 119 or BIO 119 or BS 133 or BIO 133

Attributes: Undergraduate

BIO 218 Hematology (3 credits)

Study of the blood and blood-forming tissues with emphasis on the cellular morphology and hematopoietic mechanisms of the red blood cells, white blood cells, and platelets. Also covers a wide variety of clinical disorders, particularly those involving abnormally formed cellular elements and coagulation.

Prerequisites: BS 119 or BIO 102 or BIO 119 or BS 133 or BIO 133

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 218L Hematology Lab (1 credit)

Students who register for BIO 218 must also register for a BIO 218 lab section. For example, if you register for BIO 218 you must, at the same time, register for a section of BIO 218L.

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 219 Basic Nutrition (3 credits)

A basic course in understanding nutrition and its implications in the maintenance of good health.

Prerequisites: BS 119 or BIO 102 or BIO 119 or BS 133 or BIO 133

Attributes: Undergraduate

BIO 220 Plant Diversity and Morphology (3 credits)

A study of the diversity that exists within the plant kingdom. Topics include evolutionary trends, functional anatomy, and ecological influences. Students may count only one of the following courses towards their graduation requirements: BS 220, or BIO 220, or BIO 414.

Prerequisites: BIO 201 or BIO 119 or BIO 133 or BS 119 or BS 133

Attributes: Undergraduate

BIO 230 Basic Concepts & Proc MLS (4 credits)

Fundamentals in medical laboratory sciences.

Prerequisites: BS 119 or BIO 102 or BIO 119 or BS 133 or BIO 133

Restrictions: Enrollment is limited to students with a major in Medical Laboratory Science.

Attributes: Undergraduate

BIO 230L Basic Concepts Med Lab Sci Lab (0 credits)**BIO 243 Microbial Science (3 credits)**

This course will give students a solid foundation in the science of microbiology. Students will learn about the various types of microbiological life (bacteria, archaea, viruses and single cell eukaryotes) with a special emphasis on common themes. These include: classification, structure, growth, the flow of genetic information and relevance to human activity.

Prerequisites: (BS 119 or BIO 119 or BIO 201 or BS 133 or BIO 133) and (CH 102 or CHM 125 or CH 112)

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 243L Microbial Science Lab (1 credit)

This course introduces students to the growth, classification and manipulation of microorganisms in a laboratory setting. The laboratory introduces students to aseptic/sterile technique, normal microflora, microbiological media, microbial colony isolation, classic and modern microbiological techniques. One, three-hour lab period. Students who register for BIO 243 must also register for a BIO 243L lab section. For example, if you register for BIO 243 you must, at the same time, register for a section of BIO 243L.

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

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. Students may count either BIO 260 plus BIO 261, or BIO 202 plus BIO 203, or BIO 310 plus BIO 311, or BIO 417 toward graduation, but not more than one such combination. Three 50-minute lecture periods and one three-hour lab period.

Prerequisites: BIO 102 (may be taken concurrently) or BIO 119 or BIO 133 or BS 119 or BS 133

Attributes: Undergraduate

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

Students who register for BIO 260 must also register for a BIO 260 lab section. For example, if you register for BIO 260 you must, at the same time, register for a section of BIO 260L.

Attributes: Undergraduate

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. Students may count either BIO 260 plus BIO 261, or BIO 202 plus BIO 203, or BIO 310 plus BIO 311, or BIO 417 toward graduation, but not more than one such combination. Three 50-minute lecture periods and one three-hour lab period.

Prerequisites: BIO 260

Attributes: Undergraduate

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

Students who register for BIO 261 must also register for a BIO 261L lab section. For example, if you register for BIO 261 you must, at the same time, register for a section of BIO 261L.

Attributes: Undergraduate

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. Not open to students who have taken BIO 243 or BIO 348 or BIO 416 or BIO 422 or BIO 425 or BIO 453 or BS 244 or BS 342 or BS 343 or BS 347 or BS 348 or BS 350 or BS 375 or BS 453. Three 50-minute lecture periods and one three-hour lab period.

Prerequisites: BIO 102 or BIO 119 or BS 119 or BIO 133 or BS 133

Attributes: Undergraduate

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

Students who register for BIO 270 must also register for a BIO 270L lab section. For example, if you register for BIO 270 you must, at the same time, register for a section of BIO 270L.

Attributes: Undergraduate

BIO 276 Intro to Environmental Science (3 credits)

This is an introductory course in environmental science. It is intended for any student who wants to gain a background in the major environmental issues of our present time. It will cover the issues of world population expansion, sustainability, and basic ecological principles in the context of energy issues, water and mineral resource issues, biodiversity, agricultural issues, and suburban sprawl. Pollution of the air we breathe and the water we drink will also be discussed. We will also examine the issues of solid waste disposal and the economics of environmental issues.

Prerequisites: BIO 102 or BIO 119 or BS 119 or BIO 133 or BS 133

Attributes: Undergraduate

BIO 276L Intro to Enviromntl Sci Lab (1 credit)

Students who register for BIO 276 must also register for a BIO 276L lab section. For example, if you register for BIO 276 you must, at the same time, register for a section of BIO 276L.

Attributes: Undergraduate

BIO 280 Comparative Animal Physiology (3 credits)

Study of organ and system functions in major invertebrate and vertebrate phyla. Students may count only one of the following courses towards their graduation requirements: BS 280, or BIO 280, or BIO 417.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

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. This course is taken in the fall of the sophomore year for Biology and Biomedical Sciences majors.

Attributes: Undergraduate

BIO 305 Animal Behavior (4 credits)

An introduction to the proximate causes and ultimate consequences of behavioral strategies used by individuals within a population. Specific questions concerning the behavior of individuals and populations of individuals are explored in a mechanistic and evolutionary context. Students may count only one of the following courses towards their graduation requirements: BIO 305, or BS 305, or BIO 401.

Prerequisites: BIO 102 or BIO 119 or BIO 133 or BS 119 or BS 133

Attributes: Undergraduate

BIO 305L Animal Behavior Lab (0 credits)

Students who register for BIO 305 must also register for a BIO 305L lab section.

Attributes: Undergraduate

BIO 306 Human Molecular & Cellular Bio (3 credits)

An exploration of how human cells function with an emphasis on molecular techniques used to diagnose disease. Course will provide an introduction to foundational topics in molecular and cellular biology such as, DNA replication, transcription, translation, organelles, and cell division with application to human diseases, when such components and processes fail or are mutated. Students may count only one of the following courses towards their graduation requirements: BIO 306, or BS 306, or BIO 402.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 310 Anatomy and Physiology I (3 credits)

A systemic approach to the structure and function of the human. Organ systems studied include the integumentary, skeletal, muscular, and nervous systems. Three hours of lecture and one hour of recitation. Students may also take the BIO 202L Human Structure & Function I Lab (1 credit) concurrently with this lecture. Students may count either BIO 202 plus BIO 203, or BIO 260 plus BIO 261, or BIO 310 plus BIO 311, or BIO 417 toward graduation, but not more than one such combination.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CH 102 or CHM 125 or CH 112)

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 311 Anatomy and Physiology II (3 credits)

Continuation of BS 310; systemic approach to the structure and function of the human. Organ systems studied include endocrine, circulatory, respiratory, digestive, and excretory systems. Three hours of lecture and one hour of recitation. Students may also take the BIO 203L Human Structure & Function II Lab (1 credit) concurrently with this lecture. BIO 202 plus BIO 203, or BIO 260 plus BIO 261, or BIO 310 plus BIO 311, or BIO 417 toward graduation, but not more than one such combination.

Prerequisites: BIO 310 or BS 310

Attributes: Undergraduate

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 Plant Therapeutics (3 credits)

This course considers plants as sources of alternative therapeutics and the science behind herbal medicines.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CH 102 or CHM 125 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 343 Microbial Genetics (4 credits)

Microbial genetics explores the mechanisms and regulation of information storage, duplication, transmission, and translation in living microorganisms. Major themes include DNA replication, mutation, and repair; gene expression; protein production and trafficking. Practical applications and fundamental discoveries will be emphasized.

Prerequisites: (BIO 243 or BS 243) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Restrictions: Enrollment limited to students with the University Sciences Legacy attribute.

Attributes: Undergraduate

BIO 348 Clinical Microbiology (4 credits)

A survey of the various bacteria that cause human infections. The type of infection caused, portal of entry, molecular basis of the infection process, treatment, and laboratory identification are discussed for each group of organisms. Three hours of lecture and three hours of lab. Students may count only one of the following courses towards their graduation requirements: BIO 348, BIO 270, BIO 416, BIO 422, BIO 425, BIO 453, BS 244, BS 342, BS 343, BS 347, BS 348, BS 350, BS 375, or BS 453.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Restrictions: Enrollment is limited to students with a major in Microbiology or Medical Laboratory Science.

Attributes: Undergraduate

BIO 348L Clinical Microbiology Lab (0 credits)

Students who register for BIO 348 must also register for a BIO 348L lab section. For example, if you register for BIO 348 you must, at the same time, register for a section of BIO 348L.

Restrictions: Enrollment is limited to students with a major in Microbiology or Medical Laboratory Science.

Attributes: Undergraduate

BIO 350 Clinical Immunology (3 credits)

Basic principles and types of immunity. Consideration of transplantation, AIDS, hypersensitivity, and tumor immunology of the human. Laboratory methods of serodiagnosis of disease and blood and tissue typing are emphasized. Students may count BIO 350 or BIO 415 towards their graduation requirements, but not both.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 358 Principals & App of Immunology (3 credits)

Study of the principles and mechanisms of immunology and their applications to infection, hypersensitivity, autoimmunity, transplantation, cancer and AIDS. Students may count BIO 358 or BIO 415 towards their graduation requirements, but not both.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

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 does not fulfill requirements for a Biology, Biomedical Science, or Medical Laboratory Science major or minor.

Prerequisites: (THE 153 or THE 154 or THE 155 or THE 221) and PHL 154

Attributes: Faith-Reason Course, Undergraduate

BIO 372 Aquatic Biology (4 credits)

A lecture and field course concerning the biological, physical, and chemical aspects of freshwater ecosystems. Includes collection, preservation, and recognition of aquatic organisms other than vertebrates and the study of those aspects of their biology that are important adaptations to aquatic life.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CH 102 or CHM 125 or CHM 126 or CH 112)

Attributes: Undergraduate

BIO 372L Aquatic Biology Lab (0 credits)**BIO 377 Ecology (4 credits)**

Consideration of the interaction of living organisms with the environment. Aquatic, terrestrial, and marine systems are examined. Students may count only one of the following towards their graduation requirements: BIO 372, BIO 409, or BS 377.

Prerequisites: (BIO 201 or BIO 243 or BS 243) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 377L Field Ecology Lab (0 credits)

Students who register for BIO 377 must also register for a BIO 377L lab section. For example, if you register for BIO 377 you must, at the same time, register for a section of BIO 377L.

Attributes: 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.

Restrictions: Enrollment is limited to students with a major in Biology or Biomedical Sciences.

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

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. Students may only count one of the following courses towards their graduation requirements: BS 305 or BIO 305, or BIO 401.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 401L Animal Behavior Lab (0 credits)

Students who register for BIO 401 must also register for a BIO 401L lab section.

Attributes: Undergraduate

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. Students may count only one of the following courses towards their graduation requirements: BIO 306, or BS 306, or BIO 402.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 402L Advanced Cell Biology Lab (0 credits)

Students who register for BIO 402 must also register for a BIO 402L lab section.

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. Students may count only one of the following courses towards their graduation requirements: BIO 404, or CHM 335, or CHM 341, or CHM 346, or CH 340, or CH 341, or CH 346.

Prerequisites: (BIO 201 or BIO 119 or BIO 133 or BS 119 or BS 133) and (CHM 215 (may be taken concurrently) or CH 202 or CH 212) and (CHM 125 or CH 102 or CH 112 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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112) and (PHY 101 or PHY 105 or PY 212 or PY 202)

Attributes: Undergraduate

BIO 405L Biomechanics Lab (0 credits)

Students who register for BIO 405 must also register for a BIO 405L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 406L Comparative Anatomy Lab (0 credits)

Students who register for BIO 406 must also register for a BIO 406L lab section.

Attributes: Undergraduate

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. Students may count only one of the following courses towards their graduation requirements: BIO 377, or BS 377, or BIO 409.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 409L Ecology Lab (0 credits)

Students who register for BIO 409 must also register for a BIO 409L lab section.

Attributes: Undergraduate

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. Students may count only one of the following courses towards their graduation requirements: BIO 343, or BS 343, or BIO 411.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126) and ENG 101

Attributes: Undergraduate, Writing Intensive Course- GEP

BIO 411L Molecular Genetics Lab (0 credits)

Students who register for BIO 411 must also register for a BIO 411L lab section.

Attributes: Undergraduate

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. Students may count only one of the following courses towards their graduation requirements: BIO 412 or BIO 460 or BS 460.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 412L Neurobiology Lab (0 credits)

Students who register for BIO 412 must also register for a BIO 412L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 413L Plant Physiological Eco Lab (0 credits)

Students who register for BIO 413 must also register for a BIO 413L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 414L Plant Systematics Lab (0 credits)

Students who register for BIO 414 must also register for a BIO 414L lab section.

Attributes: Undergraduate

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. Students may count BIO 350 or BIO 415 towards their graduation requirements, but not both.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 415L Immunology Lab (0 credits)

Students who register for BIO 415 must also register for a BIO 415L lab section.

Attributes: Undergraduate

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. Students may count only one of the following courses towards their graduation requirements: BIO 416 or BIO 453 or BS 453.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 416L Microbiology Lab (0 credits)

Students who register for BIO 416 must also register for a BIO 416L lab section.

Attributes: Undergraduate

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. Students may count only one of the following courses towards their graduation requirements: BS 412, or BIO 440, or BIO 417.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 417L Systemic Physiology Lab (0 credits)

Students who register for BIO 417 must also register for a BIO 417L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 419L Invertebrate Zoology Lab (0 credits)

Students who register for BIO 419 must also register for a BIO 419L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 420L Bioinformatics Lab (0 credits)

Students who register for BIO 420 must also register for a BIO 420L lab section.

Attributes: Undergraduate

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 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126) and (PHY 101 or PY 202 or PY 212 or PHY 105)

Attributes: Undergraduate

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

Students who register for BIO 421 must also register for a BIO 421L lab section.

Attributes: Undergraduate

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 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 422L Applied & Environ Micro Lab (0 credits)

Students who register for BIO 422 must also register for a BIO 422L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 423L Evolution Lab (0 credits)

Students who register for BIO 423 must also register for a BIO 423L lab section.

Attributes: Undergraduate

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 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CH 102 or CH 112 or CHM 126)

Attributes: Undergraduate

BIO 424L Biotechnology Lab (0 credits)

Students who register for BIO 424 must also register for a BIO 424L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 425L Bacterial Pathogenesis Lab (0 credits)

Students who register for BIO 425 must also register for a BIO 425L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 426L Fermentation Science Lab (0 credits)

Students who register for BIO 426 4 credits must also register for a BIO 426L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 428L Histopathology Lab (0 credits)

Students who register for BIO 428 must also register for a BIO 428L lab section.

Attributes: Undergraduate

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 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 429L Environmental Science Lab (0 credits)

Students who register for BIO 429 must also register for a BIO 429L lab section.

Attributes: Undergraduate

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. Students may count BIO 430 or BIO 460 or towards their graduation requirements, but not both.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112) and ENG 101

Attributes: Undergraduate

BIO 430L Neurological Disorders Lab (0 credits)

Students who register for BIO 430 must also register for a BIO 430L lab section.

Attributes: Undergraduate

BIO 432 Genes and Brains (3 credits)

Advances in the fields of neuroscience and genetics have begun to unravel complex ways in which our genes control proper functioning and dysfunctioning of our brains. In this course-based undergraduate research experience (CURE), students investigate emerging ideas in neurogenetics through rigorous and collaborative laboratory-based research. Students apply the scientific method to test hypotheses, collect and interpret data, and examine broader relevance of their experiments through analysis of primary literature.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BS 133 or BIO 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 433 Parasitology (3 credits)

Survey of the geographic distribution, incidence, symptoms, diagnosis, treatment, prevention, control, and immunology of important parasitic diseases in humans. Emphasis is placed on relationship of culture and social customs to the life cycles of the parasites. Class discussions and presentations will focus on ethical implications of diagnoses, as well as related Western interventions in developing countries. Note: This course does NOT serve as a 400-level biology course for legacy University of the Sciences students. It is a 300-level course for those students.

Attributes: Undergraduate

BIO 433L Parasitology Lab (1 credit)

Students who register for BIO 433 must also register for a BIO 433L lab section.

BIO 434 Biology of Aging (3 credits)

Study of the aging process, including the role of evolution and genetics, systems review, probable causes, and major consequences of aging.

Note: This course does NOT serve as a 400-level biology course for legacy University of the Sciences students. It is a 300-level course for those students.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112) and (CHM 335 (may be taken concurrently) or CHM 341 (may be taken concurrently) or CHM 346 (may be taken concurrently) or BIO 404 (may be taken concurrently) or CH 340 or CH 341 or CH 346)

Attributes: Undergraduate

BIO 435 Neuropsychology (3 credits)

This course is designed to introduce upper-level students interested in careers in medicine, clinical psychology, and related health science disciplines to the structure-function relationships of the human brain.

The course emphasizes adult brain anatomy and function. The behavioral effects of brain damage (e.g., agnosia, neglect, aphasia, apraxia, amnesia) will be related to neuropsychological theories of brain function and examined in depth through readings, case material, and presentations.

Prerequisites: (PSY 100 or PSY 101 or PS 101 or PS 111) and (BIO 102 or BS 119 or BS 133 or PSY 201)

Attributes: Undergraduate

BIO 436 Virology (3 credits)

The study of bacterial, plant, and animal viruses is presented with an emphasis on animal virology. Viral taxonomy, mechanisms of viral reproduction and replication, and the pathology of selected viral families are presented.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112) and (CHM 335 (may be taken concurrently) or CHM 341 (may be taken concurrently) or CHM 346 (may be taken concurrently) or BIO 404 (may be taken concurrently) or CH 340 or CH 341 or CH 346)

Attributes: Undergraduate

BIO 440 Human Physiology (4 credits)

Examination of critical concepts in human physiology from an integrative perspective common to current biomedical disciplines. Levels of organization within and between classical systems include skeletomuscular, nervous, endocrine, cardiovascular, respiratory, renal, and digestive systems. Recommended for pre-professional students. Students may count only one of the following courses towards their graduation requirements: BS 412, or BIO 440, or BIO 417.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112) and (PHY 101 or PHY 102 or PY 202 or PY 212)

Attributes: Undergraduate

BIO 453 Microbial Physiology (4 credits)

Survey of bacterial morphology, factors affecting growth characteristics of bacterial populations, biosynthetic processes, and biochemical and genetic factors that control these processes. Mechanisms of antibiotic activity, development of resistance, and methods of antibiotic testing are also covered.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112) and (CHM 335 (may be taken concurrently) or CHM 341 (may be taken concurrently) or CHM 346 (may be taken concurrently) or BIO 404 (may be taken concurrently) or CH 340 or CH 341 or CH 346)

Attributes: Undergraduate

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.

Prerequisites: (BIO 205 or NSC 205 or PSY 205) or (BS 260 or NS 260 or PS 260)

Attributes: Undergraduate

BIO 460 Neurobiology (3 credits)

In-depth study of the molecular and cellular components of neurons and neural networks. Neuronal functions including synaptic transmission, neurotransmitter release, signaling pathways, and gene expression will be covered. Primary literature will be used to analyze the cellular mechanisms and components regulating neural systems including sensation, integration, sleep, learning, and memory.

Prerequisites: (BS 260 or NS 260 or PS 260) or (BIO 205 or NSC 205 or PSY 205)

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 461 Cell Biology (4 credits)

Analysis of the cell at all levels of organization, which includes consideration of techniques used in the study of cells.

Prerequisites: BS 119 or BIO 119 or BS 133 or BIO 133 and CH 102 or CHM 125 or CH 112

Attributes: Undergraduate

BIO 461L Cell Biology Lab (0 credits)**BIO 462 Genetics (3 credits)**

Course covers fundamental concepts, principles, and applications of microbial, classical, and molecular genetics. This course is only open to legacy University of the Sciences students.

Prerequisites: (BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 335 (may be taken concurrently) or CHM 341 (may be taken concurrently) or CHM 346 (may be taken concurrently) or BIO 404 (may be taken concurrently) or CH 340 or CH 341 or CH 346)

Restrictions: Enrollment is limited to Undergraduate Day Division level students. Enrollment limited to students with the University Sciences Legacy attribute.

Attributes: Undergraduate

BIO 462L Genetics Lab (1 credit)

Students who register for BIO 462 must also register for a BIO 462L lab section.

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

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)

Reports and seminars on topics of current biological interest presented by students or outside speakers. Depending on the instructor, topic may be one of students' or instructor's choice. Required of all senior biological sciences majors; open to all qualified students. This course is only open to legacy University of the Sciences students.

Prerequisites: (BIO 119 or BS 119) or (BIO 133 or BS 133)

Restrictions: Enrollment is limited to Undergraduate Day Division level students. Enrollment limited to students with the University Sciences Legacy attribute.

Attributes: Undergraduate

BIO 474 Emrg Bio Threat & Glbl Sustain (3 credits)

Biological threats such as emerging human/animal diseases, food insecurity, and population growth are examined in connection with causes and effects on global changes in climate, land use, decline in biodiversity, etc. Topics are covered through journal readings, reports, presentations, and student blogs.

Prerequisites: (BIO 201 or BIO 119 or BS 119 or BIO 133 or BS 133) and (CHM 125 or CHM 126 or CH 102 or CH 112)

Attributes: Undergraduate

BIO 475 Biological Sciences Seminar II (1 credit)

Continuation of BIO 473 - Biological Sciences Seminar I. Students will integrate knowledge and ideas within biology and across other fields.

Prerequisites: (BIO 473 or BS 493)

Attributes: Undergraduate

BIO 476 Molecular Biology (3 credits)

Study of molecular biology concepts and techniques. Topics include biochemical basis of macromolecular structure, maintenance of the genome, gene expression, gene regulation, and current molecular biology techniques.

Prerequisites: BIO 492 or BS 462 or BS 466

Restrictions: Enrollment is limited to Undergraduate Day Division level students.

Attributes: Undergraduate

BIO 476L Molecular Biology Lab (2 credits)

Students who register for BIO 476 must also register for a BIO 476L lab section.

BIO 477 Seminar in Neuroscience (1 credit)

Current research and techniques in the field of neuroscience through primary literature review, discussion, and analysis. Topics will be chosen based on current discoveries and advancements in the field.

Prerequisites: (BIO 205 or NSC 205 or PSY 205) or (BS 260 or NS 260 or PS 260)

Attributes: Undergraduate

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 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 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 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 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)

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 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 710 Fundamentals of Brewing Science (3 credits)**

Comprehensive course in the brewing process and its underlying scientific principles. Students will learn methods of brewing beer from grain to glass as instructed by industry experts. There will be a focus on raw ingredient quality, assessment, application, and processing in the brewery.

BIO 711 Brewery Engineering (3 credits)

Designed to inform students of key engineering principles with application to best brewery practices. A combination of theory and application will enable the student to better understand the function, theory, and design of brewery process, equipment, and layout.

Prerequisites: BIO 710 or BS 770

BIO 712 Microbiology of Beer (2 credits)

Through laboratory exercises, students will learn general concepts in cell and molecular biology as it pertains to yeast, bacteria, and fermentation including microscopy, culturing techniques, identification, and yeast management. Through the Yeast Hunters program, students will learn essential techniques while isolating wild yeast strains.

Restrictions: Enrollment is limited to students with a major in Brewing Science.

BIO 713 Quality Control Lab (2 credits)

In this laboratory, students will practice and demonstrate the theory behind common analytical techniques as described by the American Society of Brewing Chemists. Many of these techniques can be incorporated into the brewery, while alternative / more advanced methods will inform the student of possible analytical lab expansion or outsourcing.

BIO 714 Project in Brewing Science (3 credits)

This course is an opportunity to study a topic or establish a skill set as determined by the student with program director oversight. It is meant to prepare students for the industry internship. This will likely be a team-based project that asks a research-based question, utilizing the pilot brewing system.

Restrictions: Enrollment is limited to students with a major in Brewing Science.

BIO 715 Brewing Science Internship (3 credits)**BIO 720 Science Communication & Outreach (1 credit)****BIO 767 Cell Biology Methods Lab (2 credits)**

Laboratory practice in methodologies found in a cell biology or biochemistry laboratory environment. Typical projects may include extraction and analysis of proteins, enzyme purification and characterization, flow cytometry, densitometric analysis of gels, ELISA analysis, and fluorescence microscopy of cellular components.

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 770L Adv Topics in Biology Lab (0 credits)**BIO 772 Current Topics in Zymology (3 credits)**

This course focuses on current research and techniques in fermentation science through primary literature review, discussion, and analysis.

Additional material will cover current issues such as supply chain management, regulatory compliance, and safety.

Prerequisites: BIO 710

BIO 785 Introduction to Research (1-2 credits)

This course is designed for students who are beginning the research phase of their thesis project or who are deciding between the thesis and non-thesis options. The course consists of at least two rotations in the laboratories of department faculty.

BIO 786 Research Ethics (1 credit)

This course will provide an examination of ethical behavior and practice in research in the scientific research. The course will follow a case study format in which students will be expected to present and participate in group discussions.

BIO 790 Independent Study (3 credits)**BIO 791 Graduate Internship (1-4 credits)****BIO 792 Project in Cell Bio & Biotech (1-3 credits)**

Graduate students may perform a graduate-level project under the direction of a mentor. The project must include a comprehensive literature search, an analysis of data, and a written paper.

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)

Candidates for the master of science in cell biology and biotechnology (thesis option) are required to complete a research project under the direction of an advisor chosen from within the department.

BIO 801 Scientific Discourse (2 credits)

Graduate students will learn and improve upon their skills in presentation and debate of primary scientific data. The course will take the format of student presentations about their own ongoing research to their peers. Students will be expected to actively participate in the presentation of others through discussion and critical evaluation of the work presented. General presentation skills and strategies will be covered and feedback will be provided to students on an individual basis. All levels of graduate students are welcome and those without a significantly advanced research project may, at the discretion of the instructor, present current literature related to their research topic.

BIO 861 Cell and Molecular Biology (3 credits)

This course is designed to give the student a working knowledge of modern cell biology, mostly through critical analysis of the current literature. This course will be presented in a lecture/seminar format.

BIO 887 Graduate Colloquium (1 credit)

This course is focused on those skills required by the graduate scientist and consideration of career options.

BIO 897 Scientific Proposals (3 credits)

The course is focused on writing and peer assessment of grant proposals. Thesis students will use their approved research prospectus to compose the Specific Aims page and Research Plan sections of a federally-supported funding opportunity. Non-thesis graduate students will develop a grant application focused on a research project of interest.

BIO 899 Doctoral Research (1-9 credits)

Candidates for the doctor of philosophy degree are required to fulfill their research requirements under the direction of a graduate faculty member of the department.