

## ∞ Biology

# The Biology Major

The study of science is born from the conviction of the fundamental intelligibility of the world. Science at Ave Maria University testifies to the Catholic Church's confidence in human reason and in its ability to know the truth about God's creation even apart from the illuminating power of grace. The natural sciences are not simply technological disciplines, but are truly liberal arts education in which we seek to know truth for its own sake. By enabling us to enter the simultaneous complexity and simplicity of physical reality, science instills within the students a deep sense of wonder at the natural universe.

All students take at least two semesters of natural science as part of their core curriculum in the liberal arts education. These courses train their minds to think critically and allow them to understand more of the world that is a dim reflection of its Creator.

The biology major is designed to provide a comprehensive study in several areas of modern biology, molecular biology and biochemistry. This major will serve as excellent preparation for graduate school, medical school, nursing, dentistry, veterinary medicine, or for employment in research labs, clinical labs or science education. All courses should be taken in numerical order. If prerequisites are required they are identified within the course description. In addition to the general core curriculum requirements, the courses listed below are required.

Students with an interest in biology as a potential major are strongly encouraged to speak with a biology faculty advisor before beginning their freshman year. Appropriate advising will assure that interested students begin their proper biology course sequence their freshman year and will help avoid future curriculum conflicts and delays.

### **Required Prerequisites for the Major**

CHEM 211 General Chemistry I (w/lab)  
CHEM 212 General Chemistry II (w/lab)  
CHEM 311 Organic Chemistry I (w/lab)  
CHEM 312 Organic Chemistry II (w/lab)  
PHYS 211 College Physics I (w/lab)  
PHYS 212 College Physics II (w/lab)

### **Required Major Courses**

BIOL 211 Biology I (w/lab)  
BIOL 212 Biology II (w/lab)  
BIOL 303 Genetics (with lab)  
BIOL 213 Critical Analysis I (one credit)  
BIOL 413 Critical Analysis II (one credit)

### **Elective Major Courses (4 courses or 16 credits required)**

BIOL 304 Anatomy and Physiology  
BIOL 305 Molecular Biology (w/ lab)  
BIOL 306 Basic and Clinical Pharmacology  
BIOL 401 Microbiology (w/ lab)  
BIOL 402 Microbial Ecology  
BIOL 405 Biochemistry I  
BIOL 406 Biochemistry II  
BIOL 415 Special Topics in Biology (as offered)  
BIOL 497 Directed Research

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## Minor in Biology

The biology minor allows students majoring in another discipline to develop familiarity with the biological sciences. The biology minor program consists of six courses in biology including BIOL 211 (w/ lab), BIOL 212 (w/ lab), and four additional biology courses above the 200-level.

## Minor in Chemistry

The chemistry minor allows students majoring in another discipline to develop familiarity with the chemical sciences. The chemistry minor program consists of six courses in chemistry including CHEM 211 (w/ lab), CHEM 212 (w/ lab), CHEM 311 (w/ lab), CHEM 312 (w/ lab), CHEM 405, CHEM 406. CHEM 405, 406 have additional physics courses as prerequisites.

## Course Descriptions

### Biology Courses

#### BIOL 201 CONCEPTS IN BIOLOGY I

Designed for non-majors. An introduction to the study of living systems focusing on molecular and cellular biology. (with lab) (4 cr.)

#### BIOL 202 CONCEPTS IN BIOLOGY II

Designed for non-majors. An introduction to the biology of organism physiology, anatomy, population dynamics, evolution and ecology. (with lab) (4 cr.)

#### BIOL 211 BIOLOGY I - CELLULAR AND MOLECULAR BIOLOGY

An introduction to the study of living systems illustrated by examples drawn from cell biology, biochemistry, genetics, microbiology, neurology and developmental biology. (with lab) (4 cr.)

#### BIOL 212 BIOLOGY II - ORGANISMAL AND POPULATION BIOLOGY

Introduction to the study of organisms emphasizing morphology and physiology, behavior, ecology, and evolution of whole organisms and populations. (with lab) (4 cr.)

#### BIOL 213 CRITICAL ANALYSIS I

A course designed to introduce students to researching, reading, analyzing and discussing the biological and biochemical literature. This course will involve a combination of faculty and student literature presentations and analysis. Classic and current papers from the fields of biology and biochemistry will be chosen for analysis. This course is required for the Biology major and Pre-Medicine students. Prerequisites: BIOL 211, BIOL 212 (can be taken concurrently) (1 cr.)

#### BIOL 303 GENETICS

Study of the principles of heredity in animals and plants, including the contemporary understanding of genes and gene mechanisms. Laboratory exercises will be used to elucidate genetic principles. (with lab) Prerequisites: BIOL 211, BIOL 212 (4 cr.)

## **Biology**

### **BIOL 304 ANATOMY AND PHYSIOLOGY**

A systematic analysis of the structure and function of organisms, with special emphasis on the human body. The fundamental processes of body defense, nervous function, hormones, respiration, circulation, blood and lymph, muscles, digestion, and excretion will be introduced. Prerequisites: BIOL 211, BIOL 212 (4 cr.)

### **BIOL 305 MOLECULAR BIOLOGY**

Designed to explore the biology and molecular regulation of gene expression and other cell functions. Other topics include the nature, control, recombination and rearrangement of genes, gene manipulation, and recombinant DNA techniques. (with lab) Prerequisites: BIOL 211, BIOL 212, BIOL 303. Recommended: CHEM 211, 212 (4 cr.)

### **BIOL 306 BASIC AND CLINICAL PHARMACOLOGY**

A study of the actions and uses of a range of clinically important drugs with an emphasis on their mechanism of action. The course will provide the basics of pharmacokinetics, and of pharmacodynamics. Prerequisites: CHEM 211, CHEM 212 (4 cr.)

### **BIOL 400 SPECIAL TOPICS SEMINAR IN BIOLOGY AND MEDICINE**

A seminar exploring current and important topics in medical biology, medicine, bioethics, and offering practical guidance and advice for those interested in pursuing careers in the health sciences. (Pass/Fail, zero cr.)

### **BIOL 401 MICROBIOLOGY**

A general study of microorganisms (bacteria and fungi), emphasizing morphology, physiology, ecological relationships, and the nature of disease and its control. Consideration is also given to viruses. (with lab) Prerequisites: BIOL 211, BIOL 212, BIOL 303 (4 cr.)

### **BIOL 402 MICROBIOLOGY ECOLOGY**

A study of the interactions between microbes and their environments. Discussion includes the physiological ecology of microorganisms (effects of physical parameters on microbial distribution and activities in nature), dispersal mechanisms in nature, associations with higher organisms, and the role of man in manipulating microbial activities. Prerequisites: BIOL 211, BIOL 212, BIOL 303 (4 cr.)

### **BIOL 405 BIOCHEMISTRY I**

A study of proteins, enzymes, carbohydrates, lipids and membranes with an emphasis on the relationship of structure and function. Also included is a study of catabolism with primary focus on glycolysis, gluconeogenesis, glycogen metabolism, Krebs cycle, and oxidative phosphorylation. Prerequisites: BIOL 211, BIOL 212, CHEM 211, 212, 311, 312, PHYS 211, 212. Crosslisted as CHEM 405. (4 cr.)

### **BIOL 406 BIOCHEMISTRY II**

A continuation of Biochemistry I. Topics covered are photosynthesis, biosynthesis of macromolecular precursors, the chemistry of storage, transmission and expression of genetic information, biochemical dimensions of selected physiological processes. Prerequisites: BIOL 211, BIOL 212; CHEM 211, 212, 311, 312; Physics 211, 212. Crosslisted as CHEM 406. (4 cr.)

**BIOL 413 CRITICAL ANALYSIS II**

A course designed to build on the skills introduced in BIOL 213 where students research, read, analyze, and discuss the biological and biochemical literature. This course will involve primarily student presentations and analysis. This course is required for all Biology majors. Prerequisites: Senior standing, CHEM 211, 212, 311, 312, BIOL 211, 212, PHYS 211, 212. (1 cr.)

**BIOL 415 SPECIAL TOPICS IN BIOLOGY**

Various topics will be offered as needed including courses such as Ecology, Cancer Biology, Developmental Biology, and Cell Biology. Prerequisites vary with topic. (4 cr.)

**BIOL 497 DIRECTED RESEARCH**

Students will be instructed in laboratory and/or library research on a project currently being studied by one or more faculty members. Prerequisite: Faculty approval. (4 cr.)

**Chemistry Courses**

**CHEM 211 GENERAL CHEMISTRY I** A study of the basic principles of chemistry, with an emphasis on the laws of chemical combination, descriptive inorganic chemistry, thermochemistry, the gas, liquid, and solid states of matter, the periodic law, atomic structure and chemical bonding, and the nature of intermolecular forces. MATH 150 or higher strongly recommended. (with lab) (4 cr.)

**CHEM 212 GENERAL CHEMISTRY II**

A continuation of General Chemistry I with emphasis on kinetics, chemical equilibria involving gases, weak acids and bases, and slightly soluble solids, free energy changes, electrochemistry, transition metal chemistry. (with lab) (4 cr.)

**CHEM 311 ORGANIC CHEMISTRY I**

A detailed study of organic compounds, their synthesis and reactions. An introduction to modern methods of analysis and identification is included. (with lab) Prerequisite: CHEM 211, CHEM 212 (4 cr.)

**CHEM 312 ORGANIC CHEMISTRY II**

A continuation of Organic Chemistry I. (with lab) Prerequisites: CHEM 211, CHEM 212, CHEM 311 (4 cr.)

**CHEM 405 BIOCHEMISTRY I**

A study of proteins, enzymes, carbohydrates, lipids and membranes with an emphasis on the relationship of structure and function. Also included is a study of catabolism with primary focus on glycolysis, gluconeogenesis, glycogen metabolism, Krebs cycle, and oxidative phosphorylation. Prerequisites: BIOL 211, BIOL 212, CHEM 211, 212, 311, 312, PHYS 211, 212. Crosslisted as BIOL 405. (4 cr.)

**CHEM 406 BIOCHEMISTRY II**

A continuation of Biochemistry I. Topics covered are photosynthesis, biosynthesis of macromolecular precursors, the chemistry of storage, transmission and expression of genetic information, biochemical dimensions of selected physiological processes. Prerequisites: BIOL 211, BIOL 212; CHEM 211, 212, 311, 312; Physics 211, 212. Crosslisted as BIOL 406. (4 cr.)

## **Biology**

### CHEM 415 SPECIAL TOPICS IN CHEMISTRY

This course will be offered on a periodic basis. Possible topics include Advanced Organic Chemistry, Organic Chemistry of Drug Design and Action, Bioorganic Chemistry. (4 cr.)

### **Pre-medicine Program**

The pre-medicine program is designed to offer a complete academic preparation for medical school. In addition, we offer several unique programs designed to explore the ethical, moral and social implications of modern medicine and technology. An emphasis is placed on direct interaction with leading Catholic physician-mentors from a wide range of medical disciplines who will provide the student with valuable practical guidance and advice. Students participating in the pre-medicine program can choose Biology or any other academic major.

#### **Minimal Pre-medicine Requirements**

CHEM 211 General Chemistry I (w/lab)

CHEM 212 General Chemistry II (w/lab)

CHEM 311 Organic Chemistry I (w/lab)

CHEM 312 Organic Chemistry II (w/lab)

BIOL 211 Biology I (w/lab)

BIOL 212 Biology II (w/lab)

PHYS 211 College Physics I (w/lab)

PHYS 212 College Physics II (w/lab)

BIOL 400 Special Topics Seminar in Biology and Medicine (required yearly)

Math College algebra/trigonometry required; calculus is recommended

At least one upper level Biology class is strongly recommended. Especially recommended are BIOL 305 Molecular Biology, BIOL 405/406 Biochemistry, BIOL 303 Genetics, BIOL 304 Anatomy and Physiology. It is recommended that the minimal requirements be completed by the end of the junior year as preparation for the MCAT examination. In addition to the course offering/requirements listed above, the following supplementary programs/courses are available:

- Instruction in medical bioethics from Catholic experts;
- Physician Mentoring Program: students meet individually with selected Catholic physicians (in collaboration with the Catholic Medical Association) to discuss interests and concerns in any field of medicine, and medical school experience;
- Biweekly round table discussions with faculty and invited members of the health care community (physicians, nurses, medical researchers, etc.) to discuss topics in medicine and bioethics;
- Assistance in identifying and acquiring summer internships; and
- Assistance and direction in the pursuit of independent research.

## Typical Plan—Biology Major

### Freshman Year

<u>Fall Semester</u>	<u>Credits</u>	<u>Spring Semester</u>	<u>Credits</u>
MATH 100,120,150, or 151	4	THEO 105 Sacred Scripture	4
LITR 103 Literary Tradition I	4	LITR 104 Literary Tradition II	4
BIOL 211 Biology I	4	BIOL 212 Biology II	4
LATN 101 or 103 Elem Latin	4	LATN 102 or 104 Inter Latin	4
MUSC 101 Gregorian Chant*	0		
Total	16	Total	16

\*may be taken in the Fall or Spring semester.

### Sophomore Year

<u>Fall Semester</u>	<u>Credits</u>	<u>Spring Semester</u>	<u>Credits</u>
PHIL 205 Nature Person	4	PHIL 206 Ethics	4
CHEM 211 General Chem I	4	CHEM 211 General Chem II	4
THEO 205 Sacred Doctrine	4	BIOL 303 Genetics	4
HIST 101 Western Civ I	4	HIST 102 Western Civ II	4
BIOL 213 Critical Analysis I	1	Arts Practicum*	0
Total	17	Total	16

\*may be taken in the Fall or Spring semester.

### Junior Year

<u>Fall Semester</u>	<u>Credits</u>	<u>Spring Semester</u>	<u>Credits</u>
CHEM 311 Organic Chem I	4	CHEM 312 Organic Chem II	4
PHYS 211/221 Physics I	4	PHYS 211/221 Physics II	4
BIOL Elective	4	BIOL Elective	4
HIST/POLT 203 Amer Civ	4	General Elective	4
Total	16	Total	16

### Senior Year

<u>Fall Semester</u>	<u>Credits</u>	<u>Spring Semester</u>	<u>Credits</u>
BIOL Elective	4	BIOL Elective	4
General Elective	4	BIOL 413 Critical Analysis II	1
General Elective	4	General Elective	4
General Elective	4	THEO 400 Living in Christ	4
		PHIL 400 Phil Perspectives	4
Total	16	Total	17