

The department of biological and physical sciences has as its objectives to introduce students to the methodologies and tools of science, to give them a background in science necessary for daily living and professional competence, to enable them to examine critically the contemporary issues related to the sciences, and to give science majors the proper foundations to pursue their professions or to enter graduate or professional schools.

The department offers a bachelor of science degree with a major in biology with concentrations in either physiology or biotechnology and a major in biology with secondary certification. All majors include a minor in chemistry.

The program offers a course of study that includes all courses required for admission to most professional schools. The department also offers courses needed for general education requirements, for majors in the department of human environmental sciences, for certification in elementary and middle school education, as well as minors in biology and chemistry. The department articulates with Washington University to provide two dual degree opportunities (*see below*).

## FACULTY

**Elizabeth Rayhel**, associate professor and chairperson of the department of biological and physical sciences

**Stephenie Paine-Saunders**, associate professor

**David Thomasson**, associate professor

**Minh Truong**, assistant professor

## DUAL DEGREE PROGRAM IN ENGINEERING WITH THE UNIVERSITY OF MISSOURI-KANSAS CITY OR WITH WASHINGTON UNIVERSITY IN ST. LOUIS

Fontbonne University students may choose a dual degree program of study in collaboration with either the School of Computing and Engineering at the University of Missouri-Kansas City or the School of Engineering and Applied Science at Washington University in St. Louis. This program may be combined with any major, but is most easily achieved in conjunction with a major in applied mathematics or in biology. Because of the many engineering avenues, students must work closely with the dual degree advisor to map out a curriculum plan. Students must have completed the first three years of required work in a major at Fontbonne. A minimum cumulative grade point average (GPA) of B+ (3.25 on a 4.0 scale) or better, both overall and in science and mathematics courses, is required for admission to the dual

degree program. Applicants with lower GPAs are considered on a case-by-case basis. Upon satisfactory completion of the program, the student will be awarded bachelor's degrees from both Fontbonne University and University of Missouri-Kansas City or from both Fontbonne University and Washington University in St. Louis.

## 3/2 ARRANGEMENT IN OCCUPATIONAL THERAPY WITH WASHINGTON UNIVERSITY IN ST. LOUIS

Fontbonne University students may elect to pursue a 3/2 program of study in connection with the Occupational Therapy (OT) program in the Washington University School of Medicine. Students who have completed the first three years of coursework for either a biology or a psychology degree at Fontbonne and who have a minimum cumulative grade point average of 3.0 in required prerequisite courses may apply for admission to the OT program at Washington University during their junior year at Fontbonne.

Upon satisfactory completion of the first year of coursework at Washington University, the student will be awarded a bachelor of science degree in biology or a bachelor of arts degree in psychology from Fontbonne University. It is the student's responsibility to apply for the bachelor's degree from Fontbonne during the fall semester of the student's first year at Washington University. At the end of the second year of study at Washington University, the student would qualify for a master of occupational therapy degree from the Washington University School of Medicine.

## MAJORS OFFERED

Biology with a concentration in Physiology (BS)

Biology with a concentration in Biotechnology (BS)

Biology with Secondary Certification (BS)

## Baccalaureate Degree and Residency Requirements

All requirements for an undergraduate degree are listed under academic policies and regulations in the introductory section for undergraduate programs in this catalog. These requirements include general education requirements and a graduation requirement of at least one course in religion or theology.

In addition to the degree and residency requirements of the university and the department, all students must take a nationally normalized science exit exam.

## MAJOR APPROVAL

Major approval is required during the second semester of the sophomore year, or after the completion of 45 credit hours at Fontbonne. For transfer students, major approval is required after completing the equivalent of one full semester (*a minimum of 12 credit hours*) at Fontbonne.

Students seeking major approval for a biology major must have a minimum cumulative grade point average (GPA) of 2.5 on a 4.0 scale as well as a GPA of 2.5 in the courses specified below:

- Three courses in biology (including one introductory biology course)

- One course in chemistry

- All courses for the major must be passed with a C- or better.

## General Education Requirements

The 42 credit hours of general education requirements are presented in the undergraduate academic information section in this catalog. A course that meets a general education requirement may also meet a course requirement for the major or a course requirement in another discipline.

## MAJOR IN BIOLOGY WITH CONCENTRATION IN PHYSIOLOGY

This major offers a course of study that prepares the graduates with the necessary background for a professional program, graduate school, or research in industrial, government, or university laboratories. This course of study focuses on human functioning.

### General Education Requirements

The following specific general education course must be chosen to meet the requirements for the biology major:

- MTH 115 Introduction to Statistics (3 credits)

### Courses Required in Biology (30 credits)

- BIO 112 General Biology I with Lab (4 credits)\*
- BIO 114 General Biology II with Lab (4 credits)
- BIO 207 Plant Biology with Lab (4 credits)
- BIO 250 Microbiology with Lab (4 credits)
- BIO 312 Genetics (3 credits)
- BIO 318 Cell and Molecular Biology (3 credits)
- BIO 320 Evolutionary Biology (3 credits)
- BIO 481 Biotech I (2 credits)
- BIO 496 Biology Seminar (2 credits)
- BIO 495/497 Department Research/Internship (1-4 credits)
- BIO 413 Exit Exams (0 credits)

\*BIO 108, with recommendation of instructor and approval of department chair, may substitute for BIO 112. This substitution would not transfer to other institutions, and the student must adjust total credit hours accordingly.

### Courses Required in the Physiology Concentration (15 credits):

- BIO 220 Anatomy and Physiology I with Lab (4 credits)
- BIO 222 Anatomy and Physiology II with Lab (4 credits)
- BIO 306 Kinesiology with Lab (4 credits)
- BIO 314 Developmental Biology (3 credits)

### Courses Required in Chemistry (19 credits):

- CHM 106 General Chemistry I with Lab (4 credits)
- CHM 108 General Chemistry II with Lab (4 credits)
- CHM 210 Organic Chemistry I with Lab (4 credits)
- CHM 212 Organic Chemistry II with Lab (4 credits)
- CHM 318 Biochemistry (3 credits)

### Courses Required in Mathematics and Computer Science (7 credits):

- MTH 150 Calculus with Analytic Geometry I (4 credits)
- MTH 315 Advanced Statistics (3 credits)

### Courses Required in Physics (8 credits):

- PHY 208 College Physics I with Lab (4 credits)
- PHY 210 College Physics II with Lab (4 credits)

## MAJOR IN BIOLOGY WITH CONCENTRATION IN BIOTECHNOLOGY

This major offers a course of study that prepares the graduates with the necessary background for a professional program, graduate school, or research in industrial, government, or university laboratories. This course of study focuses on applied biotechnology.

### General Education Requirements

The following specific general education course must be chosen to meet the requirements for the biology major:

- MTH 115 Introduction to Statistics (3 credits)

### Courses Required in Biology (30 credits)

- BIO 112 General Biology I with Lab (4 credits)\*
- BIO 114 General Biology II with Lab (4 credits)
- BIO 207 Plant Biology with Lab (4 credits)
- BIO 250 Microbiology with Lab (4 credits)
- BIO 312 Genetics (3 credits)
- BIO 318 Cell and Molecular Biology (3 credits)
- BIO 320 Evolutionary Biology (3 credits)
- BIO 481 Biotech I (2 credits)
- BIO 496 Biology Seminar (2 credits)
- BIO 495/497 Department Research/Internship (1-4 credits)
- BIO 413 Exit Exam (0 credits)

\*BIO 108, with recommendation of instructor and approval of department chair, may substitute for BIO 112. This substitution would not transfer to other institutions, and the student must adjust total credit hours accordingly.

**Courses Required in the Biotechnology Concentration (15 credits):**

BIO 322 Immunology (3 credits)  
 BIO 483 Biotechnology II (3 credits)  
 BIO 485 Biotechnology III (3 credits)  
 BIO 487 Biotechnology IV (3 credits)  
 BUS 230 Management Principles (3 credits)

**Courses Required in Chemistry (19 credits):**

CHM 106 General Chemistry I with Lab (4 credits)  
 CHM 108 General Chemistry II with Lab (4 credits)  
 CHM 210 Organic Chemistry I with Lab (4 credits)  
 CHM 212 Organic Chemistry II with Lab (4 credits)  
 CHM 318 Biochemistry (3 credits)

**Courses Required in Mathematics and Computer Science (7 credits):**

MTH 150 Calculus with Analytic Geometry I (4 credits)  
 MTH 315 Advanced Statistics (3 credits)

**Courses Required in Physics (8 credits):**

PHY 208 College Physics I with Lab (4 credits)  
 PHY 210 College Physics II with Lab (4 credits)

**MAJOR IN BIOLOGY WITH SECONDARY CERTIFICATION****Teacher Certification Requirements**

Full information for teacher certification policies, procedures, and requirements are found in the section titled *Teacher Certification at Fontbonne University* following the graduate programs' section in this catalog. Those interested in combining a major in biology with secondary certification must review this section in its entirety.

**General Education Requirements**

The following specific general education courses must be chosen to meet the requirements for the biology major with secondary certification:

CIS 103 Microcomputer Applications in Education (3 credits)  
 COM 102 Public Speaking (3 credits)  
 EDU 234 Philosophical Foundations of Education (3 credits)  
 GOV 101 US and MO Constitutions (1 credit)  
 MTH 115 Introduction to Statistics (3 credits)  
 PSY 200 Developmental Psychology (3 credits)

**Courses Required in Biology (39 credits)**

BIO 106 Topics in Environmental Science with Lab (3 credits)  
 BIO 112 General Biology I with Lab (4 credits)\*  
 BIO 114 General Biology II with Lab (4 credits)  
 BIO 203 The History and Philosophy of Science and Technology (2 credits)  
 BIO 207 Plant Biology with Lab (4 credits)  
 BIO 220 Anatomy and Physiology I with Lab (4 credits)  
 BIO 222 Anatomy and Physiology II with Lab (4 credits)

BIO 250 Microbiology with Lab (4 credits)  
 BIO 312 Genetics (3 credits)  
 BIO 318 Cell and Molecular Biology (3 credits)  
 BIO 320 Evolutionary Biology (3 credits)  
 BIO 371 Methods of Teaching Science in Secondary School (2 credits)  
 BIO 396 Biology Seminar (3 credits)  
 BIO 413 Exit Exam (0 credits)

\*BIO 108, with recommendation of instructor and approval of department chair, may substitute for BIO 112. This substitution would not transfer to other institutions, and the student must adjust total credit hours accordingly.

**Courses Required in Chemistry (19 credits):**

CHM 106 General Chemistry I with Lab (4 credits)  
 CHM 108 General Chemistry II with Lab (4 credits)  
 CHM 210 Organic Chemistry I with Lab (4 credits)  
 CHM 212 Organic Chemistry II with Lab (4 credits)  
 CHM 318 Biochemistry (3 credits)

**Courses Required in Mathematics and Computer Science (7 credits):**

MTH 150 Calculus with Analytic Geometry I (4 credits)  
 MTH 315 Advanced Statistics (3 credits)

**Course Required in Physics (4 credits):**

PHY 208 College Physics I (4 credits)

**Courses Required in Education (24 credits):**

EDU 120 Psychology of the Exceptional Child (3 credits)  
 EDU 201 Introduction to Classroom Teaching—Middle/Secondary (3 credits)  
 EDU 300 Classroom/Behavior Management Techniques (3 credits)  
 EDU 350 Methods of Teaching Reading in the Content Area (2 credits)  
 EDU 447 Planning for Instruction and Assessment—Middle and Secondary (3 credits)  
 EDU 451 Student Teaching at the Secondary Level (10 credits)

**MINORS**

The department of biological and physical sciences offers minors in biology and chemistry. A student must successfully complete, at Fontbonne, a minimum of 50 percent of the credit hours required for the minor. All courses for the minor must be completed with a minimum grade of C- and a GPA of 2.5 or above.

**Minor in Biology (22 credit hours):**

BIO 112 General Biology I with Lab (4 credits)  
 BIO 114 General Biology II with Lab (4 credits)  
 BIO 207 Plant Biology with Lab (4 credits)  
 BIO 250 Microbiology with Lab (4 credits)  
 BIO 312 General Genetics (3 credits)  
 BIO 318 Cell and Molecular Biology (3 credits)

**Minor in Chemistry (19 credit hours):**

- CHM 106 General Chemistry I with Lab (4 credits)
- CHM 108 General Chemistry II with Lab (4 credits)
- CHM 210 Organic Chemistry I with Lab (4 credits)
- CHM 212 Organic Chemistry II with Lab (4 credits)
- CHM 318 Biochemistry (3 credits)

**COURSES**

All prerequisites must be passed with a minimum grade of C- or better within the last five (5) years. Any prerequisite within the last five (5) years with a grade of less than C- must be approved by the department chair.

**Biological Sciences**

**BIO 106 Topics in Environmental Science with Lab (3 credits)**

An introduction as to how nature works, how the environment has been and is being modified and abused by human activities, and what can be done to protect and improve it for future generations of humans and other living things. FA (odd years)

**BIO 108 Introduction to Life Science with Lab (3 credits)**

Introductory course covering the basic principles of life with an emphasis on the scientific method, characterization of life, organization of living things, energetics, and evolution. FA, SP, SU

**BIO/CHM 111 Science Laboratory (1 credit)**

A broad-based set of laboratory experiments in biology, chemistry, physics, and/or earth science emphasizing the scientific method. Prerequisite: A minimum two credit hour science lecture course that meets GER. FA, SP

**BIO 112 General Biology I with Lab (4 credits)**

Selected principles and problems in general biology with emphasis on those principles most applicable to all living organisms: cellular organization, energy exchange, and inheritance. FA

**BIO 114 General Biology II with Lab (4 credits)**

A general course in organismal biology covering diversity of living things from the prokaryote to higher plants and animals. Prerequisite: Introductory biology course. SP

**BIO 203 The History and Philosophy of Science and Technology (3 credits)**

An introductory course examining the history of science and technology, with an emphasis on modern science, as well as the philosophy of scientific and technological thought. FA (even years)

**BIO 206 Essentials of Human Anatomy and Physiology with Lab (4 credits)**

An introduction to the human body and how it functions, with special emphasis on the skeletal, muscular, digestive, respiratory, and cardiovascular systems. Prerequisite: BIO 108. FA

**BIO 207 Plant Biology with Lab (4 credits)**

Introduction to morphology, physiology, and evolution of vascular plants; integrating form and function to understand diversity. Prerequisite: Introductory biology course. FA

**BIO 220 Anatomy and Physiology I with Lab (4 credits)**

A course designed to introduce students to those aspects related to the study of the human body. Particular attention is given to cells, tissues, integumentary, skeletal, muscular, nervous, and endocrine systems. FA, SP, SU

**BIO 222 Anatomy and Physiology II with Lab (4 credits)**

Continuation of Anatomy and Physiology I. Particular attention is given to the digestive, cardiovascular, respiratory, urinary, and reproductive systems. Prerequisite: BIO 220. SP, SU

**BIO 250 Microbiology with Lab (4 credits)**

A general course with emphasis on classification, physiology, and pathology of microorganisms. Prerequisites: Introductory biology course and introductory chemistry course. SP, SU

**BIO 306 Introduction to Kinesiology with Lab (4 credits)**

An introduction to the mechanical principles of movement. Emphasis is placed on how the use of these principles can help improve sports skills for the athlete at all levels of training. Prerequisites: BIO 206 or equivalent; PHY 108. SP

**BIO 312 Genetics (3 credits)**

Study of the fundamental laws of inheritance in biological systems. Prerequisites: Introductory biology course and MTH 115. SP (even years)

**BIO 314 Developmental Biology (3 credits)**

Study of the dynamics of development of organisms from gametogenesis to a more complex form, concentrating on mechanisms and gene regulation. Prerequisites: Introductory biology course; introductory chemistry course; and CHM 108. SP (odd years)

**BIO 318 Cell and Molecular Biology (3 credits)**

Study of fine structures, metabolism, physical, and chemical activities of cells and subcellular structures. Prerequisites: Introductory biology course; BIO 114. FA (odd years)

**BIO 320 Evolutionary Biology (3 credits)**

This course examines the basic processes and patterns of evolution: natural selection, evolutionary genetics, the analysis of adaptation, the phylogeny of life, the fossil record, molecular evolution, macroevolution and speciation; as well as an evaluation of current evolutionary issues. Prerequisites: BIO 114; BIO 312. FA (even years)

**BIO 322 Immunology (3 credits)**

Introductory course which covers the basic concepts of antibody-mediated and cell-mediated immunity. Recent advances in the field will be emphasized from basic scientific and clinical perspectives. Prerequisites: Introductory biology course; BIO 114; BIO 250; CHM 106; CHM 108. FA (odd years)

**BIO 370 Teaching of Science in Early Childhood and Elementary (2 credits)**

Application of principles of teaching science on the early childhood and elementary school level; examination of various approaches to presenting hands-on activities.

Prerequisites: BIO 108; PHY 108. FA, SP

**BIO 371 Teaching of Science in Middle and Secondary School (2 credits)**

Application of principles of teaching science on the middle and secondary school level; examination of various approaches to presenting hands-on activities. Prerequisite: BIO 370. FA, SP

**BIO 413 Department Assessment II (0 credits)**

This course is required for graduation for all designated majors in biology. The course consists of a nationally-normalized test in biology and chemistry designed to assess progress in the major field of study. FA, SP

**BIO 481 Biotechnology I (2 credits)**

A course designed to provide students with basic laboratory skills used in biotechnology methods with emphasis on solution preparation, measurements, and laboratory safety.

Prerequisites: BIO 312; BIO 318; CHM 318. FA

**BIO 483 Biotechnology II (3 credits)**

A continuation of Biotechnology I with an emphasis on DNA manipulations. Prerequisites: BIO 481. FA

**BIO 485 Biotechnology III (3 credits)**

A continuation of Biotechnology I with an emphasis on immunology and protein methods. Prerequisites: BIO 481. SP

**BIO 487 Biotechnology IV (3 credits)**

A continuation of Biotechnology I with an emphasis on cell culture. Prerequisites: BIO 481. SP

**BIO 490 Independent Study (1-4 credits)**

Course in which students may pursue a library, curriculum development, or experimental research project in some aspect of science. Students with 60 or more semester credit hours may register for an independent study course. Offered as needed with the approval of the department chair.

**BIO 495 Department Research (1-4 credits)**

This course is designed to provide the student with a non-classroom, non-structured, individualized experience in experimental research in the biological and physical sciences, utilizing the knowledge and skills obtained in other science courses. Offered with the approval of the department chair.

**BIO 496 Biology Seminar (2 credits)**

A capstone course designed to equip students with the skills of reading and evaluating primary scientific literature, while exploring current topics in science. An oral presentation will be required. Prerequisites: BIO 114; BIO 318; and at least junior status. FA

**BIO 497 Biology Internship (1-4 credits)**

A supervised, off-campus field-based experience at an approved site specifically related to students' career goals;

integrates and applies academic knowledge and skills; emphasizes professional development. Prerequisites: At least junior status with a science GPA of 3.0 or consent of instructor.

**Chemistry****CHM 102 Essentials of Chemistry with Lab (4 credits)**

An introductory course; includes stoichiometry, basic atomic theory, environmental, nuclear, acid-base, organic, and biochemistry. FA, SU

**CHM 106 General Chemistry I with Lab (4 credits)**

An introductory course in chemistry for science majors. Includes stoichiometry, atomic structure, chemical reactions, and solutions. Prerequisite: College algebra. FA

**CHM 108 General Chemistry II with Lab (4 credits)**

A continuation of CHM 106; includes kinetics, equilibrium, thermodynamics, acids and bases, and electrochemistry. Prerequisite: CHM 106. SP

**CHM 128 General, Organic, and Biological Chemistry I (4 credits)**

An introductory course exploring inorganic principles of basic human functioning. Includes lecture and lab. Prerequisite: MTH 105 with minimum grade of C within last five years or permission of department chair. SP

**CHM 210 Organic Chemistry I with Lab (4 credits)**

A study of the compounds of carbon with emphasis on functional groups, structure nomenclature, and reactions. Prerequisites: CHM 106; CHM 108. FA

**CHM 212 Organic Chemistry II with Lab (4 credits)**

A study of the mechanisms of reactions of organic compounds. Prerequisite: CHM 210. SP

**CHM 228 General, Organic, and Biological Chemistry II (4 credits)**

An overview course exploring organic chemistry principles of basic human functioning. Emphasis will be given to biologically active organic molecule chemistry such as proteins, nucleic acids, fats, and carbohydrates. Includes lecture and lab. Prerequisites: CHM 106; CHM 108 with minimum grade of C within last five years or permission of department chair. FA

**CHM 318 Biochemistry (3 credits)**

Study of chemical properties and metabolism of compounds of biological interest: carbohydrates, lipids, proteins, and nucleic acids. Prerequisites: BIO108, 112, 220 or 250; CHM 210. SP

**CHM 328 General, Organic, and Biological Chemistry III (3 credits)**

A course in biochemistry with a focus on human health and function. Prerequisites: CHM 228 or CHM 210 with a grade of B or better; and microbiology with minimum grade of C within last five years or permission of department chair. SP

**Physical Sciences**

**PHY 108 Introduction to Physical Science with Lab  
(3 credits)**

Introductory course in physical science covering the scientific method, basic principles of physics, chemistry, earth science and astronomy. FA, SP, SU

**PHY 208 College Physics I with Lab (4 credits)**

A calculus-based course intended for science and math majors. Includes principles of mechanics, heat, wave motion, and sound. Prerequisite: MTH 150. FA

**PHY 210 College Physics II with Lab (4 credits)**

A continuation of PHY 208; includes light, electricity, magnetism, and quantum physics. Prerequisite: PHY 208 or equivalent. SP