

# BIOLOGICAL SCIENCES

Greenquist 345 • (262) 595-2327 • [www.uwp.edu/academic/biology](http://www.uwp.edu/academic/biology)

## Degrees Offered:

Bachelor of Science.

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

## Professors:

Wallen, Ph.D. (Chair)

## Adjunct Professor:

Shewmake, M.D., J.D.

## Associate Professors:

Gundersen, Ph.D.; Mayer, Ph.D.; Thomson, Ph.D.;

## Adjunct Associate Professor:

Paul, Ph.D.

## Assistant Professors:

Barber, Ph.D.; Boyer, Ph.D.; Higgs, Ph.D.; Pham, Ph.D.;

Ruffolo, Ph.D.; Skendzic, Ph.D.

## Adjunct Assistant Professor:

Lewis, Ph.D., Assistant to the Dean for Health-Related Professions

## Visiting Assistant Professor:

MacWilliams, Ph.D.

## Senior Lecturers:

McKee, M.S.; Wilson, M.S.

## Lecturer:

Mossman, Ph.D.

## Student Organizations/Clubs:

Pre-Health Professions Club, Molecular Biology Club, Spanning the Divide (for prospective and new science teachers).

## 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 of young men and women for careers in life 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 insti-

tution. 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 assistant to the dean for health-related professions for advice relating to your particular career goal.

Southeastern Wisconsin is faced with rapidly growing shortages of well-qualified science, math, engineering, and technology teachers. The Biological Sciences Department has always been a leader in preparing teachers of science to help meet local, regional, and state needs. The shortages mean exciting opportunities abound for new science teachers, as detailed in the program descriptions.

The program also provides an academic minor and a teaching major and minor that satisfy state requirements. 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: Molecular Biology Club, Pre-Health Club, and Spanning the Divide (for future and new science teachers). These 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 supplies many service courses for other majors and/or programs such as nursing, biochemistry, environmental studies 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. At least 15 credits of upper-level courses in the major must be completed at UW-Parkside.

### A. Core Courses (20 Credits)

BIOS 101	Bioscience . . . . .	4 cr
BIOS 102	Organismal Biology . . . . .	4 cr
BIOS 210	Biostatistics . . . . .	3 cr
BIOS 301	Cell Biology . . . . .	3 cr
BIOS 360	General Genetics . . . . .	3 cr
BIOS 435	Experimental Methods . . . . .	2 cr
BIOS 495	Senior Seminar . . . . .	1 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 and Physics Courses (34 credits)

#### Mathematics

MATH 112	College Algebra II . . . . .	4 cr
MATH 113	Trigonometry . . . . .	2 cr
MATH 221	Calculus & Analytic Geometry I* . . . . .	5 cr

#### Chemistry

CHEM 101	General Chemistry I . . . . .	5 cr
and		
CHEM 102	General Chemistry II . . . . .	5 cr
<b>or</b>		
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
and		
PHYS 106	College Physics II . . . . .	5 cr
<b>or</b>		
PHYS 201	General Physics I . . . . .	5 cr
and		
PHYS 202	General Physics II . . . . .	5 cr

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

### C. Elective Courses (22 credits)

Each student must complete a minimum of 22 elective credits selected from 200-400 level biological sciences courses. Students must complete the required core courses but can then select among the remaining 200-400 level biological sciences courses to complete the required minimum of 42 credits.

Students who wish to specialize in the area of organismal and population biology are advised to consider choosing from the following series of elective courses:

BIOS 305	Principles of Ecology . . . . .	3 cr
BIOS 313	Invertebrate Zoology . . . . .	3 cr
BIOS 314	Evolutionary Biology . . . . .	3 cr
BIOS 317	Vertebrate Embryology . . . . .	3 cr
BIOS 318	Vertebrate Zoology . . . . .	3 cr
BIOS 324	Botany . . . . .	3 cr
BIOS 330	Field Biology . . . . .	3 cr
BIOS 414	Molecular Evolution . . . . .	3 cr

Students who wish to focus on graduate/professional work in health sciences are advised to consider choosing from the following series of elective courses:

BIOS 200	Functional Human Anatomy Laboratory . . . . .	3 cr
BIOS 303	Microbiology . . . . .	4 cr
BIOS 307	Biochemical Metabolism . . . . .	3 cr
BIOS 309	Molecular Biology . . . . .	3 cr
BIOS 341	Mammalian Physiology . . . . .	3 cr
BIOS 317	Vertebrate Embryology . . . . .	3 cr
BIOS 420	Neuroscience . . . . .	3 cr

Special advising is available to students pursuing careers in the health professions. Contact the assistant to the dean for health-related professions at (262) 595-2327.

## Requirements for the Molecular Biology and Bioinformatics Major

The major in molecular biology and bioinformatics consists of a minimum of 45 credits in biological sciences, with additional courses in mathematics, chemistry, computer science and physics. At least 15 credits of upper-level courses in the major must be completed at UW-Parkside. Students must attain a minimum UW-Parkside cumulative GPA of 2.50 in all courses required for the major.

### A. Core Courses (42 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
BIOS 303	Microbiology . . . . .	4 cr
BIOS 309	Molecular Biology . . . . .	3 cr
BIOS 360	General Genetics . . . . .	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 . . . . .	4 cr
BIOS 489	Molecular Biology & Bioinformatics Senior Project . . . . .	2 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 (40-41 credits)

##### Mathematics

MATH 221	Calculus & Analytic Geometry I . . . . .	5 cr
and		
MATH 231	Discrete Mathematics . . . . .	3 cr
or		
MATH 309	Probability and Statistics . . . . .	4 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
and		
CHEM 322	Organic Chemistry II . . . . .	4 cr

##### Computer Science

CSCI 241	Computer Science I . . . . .	4 cr
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##### Physics

PHYS 105	College Physics I . . . . .	5 cr
and		
PHYS 106	College Physics II . . . . .	5 cr
or		
PHYS 201	General Physics I . . . . .	5 cr
and		
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 (3 credits)

Each student must complete a minimum of 3 elective credits selected from 200-400 level biological sciences courses.

## 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
	Biology electives (200 level or above) . . . . .	12 cr

## Teacher Licensure

Special advising and mentoring services are available to all prospective teachers of science from a Biological Sciences adviser through the interdisciplinary Center for Science Education. Stop by as soon as possible to learn about “Spanning the Divide,” organized to keep you up to date on the latest news, “plug you in” to social and professional networking, and move you into secondary science classrooms through pioneering partnerships with regional schools. More information is available at (262) 595-2475.

New Wisconsin Department of Public Instruction (DPI) rules for teacher licensure require that all candidates demonstrate proficiency in the 10 Wisconsin Standards for Teacher Development and Licensure, as well as pass a standardized science content test. Both requirements necessitate careful advising. The content test assesses candidate knowledge and understanding of: 1) scientific methodology, techniques, and history; 2) physical sciences; 3) life sciences; 4) earth sciences; and 5) science, technology, and society. Each area is represented by 20% of the test, regardless of specific licensure being sought. To ensure appropriate preparation, all candidates are strongly urged to pursue a broad-field science concentration, as well. Due to on-going changes at the DPI in anticipation of new license requirements effective July 1, 2004, students are advised to communicate closely with the biological sciences teacher education liaison at (262) 595-2165. For general information about teacher licensure, students may contact the teacher education adviser at (262) 595-2032.

## Broad-Field Science Concentration

The following guidelines are strongly recommended to prepare prospective teachers for the newly mandated science content test. Proficient accomplishment of the following program or its equivalent also diversifies the candidate's preparation and enhances her/his employability. The biological sciences major requires the completion of 10 physics credits, 21 chemistry credits, and mathematics proficiency through trigonometry (i.e. equivalent of 6 credits of mathematics). Broad-field science candidates should complete 5 additional physics credits (including PHYS 110) and a minimum of 8 geosciences credits (GEOL 101, 102, and 104 are recommended). The concentration is rounded out with 6 credits in the history (HIST 221 or HIST 222) and philosophy (PHIL 105 or GSCI 102) of science. Once a candidate can demonstrate proficiency across the broad-field science concentration, s/he is qualified to teach general science (grades 6-9), as well as high school biology, chemistry, and physics (grades 9-12). All prospec-

tive science teachers are urged to consult the Center for Science Education for proficiency criteria and individualized guidance.

## Requirements for the Biological Sciences Teaching Major and Minor

The teaching major includes the following exceptions from the major in biological sciences:

### A. Additional Core Courses (11 credits):

BIOS 104 or 305	Environment . . . . .	3 cr
BIOS 207	Research Process in Biology . . . . .	2 cr
BIOS 314	Evolutionary Biology . . . . .	3 cr
BIOS 324 or 344	Plant Biology . . . . .	3 cr
BIOS 495	Senior Seminar (for teachers). . . . .	2 cr

### B. Recommended Electives (11 credits):

BIOS 200	Functional Human Anatomy Lab . . . . .	3 cr
BIOS (202 or 303)	Microbiology . . . . .	4 cr
BIOS 309	Molecular Biology . . . . .	3 cr
BIOS 313	Invertebrate Zoology . . . . .	3 cr
BIOS 341	Mammalian Physiology . . . . .	3 cr

The teaching minor requires a minimum of 20 credit hours, distributed as:

BIOS 101	Bioscience. . . . .	4 cr
BIOS 102	Organismal Biology. . . . .	4 cr
BIOS 207	Research Process in Biology . . . . .	2 cr
BIOS 495	Senior Seminar (for teachers). . . . .	2 cr

### Biology Core Electives (9 credits)

BIOS 104 or 305	Environment . . . . .	3 cr
BIOS 314	Evolutionary Biology . . . . .	3 cr
BIOS 324 or 344	Plant Biology . . . . .	3 cr

Available for elective credit via executive action, pending teacher certification

## Courses in Biological Sciences (BIOS)

- 100 Nature of Life** .....3 cr  
*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; 50-minute 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 Ecology Science of Survival**.....3 cr  
*Prereq: None. Freq: Fall, Spring, Summer.*  
 The ecology of and associations between human populations, resources, technology, lifestyles and environmental crisis. 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 dealing with the principles of structure and function necessary for understanding the systems of the human body; not for credit toward biological sciences major. Three-hour lecture; three-hour lab.
- 106 Human Physiology and Anatomy II** .....4 cr  
*Prereq: BIOS 105. Freq: Spring.*  
 A continuation of BIOS 105; not for credit toward biological sciences major. Three-hour lecture; three-hour lab.
- 107 Biology Through Art** .....3 cr  
*Prereq: None. Freq: Winterim, Summer*  
 Lectures integrating contemporary art and biology, which culminates with the creation of visual artworks in the laboratory; not for credit toward biological sciences major.
- 108 Nutrition, Health and Culture**.....3 cr  
*Prereq: None. Freq: Fall, Spring.*  
 Explores the role of proper nutrition in the health of the human body with an emphasis on the nutritional practices of the many ethnic groups that comprise American society; not for credit toward biological sciences major. Three-hour lecture. (Cross listed as ETHN 108.)
- 190 Fundamentals of Human Nutrition** .....2 cr  
*Prereq: BIOS 106 and CHEM 215. Freq: Fall.*  
 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. Three-hour lecture.

- 200 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.
- 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.
- 207 Research Process in Biology** .....2 cr  
*Prereq: BIOS 210 or concurrent registration and consent of instructor. Freq: Spring.*  
 Introduction to the methods of scientific inquiry. Students acquire practical experience in the whole research process, from conception of a research problem through communication of research results. Four-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 will 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. This course is intended for Molecular Biology and Bioinformatics majors only. Three-hour lecture.
- 290 Special Topics in Biological Sciences** .....1-4 cr  
*Prereq: Consent of instructor. Freq: Occasionally.*  
 Selected topics in the biological sciences.
- 301 Cell Biology** .....3 cr  
*Prereq: BIOS 101, 102, and CHEM 322, or consent of instructor. Freq: Spring.*  
 A study of cells and cellular organelles. The relationship between cellular structure and function is emphasized. Three-hour lecture.
- 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**.....3 cr  
*Prereq: BIOS 101, 102. Freq: Alternate Falls (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. Two-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 as CHEM 307.)
- 309 Molecular Biology**.....3 cr  
*Prereq: BIOS 360, 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.
- 313 Invertebrate Zoology**.....3 cr  
*Prereq: BIOS 101, 102, or consent of instructor. Freq: Alternate Falls (odd years).*  
 Ecology, classification and evolutionary relationships of nonchordate animals. Field trips, experimental research. Two-hour lecture discussion; three-hour lab.
- 314 Evolutionary Biology** .....3 cr  
*Prereq: BIOS 101, 102. Freq: Alternate Springs (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, 200, or consent of instructor. Freq: Spring.*  
 Developmental anatomy and mechanisms of representative vertebrate types from cleavage through organogenesis. Two-hour lecture; three-hour lab.
- 318 Vertebrate Zoology**.....3 cr  
*Prereq: BIOS 101, 102, or consent of instructor. Freq: Alternate Falls (even years).*  
 An introduction to the biology of vertebrates with emphasis on structure, diversity, evolution, and distribution. Field trips. Two-hour lecture; three-hour lab.
- 324 Botany** .....3 cr  
*Prereq: BIOS 101, 102. Freq: Spring.*  
 Study of plants from the view points of systematics, evolution, morphology and ecology. Field trips. Two-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 as PSYC 325.)

- 330 Topics in Field Biology** .....3 cr  
*Prereq: BIOS 101, 102 or consent of instructor. Freq: Spring.*  
 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** .....3 cr  
*Prereq: BIOS 101, 102. Freq: Occasionally.*  
 Emphasis on the evolution and complexity of animal behaviors based on a variety of animal species from invertebrates to mammals. Three-hour lecture.
- 341 Mammalian Physiology** .....3 cr  
*Prereq: BIOS 101, 102, 210, CHEM 321, or consent of instructor. BIOS 200 recommended. Freq: Fall.*  
 Advanced treatment of major mammalian organ systems and their roles in homeostasis. Three-hour lecture.
- 344 Plant Physiology, Biochemistry and Molecular Biology**.....3 cr  
*Prereq: BIOS 101, 102, 301; CHEM 322, or concurrent registration. Freq: Alternate Springs (odd years).*  
 Study of plants from the view points of physiology, biochemistry and molecular biology. Three-hour lecture.
- 360 General Genetics**.....3 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. Two-hour lecture; two-hour discussion/demo.
- 381 Molecular Aspects of Development**.....3 cr  
*Prereq: BIOS 360, 309 or concurrent registration, or consent of instructor. Freq: Occasionally.*  
 Applications of current molecular biological research to the field of developmental biology. Three-hour lecture.
- 410 Cellular and Molecular Immunology** .....3 cr  
*Prereq: BIOS 307, 309, 360 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: Alternate Springs (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 200, 341 or consent of instructor. Freq: Alternate Springs*  
 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**.....2 cr  
*Prereq: BIOS 210, 301, 360 and CHEM 322. Freq: Fall, Spring.*  
 Familiarization with the use of scientific instruments and techniques, and developing proficiency in the process of scientific investigation. Not open to students with credit in CHEM 308. Four-hour lab.
- 453 Molecular Biology and Bioinformatics I: DNA**.....4 cr  
*Prereq: BIOS 240 (or BIOS 301 and 307), 309, 360 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 BIOS 301 and 307), 309, 360, 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 240, (or BIOS 301 or 307), 309, 360 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 309, 360 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** .....4 cr  
*Prereq: BIOS 309, 360, or consent of instructor. Freq: Fall.*  
 Various aspects of bioinformatics relating to data management, data discrimination, genomics, and proteomics will be introduced to students. Lectures and computer-based exercises will emphasize basic theory and applications of this information in today's world. Two-hour lecture.

- 482 Advanced Bioinformatics: Genomics.....1 cr**  
*Coreq: BIOS 480. Freq: Occasionally.*  
 Theory and techniques will be presented to provide students perspective on the essence of life, genomic sequences. Lectures and computer-based exercises will emphasize the information content of genomic DNA and its application in today's world. Two-hour lecture/lab.
- 483 Advanced Bioinformatics: Proteomics.....1 cr**  
*Prereq: BIOS 480, consent of instructor. Freq: Occasionally.*  
 The field of bioinformatics has revolutionized the study of gene expression. A combination of lecture, lab, and computer-based exercises will provide students with expertise in the use of bioinformatic tools to assess gene expression and functional genomics. Two-hour lecture/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: Junior standing or consent of instructor. Freq: Occasionally.*  
 Individual investigations of selected problems in biology.
- 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 6 credits of BIOS 494 and 499 combined may be used toward 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: BIOS 207 and 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 can be used as electives towards the biological sciences major requirements.