

BIOLOGICAL SCIENCES

Greenquist 344 • 262-595-2744 • Keyword: *Biology*

Degrees Offered:

Bachelor of Science.
Master of Science (see graduate section of this catalog).

Professors:

Wallen, Ph.D.

Associate Professors:

Barber, Ph.D.; Gundersen, Ph.D.; Higgs, Ph.D. (chair);
Mayer, Ph.D.; Pham, Ph.D.; Ruffolo, Ph.D.; Thomson, Ph.D.

Assistant Professors:

Lee, Ph.D., Rogers, Ph.D.

Senior Lecturers:

McKee, M.S.; Mossman, Ph.D.; Wilson, M.S.

Lecturers:

MacWilliams, Ph.D.; Roelke, M.S.; Lewis, Ph.D. (assistant to the dean for health-related professions)

Student Organizations/Clubs:

Bios Club, Molecular Biology Club, Pre-Health Professions Club

Career Possibilities:

Health professional; research scientist; veterinary medicine; secondary school teacher; industrial research, development, quality control, or product specialist; zoologist; botanist; naturalist.

Department Overview

Since the opening of the university in 1968, UW-Parkside's Biological Sciences Department has developed and maintained a reputation for outstanding preparation for careers in life and health sciences. The department currently attracts many of the best students found on the campus and has one of the strongest pre-health programs in the state.

The instructional program emphasizes quality teaching, hands-on experience with state-of-the-art technology, and involvement of undergraduate students in research. The department has high-quality faculty, several of whom are nationally and internationally known. The faculty sees itself as an excellent example of the teacher-scholar model for a predominantly undergraduate institution. The department maintains active research facilities with modern instrumentation. In addition, the UW-Parkside campus, the Chiwaukee Prairie, Harris Tract, Ranger Mac's Fen, Renak Polak Woods, Petrifying Springs, and Sanders Park provide field areas for environmental studies.

The biological sciences include many different aspects of biology such as botany, microbiology, molecular biology, bioinformatics and zoology. The undergraduate majors are based on core courses designed to convey a common body of concepts and skills essential to the training of biologists regardless of their ultimate specialization. This part of the

program emphasizes the similarities and unifying ideas applicable to all living systems.

The department offers two majors. The biological sciences major is appropriate for students with a general interest in biology. The molecular biology and bioinformatics major is designed for students who wish to specialize in this rapidly growing field of biology. Both majors are appropriate for students preparing for the health professions; consult with the pre-health advisers for advice relating to your particular career goal.

Biological science majors interested in obtaining a minor in environmental studies should consult with the director of environmental studies.

The department supports several student organizations: Biology Club, Molecular Biology Club, and the Pre-Health Club. These clubs promote learning and career preparation outside the formal classroom under student governance. Activities include field trips, guest lectures, mentoring, and social activities. See your academic adviser or contact the department office for information about how to become involved.

The biological sciences program offers many courses for other majors and/or programs such as applied health sciences, biochemistry, environmental studies, gerontology, and pre-professional programs. There are also many courses available that have been designed specifically for non-science students and for general education.

Requirements for the Biological Sciences Major

The major in biological sciences consists of a minimum of 42 credits in biological sciences with additional courses in mathematics, chemistry, and physics. Within the major, a minimum of 15 credits in courses numbered 300 or above must be completed at UW-Parkside.

A. Core Courses (18 Credits)

BIOS 101	Bioscience	4 cr
BIOS 102	Organismal Biology	4 cr
BIOS 210	Biostatistics	3 cr
BIOS 260	General Genetics	4 cr
BIOS 435	Experimental Methods/ Biochemistry Lab	2 cr
BIOS 495	Senior Seminar	1 cr

Students must complete core courses numbered in the 200s and below before they enroll in 400-level biological sciences courses. Exception from this prerequisite requires approval from the program faculty. Students should consult with their academic adviser before registration if such a situation arises.

B. Mathematics, Chemistry and Physics Courses (33 credits)

Mathematics

MATH 221 Calculus and Analytic Geometry I. . . . 5 cr

Chemistry

CHEM 101 General Chemistry I. 5 cr

and

CHEM 102 General Chemistry II 5 cr

or

CHEM 113 Chemical Principles I 5 cr

and

CHEM 114 Chemical Principles II 5 cr

CHEM 321 Organic Chemistry I. 4 cr

CHEM 322 Organic Chemistry II 4 cr

CHEM 323 Organic Chemistry Laboratory* 3 cr

Physics

PHYS 105 College Physics I 5 cr

PHYS 106 College Physics II 5 cr

or

PHYS 201 General Physics I 5 cr

PHYS 202 General Physics II 5 cr

* Strongly recommended, but not required. Most graduate and professional schools require an organic chemistry course with a laboratory component. Students who plan to do graduate work are also advised to take MATH 222, Calculus and Analytic Geometry II.

C. Elective Courses (24 credits)

Each student must complete a minimum of 24 elective credits selected from 200-400 level biological sciences courses. At least 3 credit hours must be obtained from each of the four designated areas listed below. BIOS 494, Internship, and BIOS 499, Independent Study, cannot be used to satisfy the requirement within these areas. Students are required to check with their advisers concerning biological sciences special topics courses (BIOS 290, 390, 490) counting toward the topic areas listed below.

I. Cell and Molecular Biology

BIOS 240 Macromolecular Structure and Function. 3 cr

BIOS 301 Cell Biology 3 cr

BIOS 307 Biochemical Metabolism. 3 cr

BIOS 309 Molecular Biology. 3 cr

BIOS 355 Biology of Cancer. 3 cr

II. Organismal Structure and Function

BIOS 300 Functional Human Anatomy

Laboratory (L) 3 cr

BIOS 317 Vertebrate Embryology 3 cr

BIOS 325 Physiological Psychology. 3 cr

BIOS 341 Mammalian Physiology 3 cr

BIOS 344 Plant Physiology 3 cr

BIOS 420 Neuroscience 3 cr

III. Biological Diversity

BIOS 303 Microbiology (L) 4 cr

BIOS 313 Invertebrate Zoology (L). 4 cr

BIOS 318 Vertebrate Zoology (L) 4 cr

BIOS 324 Botany (L) 4 cr

IV. Population Biology

BIOS 305 Principles of Ecology (L). 4 cr

BIOS 312 Medical and Forensic Entomology (L) 4 cr

BIOS 314 Evolutionary Biology 3 cr

BIOS 330 Topics in Field Biology (L) 3 cr

BIOS 340 Animal Behavior (L) 4 cr

BIOS 414 Molecular Evolution 3 cr

A course in each of the four areas (12-14 credits) is required. Students can select among any of the remaining 200-400 level biological sciences courses to complete the required minimum of 24 elective credits, which may include up to three credits each of BIOS 494 and BIOS 499.

To complete the requirement of 24 elective credits, at least one (1) 300 level or higher elective class must include a laboratory. Classes that meet this requirement are BIOS 300, 303, 305, 312, 313, 318, 324, 330, 340, 453, 454, 455, or 480. BIOS 435 (Experimental Methods/Biochemistry Lab), as a core class, does not satisfy this requirement.

Students pursuing careers in the health professions are strongly urged to contact Dr. Bryan Lewis, assistant to the dean for health-related professions at 262-595-2327 for advising.

Requirements for the Molecular Biology and Bioinformatics Major

The major in molecular biology and bioinformatics consists of a minimum of 46 credits in biological sciences, with additional courses in mathematics, chemistry, computer science and physics. Within the major, a minimum of 15 credits in courses numbered 300 or above must be completed at UW-Parkside. Admission to the molecular biology and bioinformatics major is selective. Incoming Freshmen must have a minimum ACT score of 25. Current students wishing to enter the program must complete BIOS 260 (General Genetics) and attain a minimum UW-Parkside cumulative GPA of 2.75 at the time of application. Transfer students will be assessed on an individual basis based on these guidelines. Students must maintain a minimum UW-Parkside cumulative GPA of 2.50 in all courses required for the major to graduate.

A. Core Courses (47 Credits)

BIOS 101 Bioscience 4 cr

BIOS 102 Organismal Biology 4 cr

BIOS 210 Biostatistics. 3 cr

BIOS 240 Macromolecular Structure and Function 3 cr

or

BIOS 301 Cell Biology 3 cr

Note: only one of these can count toward the major.

BIOS 260 General Genetics 4 cr

BIOS 303 Microbiology 4 cr

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BIOS 309	Molecular Biology.	3 cr
BIOS 453	Molecular Biology and Bioinformatics I: DNA.	4 cr
BIOS 454	Molecular Biology and Bioinformatics II: RNA.	4 cr
BIOS 455	Molecular Biology and Bioinformatics III: Proteins.	4 cr
BIOS 480	Bioinformatics Programming.	4 cr
BIOS 489	Molecular Biology & Bioinformatics Senior Project.	2 cr
BIOS 499	Independent Study, over two semesters.	4 cr

Students must complete core courses numbered in the 300s and below before they enroll in 400-level biological sciences courses. Exception from this prerequisite requires approval from the program faculty. Students should consult with their academic adviser before registration if such a situation arises.

B. Mathematics, Chemistry, Computer Science and Physics Courses (36-38 credits)

Mathematics

MATH 221	Calculus and Analytic Geometry I.	5 cr
and		
MATH 231	Discrete Mathematics.	3 cr
or		
MATH 222	Calculus and Analytic Geometry II.	5 cr

Chemistry

CHEM 101	General Chemistry I.	5 cr
and		
CHEM 102	General Chemistry II.	5 cr
or		
CHEM 113	Chemical Principles I.	5 cr
and		
CHEM 114	Chemical Principles II.	5 cr
CHEM 321	Organic Chemistry I.	4 cr
CHEM 322	Organic Chemistry II.	4 cr

Physics

PHYS 105	College Physics I.	5 cr
PHYS 106	College Physics II.	5 cr
or		
PHYS 201	General Physics I.	5 cr
PHYS 202	General Physics II.	5 cr

Students who plan to do graduate work are advised to also take MATH 222, Calculus and Analytic Geometry II; and CHEM 302 & 303, Physical Chemistry I and II.

C. Elective Courses (6 credits)

Each student must complete a minimum of 6 elective credits selected from the following list:

Any 300 - 600 level biological sciences courses, except: BIOS 435, Experimental methods; BIOS 495, Senior Seminar; BIOS 499, Independent Study

CHEM 620	Advanced Biochemistry.	3 cr
CSCI 241	Computer Science I.	4 cr

CSCI 242	Computer Science II.	4 cr
MIS 322	Object-Oriented Programming I.	3 cr
MIS 328	Database Management Systems.	3 cr

Requirements for the Biological Sciences Minor

The academic minor requires a minimum of 20 credit hours. Requirements for completion are:

BIOS 101	Bioscience.	4 cr
BIOS 102	Organismal Biology.	4 cr
BIOS Electives	200 level or above not including BIOS 202.	12 cr

Departmental Honors Program

Students completing a bachelor of science degree in either biological sciences or molecular biology and bioinformatics may earn departmental honors reflecting outstanding achievement in academics and research. To attain honors a student must have:

- A cumulative GPA of 3.0 or higher and a GPA of 3.5 or higher for all courses required within one of the majors,
- Minimum of four credits of Independent Research (BIOS 499),
- Successfully complete an oral or poster presentation detailing independent research accomplishments within BIOS 499,
- Successfully complete a written research thesis detailing independent research accomplishments within BIOS 499,
- Satisfactory completion of the above requirements must be evaluated and approved by a departmental committee composed of three biological sciences faculty members.

Students interested in completing departmental honors must file a biological sciences honor application with the department prior to their senior year.

Teacher Licensure

Students seeking teacher licensure in a biological sciences major or minor must fulfill Wisconsin Department of Public Instruction requirements; therefore course requirements may differ from those of the non-teaching major and minor. Information about the teacher education program and additional requirements for licensure can be obtained from the Biological Sciences Department or the teacher education advisor at 262-595-2100.

Courses in Biological Sciences (BIOS)

100 Nature of Life.	3 cr
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Prereq: None. Freq: Fall, Spring.

Nature of living things is explored and current developments in biology are discussed. Designed specifically for non-science majors; not for credit toward biological sciences major. Two-hour lecture; one-hour demo/discussion.

- 101 Bioscience**4 cr
Prereq: None. Freq: Fall, Spring.
 This course focuses on biochemistry, cell biology, genetics, and molecular biology. It is intended to provide a background upon which upper division courses will be built. Three-hour lecture; three-hour lab.
- 102 Organismal Biology**4 cr
Prereq: None. Freq: Fall, Spring.
 A broad introduction to the diversity of life, recognizing functional similarities and dissimilarities as related to successful adaptation to the environment. It is intended to provide a background upon which upper division courses will be built. Three-hour lecture; three-hour lab.
- 103 Human Biology**3 cr
Prereq: None. Freq: Yearly.
 A general course which covers basic information about the human body. Designed specifically for non-science majors; not for credit toward biological sciences major. Three hour lecture.
- 104 Environmental Science: A Biological Approach**.....3 cr
Prereq: None. Freq: Fall, Summer.
 The study of the associations between human populations, biodiversity, resources, technology, lifestyles and environmental crisis from a biological approach. Meets DPI content requirement in environmental education; not for credit toward biological sciences major. Three-hour lecture.
- 105 Human Physiology and Anatomy I**.....4 cr
Prereq: None. Freq: Fall.
 An integrated lecture/laboratory course using a system approach to understand structure and function of the human body. Topics include homeostasis, biological and chemical principles, tissues, skin, skeleton, muscles and digestion, and includes cat dissection and cadaver demonstration. Not for credit toward biological sciences major. Three-hour lecture; two-hour discussion; two-hour lab.
- 106 Human Physiology and Anatomy II**4 cr
Prereq: BIOS 105. Freq: Spring.
 A continuation of BIOS 105; focusing on the nervous, immune, circulatory, respiratory, urinary, endocrine and reproductive systems. Not for credit toward biological sciences major. Three-hour lecture; two-hour discussion; two-hour lab.
- 109 Biology of Aging**.....3 cr
Prereq: None. Freq: Spring
 This course is intended to give the non-science major an introduction to the age-related changes in each body system from the standpoint of normal structure and function. The concept of homeostasis is emphasized in relation to age-related abnormal changes in addition to causative factors. Three-hour lecture.
- 114 Freshman Seminar in Biological/Health Sciences**.... 1 cr
Prereq: None. Freq: Fall .
 Overview of education, careers, and potential growth opportunities in health-related fields and biological sciences. Not for credit towards biological sciences major. Two-hour lecture.
- 190 Fundamentals of Human Nutrition**2 cr
Prereq: BIOS 106 and CHEM 215. Freq: Spring.
 A study of requirements and functions of essential nutrients throughout life. Cultural influences on food habits and the basis for diet assessment will also be discussed. Recommended for UW-Milwaukee nursing students; not for credit toward biological sciences major. Two-hour lecture.
- 202 General Microbiology**4 cr
Prereq: BIOS 105, 106 or concurrent registration and CHEM 102 or 115, or consent of instructor. Freq: Fall.
 Structure, growth, reproduction, and activities of microorganisms including medical applications. Isolation and propagation of bacteria; not for credit toward biological sciences major. Three-hour lecture; three-hour lab.
- 210 Biostatistics**3 cr
Prereq: BIOS 101, 102 and MATH 112, 113 or equivalent. Freq: Fall, Spring.
 An introduction to quantitative methods of scientific inference used in the analysis and design of biological observations and experiments. Topics covered include measurement, sampling, descriptive statistics, analysis of variance, correlation, regression, and analysis of frequencies. Two-hour lecture; three-hour lab.
- 240 Macromolecular Structure and Function**.....3 cr
Prereq: BIOS 101, 102, 210; CHEM 322 or concurrent registration. Freq: Spring.
 Introduction to eukaryotic cellular structures and biosynthesis; reaction mechanisms in biological catalysis; and principles of macromolecular structure. Three-hour lecture.
- 260 General Genetics**.....4 cr
Prereq: BIOS 101, 102, 210 and CHEM 321 or concurrent registration. CHEM 322 or concurrent registration recommended. Freq: Fall, Spring.
 Fundamental genetic principles with examples from microorganisms, plants, lower animals, and humans. For students majoring in science, mathematics or biology-related professions. Three-hour lecture; two-hour discussion/demo.
- 290 Special Topics in Biological Sciences**1-4 cr
Prereq: Varies with topic. Freq: Occasionally.
 Selected topics in the biological sciences.
- 300 Functional Human Anatomy Laboratory**3 cr
Prereq: BIOS 101 and 102 or consent of instructor. Freq: Fall, Spring.
 Fundamental study of organization and structure of tissues, organs and systems of the human body and their relationship to function. Two, three-hour labs.
- 301 Cell Biology**3 cr
Prereq: BIOS 260, and CHEM 322, or consent of instructor. Freq: Spring.
 A study of cells and cellular organelles. The relationship between cellular and macromolecular structure and function is emphasized. Three-hour lecture and one-hour discussion.

- 303 Microbiology**4 cr
Prereq: BIOS 101, 102, and CHEM 322 or concurrent registration.
Freq: Spring.
 Advanced treatment of the structure, growth and activities of microorganisms including medical microbiology, microbial pathogenesis and environmental microbiology. Three-hour lecture; three-hour lab.
- 305 Principles of Ecology**.....4 cr
Prereq: BIOS 101, 102. Freq: Spring (odd years).
 An introduction to the relations of plants and animals to their organic and inorganic environments, with an emphasis on the phenomena and causes of distribution and abundance at the population and community levels. Includes a field-oriented laboratory. Three-hour lecture; three-hour lab; field trips.
- 307 Biochemical Metabolism**.....3 cr
Prereq: BIOS 101, 102 and CHEM 322 or consent of instructor.
Freq: Fall.
 A study of the chemistry of biological systems with emphasis on metabolism and macromolecular biosynthesis. Three-hour lecture. Cross-listed with CHEM 307.
- 309 Molecular Biology**.....3 cr
Prereq: BIOS 260, CHEM 322 or consent of instructor. Freq: Spring.
 Regulation of DNA, RNA, and protein synthesis and the control of the synthesis of other macromolecules. Three-hour lecture/discussion.
- 312 Medical and Forensic Entomology**4 cr
Prereq: BIOS 101, 102 and 210. Freq: Fall, (even years).
 Ecology of human and insect interactions, their significance to public health, and application to forensic science. Three-hour lecture; three-hour lab.
- 313 Invertebrate Zoology**.....4 cr
Prereq: BIOS 101, 102, and 210. Freq: Fall (odd years).
 Ecology, classification and evolutionary relationships of non-chordate animals. Field trips, experimental research. Three-hour lecture discussion; three-hour lab.
- 314 Evolutionary Biology**3 cr
Prereq: BIOS 101, 102, Bios 260. Freq: Spring (odd years).
 An introduction to the basic mechanisms of evolutionary change including population genetics and speciation, and a consideration of evolutionary history including phylogenetic estimation, the fossil record, and biogeography. Three-hour lecture.
- 317 Vertebrate Embryology**3 cr
Prereq: BIOS 101, 102, 300, or consent of instructor.
Freq: Spring.
 Developmental anatomy and mechanisms of representative vertebrate types from cleavage through organogenesis. Three-hour lecture.
- 318 Vertebrate Zoology**.....4 cr
Prereq: BIOS 101, 102, or consent of instructor.
Freq: Fall (even years).
 An introduction to the biology of vertebrates with emphasis on structure, diversity, evolution, and distribution. Field trips. Three-hour lecture; three-hour lab.
- 324 Botany**4 cr
Prereq: BIOS 101, 102. Freq: Fall (even years).
 Study of plants from the view points of systematics, evolution, morphology and ecology. Field trips. Three-hour lecture; three-hour lab.
- 325 Physiological Psychology**.....3 cr
Prereq: BIOS 101, 102. Freq: Spring.
 Physiological relation of neurophysiological and neurochemical processes to behavior. Three-hour lecture. Cross-listed with PSYC 325.
- 330 Topics in Field Biology**3 cr
Prereq: BIOS 101, 102 or consent of instructor. Freq: Occasionally.
 A field-oriented course including topics such as ecology of major biomes, geographical and geological impact on organisms, aspects of plant/animal systematics. The course will focus on selected areas of interest in field biology. Field trips. Special fees required. One-hour lecture.
- 340 Animal Behavior**4 cr
Prereq: BIOS 210 or concurrent registration. Freq: Spring (even years).
 Emphasis on the evolution and complexity of animal behaviors based on a variety of animal species from invertebrates to mammals. Three-hour lecture; three-hour lab.
- 341 Mammalian Physiology**3 cr
Prereq: BIOS 210, CHEM 321, or consent of instructor.
BIOS 300 recommended. Freq: Fall.
 Advanced treatment of major mammalian organ systems and their roles in homeostasis. Three-hour lecture.
- 344 Plant Physiology**3 cr
Prereq: BIOS 324 or consent of instructor. Freq: Occasionally.
 Study of plant growth, development and nutrition from the physiology point of view. The roles of plants in food production and the environment will be included. Three-hour lecture.
- 351 Virology**3 cr
Prereq: BIOS 260, CHEM 321, or consent of instructor. Freq: Fall (odd years)
 Presents a broad overview of viruses and other subcellular infectious agents with respect to their molecular structure, diversity of chemical composition, taxonomy, and strategies of infection and replication. Bacteriophage, plant viruses and animal viruses will be discussed. Special topics include biotechnological applications of viruses, the remodeling of their hosts by bacteriophage, defense against viral infection, and viruses and cancer.
- 353 Infectious Disease Epidemiology in History**.....3 cr
Prereq: BIOS 101, 102; or BIOS 202. Freq: Spring (odd years)
 Historical perspective of how infectious diseases have impacted on the human population. Examines the history of medicine, the evolution of scientific thought and the past and present social and ethical viewpoints towards human infectious diseases.
- 355 Biology of Cancer**.....3 cr
Prereq: BIOS 260, and CHEM 322 or concurrent registration.
Freq: Spring (even years).
 A study of the genetic and molecular mechanisms underlying the broad disease of cancer. Three-hour lecture/discussion.

- 390 Special Topics in Biological Sciences**1-4 cr
Prereq: Varies with topic. Freq: Occasionally.
 Selected topics in the biological sciences.
- 410 Cellular and Molecular Immunology**3 cr
Prereq: BIOS 260, 307, 309, and consent of instructor.
Freq: Occasionally.
 The immune system and its analysis at the cellular and molecular level. Three-hour lecture.
- 414 Molecular Evolution**.....3 cr
Prereq: BIOS 309 or 314, or consent of instructor.
Freq: Spring (even years).
 The evolution of nucleic acids and proteins. Five major topics are considered in turn: genetic variability; the causes of molecular evolution and the neutral theory; methods of detecting genetic variability; the use of molecular markers for estimating phylogeny; and the evolution of genome structure. Three-hour lecture/discussion.
- 420 Neuroscience**.....3 cr
Prereq: BIOS 300, 341 or consent of instructor. Freq: Occasionally.
 This course emphasizes the neuroanatomy and the related neurophysiology of the human nervous system. Communication between the external environment and the central nervous system is presented using electrical and chemical methods of cell signaling systems, integration of sensory and motor function, and some of the pathology associated with the nervous system. Three-hour lecture; one-hour discussion.
- 435 Experimental Methods/Biochemistry Lab**.....2 cr
Prereq: CHEM 322. and consent of instructor.
Freq: Fall, Spring.
 Familiarization with the use of scientific instruments and techniques, and developing proficiency in the process of scientific investigation. This is a capstone course intended for biological sciences majors who have completed all 200-level core courses. Cross-listed with CHEM 308. Four-hour lab.
- 453 Molecular Biology and Bioinformatics I: DNA**.....4 cr
Prereq: BIOS 240 or 301, 260, 309, and consent of instructor.
Freq: Fall.
 Techniques and theory of DNA isolation and analysis including laboratory and computational methods. Eight-hour lecture/lab.
- 454 Molecular Biology and Bioinformatics II: RNA**.....4 cr
Prereq: BIOS 240 or 301, 260, 309, and consent of instructor.
Freq: Fall.
 Theory and techniques for investigating RNA. Common laboratory methods for isolating and characterizing RNA will be performed. In addition, computer applications will be used to study RNA bioinformatics, structure, and function. Eight-hour lecture/lab.
- 455 Molecular Biology and Bioinformatics III: Proteins**....4 cr
Prereq: BIOS 260, 309, any one of 240, 301, 307, and consent of instructor. Freq: Spring.
 The role of proteins in biology will be assessed, providing both an understanding of these macromolecules and practical experience in biochemistry. In particular, comprehension of protein characteristics and function will be emphasized to provide insight into cell physiology or functional genomics. Eight-hour lecture/lab.
- 470 Advanced Molecular Genetics**3 cr
Prereq: BIOS 260, 309, and consent of instructor.
Freq: Occasionally.
 In-depth coverage of selected current research topics in the molecular genetics of genomes, genes and gene products. Three-hour lecture.
- 480 Bioinformatics Programming**.....4 cr
Prereq: BIOS 260, 309, and consent of instructor. Freq: Fall.
 This course focuses on implementation of programming languages, data structures, and data management strategies for bioinformatics applications. Lectures and computer-based exercises emphasize both theory and analysis of genomic and proteomic data. Three-hour lecture; three-hour lab.
- 489 Molecular Biology and Bioinformatics Senior Project**1 cr
Prereq: BIOS 453, 454, and 455. Freq: Fall, Spring, Summer.
 Students work independently on a project, applying skills and knowledge acquired from previous course work. Students submit a written report and give a public, oral presentation of their project. May be repeated for maximum of 2 credits.
- 490 Advanced Topics in Biology**1-4 cr
Prereq: Varies with topic. Freq: Occasionally.
 Selected advanced topics in the biological sciences.
- 494 Internship in Biological Sciences**1-3 cr
Prereq: BIOS 210, 2.80 GPA, consent of instructor.
Freq: Fall, Spring, Summer.
 Provides learning experiences in which a student works with a sponsoring organization in either the public or private sector under the joint guidance of a member of the sponsoring organization and a faculty member. Graded credit/no credit. A maximum of 3 credits of BIOS 494 may be used toward elective credit in the major.
- 495 Senior Seminar**.....1 cr
Prereq: Senior standing and consent of instructor.
Freq: Fall, Spring.
 Each participant presents several seminars involving literature search, synthesis of research data, and organization into an effective oral presentation.
- 499 Independent Study**1-3 cr
Prereq: Consent of instructor and department chair. Junior standing and minimum 2.80 GPA in BIOS courses recommended.
Freq: Fall, Spring, Summer.
 Student research performed under the supervision of a regular faculty member. A maximum of 3 credits may be used toward elective credit in the major.

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