Biology

Division of Science and Mathematics

- **BA: 41-45 hours**
- **BS: 63-70 credit hours**
- **Minor: 19 hours**
- **Major/minor GPA required for graduation: 2.50**

PROGRAM REQUIREMENTS:

- **Capstone: Biology Research Methods (BIO 455) (W)**
- **Research: Biology Research Methods (BIO 455) (W)**

OTHER REQUIREMENTS:

- **Complete Biology Core and Additional Requirements for specific degrees**

Description of Major: The university's mission is reflected in the biology major through its special emphasis on engaging students in scientific inquiry and the practice of science, developing skills for responsibly communicating science, and mentoring of students as they develop life-long skills to take advantage of professional opportunities.

Student Learning Outcomes

Students will:

- Practice biological inquiry using the scientific method.
- Demonstrate proficiency in scientific language and basic laboratory skills, including the use of modern technology.
- Communicate their findings to a broad audience, including individuals with scientific and non-scientific backgrounds.
- Develop an action plan tailored to their career goals.

Preparation: The degree prepares students for immediate employment in a variety of areas, including conservation, wildlife biology, education, research (government, business, or academic settings), laboratory work in medicine, or work in biotechnology. Graduates are equally prepared to enter graduate or professional school in preparation for careers in research, teaching, or fields such as medicine (Medical Doctor, Physician's Assistant, Doctor of Osteopathic Medicine), physical therapy, nursing, pharmacy, dentistry, optometry, or veterinary science.

Students wishing to teach biology in a public school setting must fulfill all of the requirements in the Science Education: Biology Emphasis section of the catalog under "School of Education."

Please note, students wishing to pursue graduate work or advanced study (professional school) should research the requirements and prerequisites for their desired programs early enough to ensure that additional coursework can be added, if needed. This major is intended to provide a solid foundation, but additional courses may be required for admission to specific programs. For example, students wishing to attend professional programs (medical, dental, veterinary, etc.) after graduation are strongly advised to complete a pre-professional studies minor and should consult that section of the catalog.

BIOLOGY MAJOR CORE REQUIREMENTS		32 crs.
All students majoring in biology must complete the following:		
BIO 108	BIOLOGY CORNERSTONE	1
BIO 110	PRINCIPLES OF CELLULAR AND MOLECULAR BIOLOGY	5
BIO 111	PRINCIPLES OF ORGANISMAL AND POPULATION BIOLOGY	5
BIO 211	GENETICS	4
BIO 202	SCIENTIFIC COMMUNICATION (W)	3
BIO 220	EVOLUTION	3
BIO 455	BIOLOGY RESEARCH METHODS (W)	2
BUS 101	EXCEL I	1
CHE 105	GENERAL CHEMISTRY I	4
CHE 106	GENERAL CHEMISTRY II	4

BACHELOR OF ARTS		41-45 crs.

Complete the core requirements, plus the following:

BIOLOGY ELECTIVES		(6-10)
Students must take two elective courses in biology that satisfy both of the following required areas: cellular/molecular and ecology/evolution. (See below for a list of courses.)		
MTH 133	**PRECALCULUS**	**3**
or		
MTH 170	**STATISTICS**	**3**

BACHELOR OF SCIENCE		63-70 crs.

Complete the core requirements, plus the following:

BIO 300	**BIOSTATISTICS**	**3**
BIO 303	**ECOLOGY**	**4**
BIO 313	**CELLULAR BIOLOGY**	**4**
CHE 205	**ORGANIC CHEMISTRY I**	**4**
MTH 210	**CALCULUS I**	**4**

BIOLOGY ELECTIVES	(12-19)

Students must take four elective courses in biology that satisfy both of the following required areas: cellular/molecular and ecology/evolution. (See below for a list of courses.) As long as one course in each area is taken, students are free to take additional required courses in either of the two areas. Students are free to take additional elective courses as long as the minimum elective requirements are met.

Please note: Students should speak with their advisor and identify the requirements and prerequisites for their desired programs early enough to ensure that additional coursework can be added, if needed. (See below for a list of courses.)

Cellular/Molecular:

BIO 308	**HUMAN ANATOMY AND PHYSIOLOGY I**	**5**
BIO 309	**HUMAN ANATOMY AND PHYSIOLOGY II**	**5**
BIO 311	**MICROBIOLOGY**	**5**
BIO 340	**DEVELOPMENTAL BIOLOGY**	**3**
BIO 342	**NEUROBIOLOGY**	**3**
BIO 410	**ANIMAL PHYSIOLOGY**	**4**
BIO 430	**BIOTECHNOLOGY**	**4**

Ecology/Evolution:

BIO 250	**ENVIRONMENTAL SCIENCE**	**3**
BIO 320	**CONSERVATION BIOLOGY**	**3**
BIO 325	**FIELD BOTANY**	**4**
BIO 335	**FISH BIOLOGY AND CONSERVATION**	**4**
BIO 350	**ANIMAL BEHAVIOR**	**3**
BIO 420	**COMPARATIVE VERTEBRATE ANATOMY**	**5**

To complete a minor in biology, students must complete the requirements listed below.

BIOLOGY MINOR REQUIREMENTS		21 crs.
BIO 110	**PRINCIPLES OF CELLULAR AND MOLECULAR BIOLOGY**	**5**
BIO 111	**PRINCIPLES OF ORGANISMAL AND POPULATION BIOLOGY**	**5**
BIO 211	**GENETICS**	**4**
BIO 220	**EVOLUTION**	**3**
BIO ELECTIVES (300 *or* 400 LEVEL)		**4**

Biology (BIO)

BIO 101 **4**
BIOLOGY FOR LIFE
This course is intended for the non-science major. The principal objectives are to prepare students to be scientifically literate citizens and to connect biological principles to real-world problems. This includes the effect of biotechnology on society as well as environmental issues such as climate change and habitat destruction. This course meets for three hours of lecture per week and one three-hour laboratory per week. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 108 **1**
BIOLOGY CORNERSTONE
This course serves as an introduction to the biology program and the field of biology. The class will focus on strategies for success both in the program and after graduation, highlighting the various subfields of biology, career opportunities, graduate and professional school preparation, skills for critical reading of the primary literature, and communicating scientifically.

BIO 110 **5**
PRINCIPLES OF CELLULAR AND MOLECULAR BIOLOGY
This course is an introductory biology course for biology majors that emphasizes basic principles of cellular and molecular biology including the biochemical basis of life, cellular structure and function, metabolism, and genetics. The course meets for three hours of lecture per week and one three-hour laboratory per week. Prerequisite: One year of high school biology or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 111 **5**
PRINCIPLES OF ORGANISMAL AND POPULATION BIOLOGY
This course is an introductory biology course for biology majors which emphasizes basic principles of organismal and population biology including animal and plant structure and function, evolutionary principles and mechanisms, the diversity of life, and ecology. This course meets for three hours of lecture per week and one three-hour laboratory period per week. Prerequisite: 1 year of high school biology or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 202 **3**
SCIENTIFIC COMMUNICATION (W)
Scientists are responsible for not only generating data, but for communicating data both to other scientists and the general population. As the communication process within the sciences is in many ways different from that found in other subject areas, this course will provide students with the background needed to master those skills. Major areas of skill development include the composition of formal manuscripts and review articles, the development of figures and tables that summarize and effectively communicate findings, and the spoken presentation of original data sets to an audience. Prerequisite: Biology, biopsychology, or environmental studies major.

BIO 211 **4**
GENETICS
Genetics is the study of DNA, the information-bearing material of inheritance, as well as related molecules and processes. This course will examine how DNA is organized, how its information is transmitted from one generation to the next, and how the information it bears is utilized. The study of genetics is foundational to many other biological fields, and this course will provide students with the background they need to go on in such diverse topics as development, physiology, and evolution. This course meets for three hours of lecture per week and one three-hour laboratory period per week. Prerequisites: BIO 110 and C- or better in BIO 110, or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 220 **3**
EVOLUTION
This course introduces the major principles of evolutionary biology. Specific topics include a brief history of evolutionary thought, concepts of evolutionary genetics, adaptation and natural selection, origins of biological diversity, and paleobiology and macroevolution. This course meets for three hours of lecture per week. Prerequisites: BIO 110, 111, 211, or instructor consent.

BIO 250 **3**
INTRODUCTION TO ENVIRONMENTAL SCIENCE
This course introduces the interrelationships among the natural environment, humans, and the human environment. The focus is on building a scientific framework to understand current environmental challenges while incorporating an understanding of interdisciplinary perspectives when considering potential solutions. Students will examine issues such as air and water pollution, global climate change, energy, agriculture, and biodiversity loss.

BIO 280-289 **1-3**
SPECIAL TOPICS IN BIOLOGY

BIO 299 **1-3**
PRACTICUM IN BIOLOGY
For students at the sophomore level or above who wish to arrange a practicum in the laboratory or other appropriate direct-experience learning situation in biology. Prerequisites: 15 hours of related coursework, grade point average consistent with biology program graduation requirements, and instructor consent. No more than eight credit hours combined total for this practicum and an internship may be counted as credit toward the major.

BIO 300 **3**
BIOSTATISTICS
Students will cover the use of statistical analysis methods to address biological problems. Emphasis is placed on hypothesis development, statistical testing and interpretation of statistical outputs in R, communication of results in proper scientific format, and the production of figures to graphically display data. Prerequisites: BIO 110 or 111, or instructor consent.

Biology (BIO)

BIO 303 **4**
ECOLOGY
Ecology is a quantitative science that focuses on the diverse interactions between organisms and their biotic and abiotic environment. This course examines factors that control energy and nutrient cycling in ecosystems, population dynamics of organisms, and the structure and function of biological communities, as well as principles that govern ecological responses to anthropogenic changes such as global climate change and habitat fragmentation. The class meets for three hours of lecture per week and one three-hour laboratory period per week. This course satisfies the ecology/evolution elective area for students pursuing a Bachelor of Arts in Biology. Prerequisites: BIO 111, 300, and C- or better in BIO 111, or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 308 **5**
HUMAN ANATOMY AND PHYSIOLOGY I
This course provides an in-depth study of the muscular, skeletal, nervous, endocrine, and reproductive systems. For each organ system, anatomy, physiology, and role within the whole organism are discussed concurrently. Gross anatomy is explored in lab utilizing dissections and/or models; characteristics of tissues and cells is investigated with microscopy. Function of each organ system is investigated in lab by physiological observation and experimentation. This course satisfies the cellular/molecular elective area. This course meets for three hours of lecture per week and two two-hour laboratory periods per week. Prerequisite: BIO 101 or 110. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 309 **5**
HUMAN ANATOMY AND PHYSIOLOGY II
This course provides an in-depth study of the cardiovascular, respiratory, immune, digestive, and urinary systems. For each organ system, anatomy, physiology, and role within the whole organism are discussed concurrently. Gross anatomy is explored in lab utilizing dissections and/or models; characteristics of tissues and cells is investigated with microscopy. Function of each organ system is explored in lab by physiological observation and experimentation. This course satisfies the cellular/molecular elective area. This course meets for three hours of lecture per week and two two-hour laboratory periods per week. Prerequisite: BIO 101 or 110. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 311 **5**
MICROBIOLOGY
This course deals with the morphology, genetics, physiology, and ecology of bacteria and other microbes. In the laboratory, microbiological techniques and applications are stressed. This course meets for three hours of lecture per week and two two-hour laboratory periods per week. This course satisfies the cellular/molecular elective area. Prerequisites: BIO 110, CHE 105, 106, or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 313 **4**
CELLULAR BIOLOGY
This course is an introduction to the biology of all cells with an emphasis placed on eukaryotic cells. Organelles will be studied with attention to their composition, organization, and function. Additional topics to be covered are protein structure/function, bioenergetics, protein sorting, cell communication, and regulation of the cell cycle. The laboratory will emphasize various methods used by cell biologists as powerful tools for examining cell function. This course meets for three hours of lecture per week and one three-hour laboratory per week. This course satisfies the cell/molecular elective area for students pursuing a Bachelor of Arts in Biology. Prerequisites: BIO 110, CHE 105, 106, and junior standing, or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 320 **3**
CONSERVATION BIOLOGY
This course examines issues related to understanding and preventing the decline of populations and extinction of species. Lectures will discuss fundamental principles of biodiversity maintenance at the level of species, population, and ecosystems. Students will develop knowledge of both ecological and evolutionary principles related to the topic. This course satisfies the ecology/evolution elective area. Prerequisite: BIO 111.

BIO 325 **4**
FIELD BOTANY
This is a field-oriented course that surveys local vascular flora and habitats. Field exploration focuses on identification and techniques, with emphasis given to the taxonomy, ecology, evolution, and systematics of native and naturalized plants. This course meets for two three-hour periods per week that will be divided between lecture and laboratory work. This course satisfies the ecology/evolution elective area. Prerequisite: BIO 111 or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 335 **4**
FISH BIOLOGY AND CONSERVATION
This course will provide a broad overview of numerous aspects of fish biology, including anatomy, physiology, taxonomy, evolution, and ecology. In addition, the course will also examine management strategies for preserving aquatic ecosystems, with an emphasis on the conservation and management of fish populations targeted by recreational and/or commercial fishing. The laboratory portion of the course will be partially field-based, providing students with the opportunity to sample fishes using techniques employed by natural resources managers. The course will also provide background in the process of identifying local fish species, for the purpose of population assessment and environmental monitoring. This course satisfies the ecology/evolution elective requirement. Prerequisites: BIO 111, 202.

BIO 340 **3**
DEVELOPMENTAL BIOLOGY
This course focuses on the fundamental events of embryonic development, with an emphasis on genetic and molecular approaches used in modern experimental embryology. As modern developmental biology employs information and techniques from many different fields of biology, this course provides the challenge of learning and integrating diverse topics in biology including cell biology, genetics, molecular biology, biochemistry, and evolution. We explore the common features of development that are shared by different kinds of organisms and emphasize how diverse organisms use the same signaling and regulatory molecules during embryogenesis. This course meets for three hours of lecture per week. This course satisfies either the ecology/evolution or cell/molecular elective area. Prerequisites: BIO 110, 211, CHE 105, 106, or instructor consent.

Biology (BIO)

BIO 342 **3**
NEUROBIOLOGY
This course focuses on various topics in neurobiology, with an emphasis on genetic and molecular approaches used in modern experimental biology. We explore the organization of neurons and glial cells, as well as their development and change over time. We discuss membrane potential at the cellular level and learn about techniques to record electrical potentials. Finally, we examine topics in sensation and perception, as well as motor responses and the related circuitry. This course focuses on reading and interpreting primary literature, as well as presentation of figures and designing next-step experiments. This course meets for three hours of lecture each week. This course satisfies the cellular/molecular elective area. Prerequisites: BIO 110 or instructor consent.

BIO 350 **3**
ANIMAL BEHAVIOR
This course will examine the evolutionary (ultimate) and mechanistic (proximate) underpinnings of animal behavior in a number of contexts including foraging, fighting, learning, mating, parental care, and social behavior. Throughout this course, students will also examine principles and methods of scientific investigation and communication. This course meets for three hours of lecture per week. This course satisfies the ecology/evolution elective area. Prerequisite: BIO 111.

BIO 380-389 **1-3**
SPECIAL TOPICS IN BIOLOGY

BIO 410 **4**
ANIMAL PHYSIOLOGY
This course provides an introduction to the structure and function of physiological systems in animals. The primary emphasis is on vertebrates, with comparisons drawn from the entire animal kingdom. Topics include a general introduction to principles of physiology, an overview of physiological processes, and the integration of physiological systems. This course meets for three hours of lecture and one three-hour laboratory session per week. This course satisfies the cell/molecular elective area. Prerequisites: BIO 110, CHE 105, 106, or instructor consent. Recommended: CHE 205. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 420 **5**
COMPARATIVE VERTEBRATE ANATOMY
This course examines the anatomical and physiological adaptations of vertebrates from an evolutionary perspective using lectures and laboratory exercises. Vertebrate diversity is studied by examining all major living clades. An organ systems approach is used to illustrate general structural and functional patterns across different vertebrates. The laboratory portion of the course requires the dissection of several representative vertebrates. This course meets for three hours of lecture and for two two-hour laboratory sessions per week. This course satisfies the ecology/evolution elective area. Prerequisites: BIO 110, 111, 220, or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 430 **4**
BIOTECHNOLOGY
Modern genetic techniques have revolutionized the biological sciences, and an understanding of genetics is essential to the fields of biotechnology. This course builds upon students' basic understanding of genetics to develop new molecular genetic skills, a better understanding of experimental approaches, and the ability to access and organize genetic information from the burgeoning bioinformatics databases. The class meets in the laboratory for two two-hour periods per week. In addition, students may be required to work in the laboratory outside of scheduled class time, depending on the nature of the experiments conducted. This course satisfies the cell/molecular elective area. Prerequisites: BIO 210, CHE 105, 106. Recommended: CHE 205. A student must pass the laboratory portion of any science course to pass the entire course.

BIO 451 **2**
SEMINAR IN BIOLOGY
This course allows students to explore a variety of topics and discuss their understanding and interpretation of biological subjects with their peers. The goal of this course is to allow students to pursue specific topics in more detail and to develop the skills necessary to critically evaluate and discuss literature in biology. The course may be taken up to two times for credit towards the major requirements. This course meets for one two hour discussion period per week. Prerequisite: Junior standing and biology major.

BIO 455 **2**
BIOLOGY RESEARCH METHODS (W)
This is the capstone course in biology. It will provide an overview of topics important to biological research and allow students to apply information they have learned throughout the biology curriculum in a research setting. This course focuses on critical analysis of primary literature and data, as well as scientific communication in the form of both writing and presentations. Prerequisites: Biology major and senior standing, or instructor consent.

BIO 470 **3-8**
INTERNSHIP IN BIOLOGY
No more than four hours of internship may be counted toward a major in biology.

BIO 480 **1-4**
INDEPENDENT STUDY

BIO 492 **1**
BIOPSYCHOLOGY CAPSTONE
This course is the capstone experience for biopsychology majors. The goals are to provide students the opportunity to learn about biopsychology topics and engage with current research in the field. An emphasis will be placed on field trips and guest speakers to allow for greater lifelong learning. Same as PSY 492. Prerequisite: PSY 275.