The General Education Requirement in the Biological Sciences

All students are required to complete at least two quarters of Biological Sciences course work to satisfy the general education requirement in the biological sciences. The goal is to provide students of all majors and academic interests with a broad foundational understanding of the concepts of biology and an opportunity to focus on a specific area of interest within the discipline. The requirement should be completed by the end of the second year.

Students choose one of the following options to meet the general education requirement in the biological sciences:

1. A two-quarter general education sequence for non–Biological Sciences majors; options include BIOS 10130 Core Biology followed by any Topics course (course numbers BIOS 11125-BIOS 16120) OR one of three two-quarter Core Biology sequences (course numbers BIOS 10450-BIOS 10451, BIOS 10500-BIOS 10501, or BIOS 10602-BIOS 10603).

2. The first two courses of the Pre-Med Sequence (BIOS 20170 Microbial and Human Cell Biology through BIOS 20175 Biochemistry and Metabolism) for students interested in completing the requirements for medical school but not majoring in Biological Sciences. NOTE: BIOS 20171 requires concurrent enrollment with BIOS 20172.

3. The first two courses in a Fundamentals Sequence for Biological Sciences majors: BIOS 20153 Fundamentals of Ecology and Evolutionary Biology and BIOS 20151 Introduction to Quantitative Modeling in Biology (Basic) or BIOS 20152 Introduction to Quantitative Modeling in Biology (Advanced).

4. Completion of three quarters of the Advanced Biology Fundamentals Sequence. Students with a score of 4 or 5 on the AP Biology test who complete the first three quarters of an Advanced Biology Fundamentals Sequence will be awarded a total of two quarters of credit to be counted toward the general education requirement in the biological sciences and three quarters of credit toward the Biological Sciences major. For more information about the Advanced Biology Fundamentals Sequence, see the Biological Sciences Program of Study page in this catalog.

Advanced Placement Credit

For students who do not plan to major in the Biological Sciences or prepare for the health professions, a score of 4 or 5 on the AP Biology test confers credit for BIOS 10130 Core Biology. These students complete the general education requirement with either one or two Topics courses in the biological sciences, depending on how the requirements in the mathematical and physical sciences are met; students should contact their College adviser for details.

Students with a score of 4 or 5 on the AP Biology test who complete the first three quarters of an Advanced Biology Fundamentals Sequence will be awarded a total of two quarters of credit to be counted toward the general education requirement in the biological sciences.

General Education Sequences for Non–Biological Sciences Majors

Core Biology

BIOS 10130. Core Biology. 100 Units.

What is life? How does it work and evolve? This course uses student-centered interactive learning in the lab, assigned readings from both the popular press and primary scientific literature, and directed writing exercises to explore the nature and functions of living organisms, their interactions with each other, and their environment.

Instructor(s): Staff Terms Offered: Autumn,Spring,Winter

Multiple sections of BIOS 10130 Core Biology are taught throughout the year. Sections are taught from a different perspective based upon the specialty of the instructor. The different descriptions are listed below. Students should register for the section that best suits their interests based upon the descriptions below:

A. Neurobiology. This course explores the principles governing the organization, operation, and evolution of living systems by examining these concepts through the lens of neuroscience. Through laboratory investigations, readings from the popular and scientific press, and directed writing exercises, the methods of scientific inquiry and logic of scientific reasoning will be introduced. In this exploration, the following questions will be addressed: How are all living organisms organized and how does that organization contribute to their function? What are the mechanisms by which organisms sense and respond to changes in their environment and engage in functional interactions within that environment? What are the biological and evolutionary mechanisms that underlie natural organismal behaviors including, but not limited to, motivated and circadian-driven behaviors? Both invertebrate and vertebrate model systems will be examined to explore the processes at work in all living systems as well as the mechanisms underlying the formation and maintenance of life's diversity. M. McNulty. Autumn, Spring, L.

B. Microbes and Immunity. This section covers the most basic concepts in biology, such as life, macromolecules, cells, energy, metabolism, evolution, and genomics, as well as human anatomy and physiology, drawing examples from microbiology and immunology to tie these basic concepts together. The impact of our interactions with microorganisms in our evolution is highlighted in many ways. Hands-on laboratories, readings, and discussion sessions complement lectures. B. Fineschi. Autumn, Winter, Spring, L.

C. Basic Biology. What is life? How does it work and evolve? This course uses student-centered interactive learning in the lab, assigned readings from both the popular press and primary scientific literature, and directed writing exercises
to explore the nature and functions of living organisms, their evolution, and their interactions with each other. *A. Hunter. Autumn, Spring. L.*

**D. Biotechnology.** In the first half of this course, basic biology concepts related to biotechnology are covered. These include lectures on life, cells, macromolecules, metabolism, and genetics, complemented by hands-on laboratories. The second half of the course involves student-led topical research and presentations on various aspects of biotechnology, such as plant biotechnology, animal biotechnology, microbial biotechnology, response to bioterrorism, and examining the consequences of developments in these areas. *N. Bhasin. Winter. L.*

**E. Ecology.** Have you wondered how the environment has influenced your anatomy, physiology, and psychology through your lifetime? Each one of us continuously interacts, directly or indirectly, with the rest of the Earth’s biodiversity at different levels, from molecules, cells, organisms, populations, ecosystems, and the whole biosphere. Are we really independent individuals, or do we need a better concept that broadens our understanding of the world we live in? In this course you will examine fundamental biological principles to understand how organisms live and thrive in a complex and intricate network that we call nature. You will develop your own criteria based on evidence obtained through hypothesis testing and identification of legitimate sources of information. *O. Pineda. Autumn, Winter. L.*

**F. Ecology and Evolution.** This course focuses on the interaction of organisms with their environment and evolutionary processes that lead to diversity and adaptation. We will examine biological processes at the cellular and organismal levels across a wide range of organisms, considering their ecological similarities and differences in an evolutionary framework. Population and ecosystem levels will be examined to promote understanding of the importance of diversity in ecosystem health and the impacts of an ever increasing human population. *E. Larsen. Winter. L.*

**G. Cell and Developmental Biology.** This course covers basic concepts in life science including molecular biology, cells, genetics, development, evolution, and ecology, with examples being derived from cell and developmental biology. We will use laboratory activities, readings from the scientific literature, and writing exercises to learn about scientific methodology and how that is applied in the biological sciences. *A. Brock. Autumn, Winter. L.*

**Topics Courses for Non-Majors**

The courses that follow have a prerequisite of BIOS 10130 Core Biology, or a score of 4 or 5 on the AP Biology test. Attendance is required at the first class to confirm enrollment. Students who choose to complete only one general education course in the mathematical sciences may take a second topics course as part of the general education requirements.
BIOS 11125. Life Through a Genomic Lens. 100 Units.
The implications of the double helicidal structure of DNA triggered a revolution in cell biology. More recently, the technology to sequence vast stretches of DNA has offered new vistas in fields ranging from human origins to the study of biodiversity. This course considers a set of these issues, including the impact of a DNA perspective on the legal system, on medicine, and on conservation biology.
Instructor(s): A. Turkewitz, M. Nobrega Terms Offered: Winter
Prerequisite(s): BIOS 10130. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.
Equivalent Course(s): ENST 12402

BIOS 11140. Biotechnology for the 21st Century. 100 Units.
This course is designed to provide a stimulating introduction to the world of biotechnology. Starting with an overview of the basic concepts of molecular biology and genetics that serve as a foundation for biotechnology, the course will segue into the various applied fields of biotechnology. Topics will include microbial biotechnology, agricultural biotechnology, biofuels, cloning, bioremediation, medical biotechnology, DNA fingerprinting and forensics. The goal of this course is to provide the Biology non-majors with an appreciation of important biotechnology breakthroughs and the associated bioethics issues.
Instructor(s): N. Bhasin Terms Offered: Winter
Prerequisite(s): BIOS 10130. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

BIOS 12114. Nutritional Science. 100 Units.
This course examines the underlying biological mechanisms of nutrient utilization in humans and the scientific basis for setting human nutritional requirements. The relationships between food choices and human health are also explored. Students consider how to assess the validity of scientific research that provides the basis for advice about how to eat healthfully. Class assignments are designed to help students apply their knowledge by critiquing their nutritional lifestyle, nutritional health claims, and/or current nutrition policy issues.
Instructor(s): P. Strieleanman Terms Offered: Autumn, Spring, Summer
Prerequisite(s): BIOS 10130. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.
Note(s): Credit may not be earned for both BIOS 12114 and BIOS 10501

BIOS 12115. Responses of Cardiopulmonary System to Stress. 100 Units.
This course is designed to provide students an overview of basic concepts involved in the functioning of cardiopulmonary vascular systems. Special emphasis will be given to different regulatory mechanisms working at the cell, tissue and organ levels to control the systems functioning during stress conditions. We also discuss recent topics related to molecular basis of adaptation and drugs designed to treat mal-adaptive changes taking place in the heart and lungs (vessels) subjected to various-types of pathological stresses. Instructors, who are both actively engaged in research to understand molecular basis of cardiopulmonary vascular diseases, take this course beyond the knowledge of standard textbook content.
Instructor(s): M. Gupta, Y. Fang Terms Offered: Spring
Prerequisite(s): BIOS 10130. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

BIOS 12116. The Human Body in Health and Disease. 100 Units.
This course is designed to provide a stimulating introduction to the world of biotechnology. Starting with an overview of the basic concepts involved in the functioning of cardiopulmonary vascular systems. Special emphasis will be given to different regulatory mechanisms working at the cell, tissue and organ levels to control the systems functioning during stress conditions. We also discuss recent topics related to molecular basis of adaptation and drugs designed to treat mal-adaptive changes taking place in the heart and lungs (vessels) subjected to various-types of pathological stresses. Instructors, who are both actively engaged in research to understand molecular basis of cardiopulmonary vascular diseases, take this course beyond the knowledge of standard textbook content.
Instructor(s): M. McNulty Terms Offered: Autumn
Prerequisite(s): BIOS 10130. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

BIOS 12117. The 3.5 Billion Year History of the Human Body. 100 Units.
This course looks at the structure, function, and deep history of the human body. Each major organ and system of the body is explored from perspectives of anatomy, paleontology, and developmental genetics to reveal the deep history of the body and our connections to the rest of the life on the planet.
Instructor(s): N. Shubin Terms Offered: Autumn
Prerequisite(s): BIOS 10130. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.
Note(s): Due to significant overlap of course content, students may register for only one of PHSC 11000, BIOS 12117, or GEOS 13900/BIOS 13123

BIOS 12121. Physiology in Extreme Environments. 100 Units.
Humans live nearly everywhere, including arid deserts, the tops of mountains, and frigid arctic tundra. We have also expanded our reach to include the bottom of the ocean and the International Space Station. Our bodies' ability to make physiological adaptations allows us to survive in each of these environments. Physiology in Extreme Environments will enhance your understanding of how your body reacts to stressors such as high altitude, diving, spaceflight, isolation, and more. Discussion topics will include a review of the cardiovascular and respiratory systems, exercise physiology, and cerebral blood flow. We will also discuss the physiology of sleep and fatigue. This knowledge will then be used to explain how life support environments work and how we survive in dangerous environments.
Instructor(s): K. Ruskim, A. Garcia, A. Clebone Terms Offered: Spring
Prerequisite(s): BIOS 10130. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

BIOS 12122. Gourmet Biology: Exploring Relationships between Human Nutrition, Food & Biodiversity. 100 Units.
Sequences
These sequences are an alternative to taking BIOS 10130 Core Biology plus a Topics course to fulfill the general education requirement in the biological sciences. Students MUST take BOTH courses in a sequence.

Pharmacology Sequence

**BIOS 10450. Pharmacological Perspectives in Cell and Molecular Biology. 100 Units.**
This course introduces concepts related to the use, pharmacodynamic properties, manner in which drugs act at the molecular and/or cellular level, and their effects at the organismal level.
Instructor(s): R. Zaragoza Terms Offered: Autumn
Prerequisite(s): NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

**BIOS 10451. Pharmacological Perspectives II. 100 Units.**
Must be taken in sequence with BIOS 10450. The goal of this course is to learn the pharmacological principles by which drugs act, at the molecular and cellular level, to affect an organ/organ system of the human body. The pharmacodynamics, pharmacokinetic, pharmacotherapeutics and toxicology of a number of drugs are discussed. Drugs currently in the media, how these drugs affect different systems ranging from cardiovascular to the central nervous system, and the fundamental basis for the use of drugs are covered.
Instructor(s): R. Zaragoza Terms Offered: Winter
Prerequisite(s): BIOS 10450. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

Metabolism Sequence

**BIOS 10500. Metabolism and Exercise. 100 Units.**
Must be taken in sequence with BIOS 10501. This course examines the flow of energy through the human body—from what we eat to what we can do. Basic physiology, metabolism, and exercise concepts are covered from cells to systems. Students should be prepared to alter their diet and/or physical activity. This course is intended to be followed by BIOS 10501 (Metabolism and Nutrition). Prerequisite(s): This course MUST be followed by the second course in the sequence. NO BIOLOGICAL SCIENCES MAJORS, except by petition.
Instructor(s): J. Kennedy Terms Offered: Autumn
Prerequisite(s): This course MUST be followed by the second course in the sequence. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

**BIOS 10501. Metabolism and Nutrition. 100 Units.**
Must be taken in sequence with BIOS 10500. Taking a scientific approach to nutrition, this course covers nutritional requirements and why they are required for human health by exploring their function at the cellular and molecular level. Basic physiology concepts related to nutritional health are covered, including digestive physiology and some aspects of endocrinology. As a continuation of the exercise concepts covered in BIOS 10501, the relationship between exercise and nutrition is considered. Students complete a dietary analysis of their food intake to critique their individual nutritional health.
Instructor(s): P. Streileman Terms Offered: Winter
Prerequisite(s): BIOS 10500. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

Note(s): Credit may not be earned for both BIOS 10501 and BIOS 12114.

Computer Modeling Sequence

**BIOS 10602. Multiscale Modeling of Biological Systems I. 100 Units.**
Modern biology generates massive amounts of data; this course is devoted to biological information and the models and computational techniques used to make sense of it. The first course in the sequence begins with the organization of life at the molecular level, and builds a physical understanding to the structure of macromolecules such as DNA, RNA and proteins. Students learn about biological databases, algorithms for sequence alignment and phylogenetic tree building. Students will also be introduced to basics of high performance computation and its application to the field of bioinformatics. They will learn how to use our in-house supercomputer to process and analyze next generation gene sequencing data in order to identify disease-relevant variants. Students implement computational algorithms using R and Unix.
Instructor(s): E. Haddadian Terms Offered: Autumn. L.
Prerequisite(s): MATH 13300/15300/16300 or equivalent placement. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition. This course MUST be followed by the second course in the sequence.

**BIOS 10603. Multiscale Modeling of Biological Systems II. 100 Units.**
Must be taken in sequence with BIOS 10602. Major Advances in understanding how life works at the molecular level have revolutionized biology. The second course in the sequence is dedicated to the study of how large molecules, such as proteins, DNA, carbohydrates, and phospholipids, perform their functions. The course will begin with a solid grounding in molecular chemistry and the forces that govern interactions between atoms and molecules. This is followed by an overview of structure and function of macromolecules, in particular of proteins and enzymes. The students will learn how to visualize macromolecules and measure their basic properties and to model their physical movements by means of molecular dynamic simulations running at university's super computer facility. The course will then proceed to describe how interactions of these molecules produce functioning organelles and cells, and how molecular mishaps can lead to disease.
Instructor(s): E. Haddadian Terms Offered: Winter. L.
Prerequisite(s): BIOS 10602 or consent of instructor. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

Pre-Med Sequence for Non-Majors

**BIOS 20170 through BIOS 20175**
This integrated sequence explores the molecular, cellular, organismal, and biochemical properties of living systems. It is open only to those who have earned a B or better in college level biology, or to those who have earned a B or better in biology for another degree. The five courses in the sequence are:

**BIOS 20170. Microbial and Human Cell Biology. 100 Units.**
Must be taken in sequence with BIOS 10500. This course is the entry point into an integrated biology sequence designed to prepare non-biology majors for application to medical school. We explore topics in human cell biology within the context of evolutionary biology, chemistry, physiology, and medicine. We pay special attention to the influence of prokaryotes on the history of life and to the ecological interactions between humans and their microbiota, which have major implications for human health and disease.
Instructor(s): C. Andrews, R. Zaragoza, E. Kovar Terms Offered: Winter. L.

**BIOS 20171. Human Genetics and Developmental Biology. 100 Units.**
Students read and discuss papers from the scientific literature, attend discussions led by physicians, researchers, and other medical professionals, and gain experience with microbiological basic microscopy techniques in lab. Students should be prepared to alter their diet and/or physical activity. This course is intended to be followed by BIOS 10501 (Metabolism and Nutrition). Prerequisite(s): NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

**BIOS 20172. Mathematical Modeling for Pre-Med Students I. 100 Units.**
Instructor(s): T. Price, M. Kronforst, C. Andrews, A. Hunter. Terms Offered: Winter. L.
In this course students learn the fundamental structures and models used in the physical, chemical, and biological sciences, and how these models and systems are applied to a variety of contexts. Students will be introduced to basics of high performance computation and its application to the field of bioinformatics. They will learn how to use our in-house supercomputer to process and analyze next generation gene sequencing data in order to identify disease-relevant variants. Students implement computational algorithms using R and Unix.

**BIOS 20173. Perspectives of Human Physiology. 100 Units.**
Instructor(s): J. Kennedy Terms Offered: Autumn
In this course students read and discuss papers from the scientific literature, attend discussions led by physicians, researchers, and other medical professionals, and gain experience with microbiological basic microscopy techniques in lab. Students should be prepared to alter their diet and/or physical activity. This course is intended to be followed by BIOS 10501 (Metabolism and Nutrition). Prerequisite(s): NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

**BIOS 20175. Biochemistry and Metabolism. 100 Units.**
Students should note that several majors have specified requirements for how the biological sciences portion of the general education must be fulfilled. These sequences are an alternative to taking BIOS 10130 Core Biology plus a Topics course to fulfill the general education requirement in the biological sciences. Students MUST take BOTH courses in a sequence.
Instructor(s): T. Price, M. Kronforst, C. Andrews, A. Hunter. Terms Offered: Winter. L.
In this course students learn the fundamental structures and models used in the physical, chemical, and biological sciences, and how these models and systems are applied to a variety of contexts. Students will be introduced to basics of high performance computation and its application to the field of bioinformatics. They will learn how to use our in-house supercomputer to process and analyze next generation gene sequencing data in order to identify disease-relevant variants. Students implement computational algorithms using R and Unix.

**BIOS 20174. Perspectives of Human Physiology. 100 Units.**
Instructor(s): J. Kennedy Terms Offered: Autumn
In this course students read and discuss papers from the scientific literature, attend discussions led by physicians, researchers, and other medical professionals, and gain experience with microbiological basic microscopy techniques in lab. Students should be prepared to alter their diet and/or physical activity. This course is intended to be followed by BIOS 10501 (Metabolism and Nutrition). Prerequisite(s): This course MUST be followed by the second course in the sequence. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

**BIOS 20176. Pharmacological Perspectives II. 100 Units.**
Must be taken in sequence with BIOS 10450. The goal of this course is to learn the pharmacological principles by which drugs act, at the molecular and cellular level, to affect an organ/organ system of the human body. The pharmacodynamics, pharmacokinetic, pharmacotherapeutics and toxicology of a number of drugs are discussed. Drugs currently in the media, how these drugs affect different systems ranging from cardiovascular to the central nervous system, and the fundamental basis for the use of drugs are covered.
Instructor(s): R. Zaragoza Terms Offered: Winter
Prerequisite(s): BIOS 10450. NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.

**BIOS 20177. Pharmacological Perspectives in Cell and Molecular Biology. 100 Units.**
This course introduces concepts related to the use, pharmacodynamic properties, manner in which drugs act at the molecular and/or cellular level, and their effects at the organismal level.
Instructor(s): R. Zaragoza Terms Offered: Autumn
Prerequisite(s): NO BIOLOGICAL SCIENCES MAJORS OR NON-BIOLOGY PRE-MED STUDENTS, except by petition.
Font Notice

This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

- Times was used instead of Trajan.
- Times was used instead of Palatino.

The editor may contact Leepfrog for a draft with the correct fonts in place.