BIOLOGICAL SCIENCES
UW-PARKSIDE 2015-17 CATALOG

College:  
Natural and Health Sciences

Degrees and Programs Offered:  
Bachelor of Science and Master of Science

Majors - Biological Sciences, Molecular Biology and Bioinformatics  
Minor - Biological Sciences

Student Organizations/Clubs:  
Biology 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; ecologist; conservation biologist; 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 Professions 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.

Program Level Objectives for Biological Sciences

1. Biological complexity and evolution
2. Inquiry and research methods
3. Scholarship and communication

Requirements for the Biological Sciences Major (76-79 credits)

The major in biological sciences consists of a minimum of 43 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. Required Core Courses (19 Credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOS 101</td>
<td>Bioscience</td>
<td>4 cr</td>
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<tr>
<td>BIOS 102</td>
<td>Organismal Biology</td>
<td>4 cr</td>
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<td>BIOS 210</td>
<td>Biostatistics</td>
<td>4 cr</td>
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<td>BIOS 260</td>
<td>General Genetics</td>
<td>4 cr</td>
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<td>BIOS 435</td>
<td>Experimental Methods/</td>
<td>4 cr</td>
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<td></td>
<td>Biochemistry Lab</td>
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<tr>
<td>BIOS 495</td>
<td>Senior Seminar</td>
<td>1 cr</td>
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</tbody>
</table>
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 (33-36 credits)**

1. **Mathematics Courses (5 credits)**
   - MATH 221 Calculus and Analytic Geometry I ...... 5 cr

2. **Chemistry Courses (18-21 credits)**
   - CHEM 101 General Chemistry I ....................... 5 cr
   - CHEM 102 General Chemistry II ...................... 5 cr
   - CHEM 321 Organic Chemistry I ...................... 4 cr
   - CHEM 322 Organic Chemistry II ..................... 4 cr

   Recommended:
   - CHEM 323 Organic Chemistry Laboratory* .......... 3 cr

3. **Physics Courses (10 credits)**
   - 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 advisors concerning biological sciences special topics courses (BIOS 290, 390, 490) counting toward the topic areas listed below.

1. **Cell and Molecular Biology**
   - 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

2. **Organismal Structure and Function**
   - BIOS 300 Human Functional Anatomy (L) ........ 4 cr
   - BIOS 317 Developmental Biology ....................... 3 cr
   - BIOS 341 Mammalian Physiology ....................... 3 cr
   - BIOS 344 Plant Physiology ............................... 3 cr
   - BIOS 420 Neuroscience .................................. 3 cr

3. **Biological Diversity**
   - BIOS 303 Microbiology (L) ............................... 4 cr
   - BIOS 311 Parasitology (L) ............................... 4 cr
   - BIOS 313 Invertebrate Zoology (L) .................... 4 cr
   - BIOS 318 Vertebrate Zoology (L) ....................... 4 cr
   - BIOS 324 Botany (L) .................................... 4 cr
   - BIOS 351 Virology ...................................... 3 cr

4. **Population Biology**
   - BIOS 305 Principles of Ecology (L) ................. 4 cr
   - BIOS 314 Evolutionary Biology ......................... 3 cr
   - BIOS 330 Topics in Field Biology (L) ............... 3 cr
   - BIOS 336 Conservation Biology ......................... 3 cr
   - BIOS 340 Animal Behavior (L) ........................... 4 cr
   - BIOS 414 Molecular Evolution ........................... 3 cr

A course in each of the four areas is required. Students can select among any of the remaining 200-400 level biological sciences courses to complete the remaining 12 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 300 level or higher elective class must include a laboratory. Classes that meet this requirement are marked with an (L) in the list above as well as BIOS 453, 455 and 480. BIOS 435 Experimental Methods/Biochemistry Lab is a core class and does not satisfy this requirement.

Students pursuing careers in the health professions are strongly urged to contact the Pre-Health office at 262-596-2327 for advising.

**Concentration in Pre-Health Professions (27 credits)**

Students who are planning to pursue graduate/professional work in health sciences should consider completing the biological sciences major with a concentration in pre-health professions. Students complete the same biological sciences major core course requirements (A) and mathematics, physics and chemistry course requirements (B), but use the following course plan for the elective course requirements (C):

1. **Required Concentration Courses (20 credits)**
   - BIOS 300 Human Functional Anatomy (L) ........... 4 cr
   - BIOS 303 Microbiology (L) ............................... 4 cr
   - BIOS 307 Biochemical Metabolism ..................... 3 cr
   - BIOS 341 Mammalian Physiology ....................... 3 cr
   - CHEM 323 Organic Chemistry Laboratory ............... 3 cr
   - BIOS 314 Evolutionary Biology .......................... 3 cr
   - OR
   - BIOS 414 Molecular Evolution ........................... 3 cr

2. **Elective Concentration Courses (7 credits)**
   - BIOS 301 Cell Biology .................................... 3 cr
   - BIOS 309 Molecular Biology ............................. 3 cr
   - BIOS 311 Parasitology (L) ............................... 4 cr
   - BIOS 317 Developmental Biology ....................... 3 cr
   - BIOS 342 Mammalian Physiology Laboratory .......... 1 cr
   - BIOS 351 Virology ...................................... 3 cr
   - BIOS 355 Biology of Cancer ............................. 3 cr
   - BIOS 420 Neuroscience .................................. 3 cr

**Program Level Objectives for Molecular Biology and Bioinformatics**

1. **Knowledge of the Natural World:** Breadth of scientific knowledge, specifically, the ability to think beyond one’s area of concentration.

2. **Critical and Creative Thinking Skills:** Experiential and problem solving skills as well as higher order qualitative and quantitative reasoning.

4. Individual, Social and Environmental Responsibility: Civic knowledge and engagement (both local and global), ethical reasoning, and action; ability to interact and work with people under standard civility and professional norm.

Requirements for the Molecular Biology and Bioinformatics Major (80-82 credits)
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. Required Core Courses (36 credits)

- BIOS 101 Bioscience..............................4 cr
- BIOS 102 Organismal Biology.....................4 cr
- BIOS 210 Biostatistics............................4 cr
- BIOS 260 General Genetics........................4 cr
- BIOS 301 Cell Biology................................3 cr
- BIOS 309 Molecular Biology........................3 cr
- BIOS 453 Molecular Biology and Bioinformatics of Nucleic Acids..........................4 cr
- BIOS 455 Protein Biochemistry and Bioinformatics...4 cr
- BIOS 489 Molecular Biology and 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)

1. Mathematics Courses (5-8 credits)

- 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

2. Chemistry Courses (18 credits)

- CHEM 101 General Chemistry I........................5 cr
- CHEM 102 General Chemistry II.........................5 cr
- CHEM 321 Organic Chemistry I..........................4 cr
- CHEM 322 Organic Chemistry II..........................4 cr

3. Physics Courses (10 credits)

- 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 (8 credits)

Choose from:

- BIOS 300 - 600 level courses (excluding: 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 Business Programming II-C#.................3 cr
- MIS 328 Database Management Systems...............3 cr

Requirements for the Biological Sciences Minor (20 credits)

A. Required Courses (8 credits)

- BIOS 101 Bioscience....................................4 cr
- BIOS 102 Organismal Biology..........................4 cr

B. Elective Courses (12 credits)

- BIOS 200+ Electives 200 level or above

Choose from:

- (excluding BIOS 202 General Microbiology)...........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 BIOS 499 Independent Research,
- 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 Education Licensure in Biological Sciences

Students interested in becoming teachers will need to complete an approved program pathway to a Wisconsin initial educator license. The approved pathway to this license is a structured
collaboration between the biological sciences department and the Institute of Professional Educator Development (IPED). The requirements for teacher licensure are specific and therefore students must meet with the IPED Adviser to coordinate the major and teacher education curriculum. It is very important to contact the IPED adviser at 262-595-2180 or Molinaro D111 as soon as possible. Students are required to seek advising each semester from both the IPED Adviser and the biological sciences department liaison to the teacher education program. Complete information about the Teacher Education Program can be found on the IPED website at: http://www.uwp.edu/learn/departments/educatordevelopment/index.cfm

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. Three-hour lecture.

101 Bioscience .................................................. 4 cr
   Prereq: MATH 111 or concurrent enrollment; placement into ENGL 100 or higher. 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: MATH 111 or concurrent enrollment; placement into ENGL 100 or higher. 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: Spring, 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 .................. 5 cr
   Prereq: None. Freq: Fall, Spring.
   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 .................. 5 cr
   Prereq: BIOS 105. Freq: Fall, 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.

108 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 toward biological sciences major. Two-hour lecture.

190 Fundamentals of Human Nutrition .................... 2 cr
   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; three-hour lab.

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.

203 Introduction to Aquatic and Environmental Microbiology .... 4 cr
   Prereq: BIOS 101, GEOS 106, MATH 111, and CHEM 101; or consent of instructor. Freq: Occasionally.
   Understanding and application of basic microbiological and ecological principles related to microbial processes in freshwater and groundwater environments. Three-hour lecture; three-hour lab.

210 Biostatistics .............................................. 4 cr
   Prereq: BIOS 101, 102 and MATH 112, 113; or equivalent. Freq: Fall, Spring.
   Introduces quantitative methods of scientific inference used in the analysis and design of biological observations and experiments. Topics include measurement, sampling, descriptive statistics, analysis of variance, correlation, regression, and analysis of frequencies. Three-hour lecture; three-hour lab.

260 General Genetics ......................................... 4 cr
   Prereq: BIOS 101, 102; 210 or concurrent registration and CHEM 102; Freq: Fall, Spring.
   Fundamental principles including transmission, molecular and population genetics. Laboratory introduces techniques appropriate for investigating a variety of organisms used in the discipline, including microorganisms, plants, lower animals, and humans. For students majoring in science, mathematics or biology-related professions. Three-hour lecture; three-hour lab.

290 Special Topics in Biological Sciences .................. 1-4 cr
   Prereq: Varies with topic. Freq: Occasionally.
   Selected topics in the biological sciences.

300 Human Functional Anatomy ................................ 4 cr
   Prereq: BIOS 101, 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. Three-hour lecture; three-hour lab.

301 Cell Biology ............................................... 3 cr
   Prereq: BIOS 260, CHEM 322; or consent of instructor. Freq: Spring (odd years).
   Studies cells and cellular organelles. Emphasizes the relationship between cellular and macromolecular structure and function. Three-hour lecture; one-hour discussion.

303 Microbiology ............................................. 4 cr
   Prereq: BIOS 260 or consent of instructor. 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, and 210. Freq: Fall (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.

311 Parasitology ............................................................ 4 cr
Prereq: BIOS 101, 102; or consent of instructor. Freq: Fall (odd years).
Investigates the ecology of human and insect interactions, their significance to public health, and application to forensic science. Three-hour lecture; three-hour lab.

312 Medical and Forensic Entomology ................................. 4 cr
Investigates the biology, ecology, classification, and significance of parasitic animals of humans and wildlife in Southeast Wisconsin. Includes host-parasite interactions, distribution of parasites throughout the world and examination of parasite life cycles and transmission. Three-hour lecture; three-hour lab.

317 Developmental Biology ............................................. 3 cr
Prereq: BIOS 101, 102; or consent of instructor. Freq: Spring.
Studies developmental anatomy and molecular mechanisms of development among 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.
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: Alternate years.
Studies plants from the viewpoints of systematics, evolution, morphology and ecology. Field trips. Three-hour lecture; three-hour lab.

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.

333 Restoration Ecology ................................................ 4 cr
Prereq: BIOS 102 or 104, Freq: Occasionally.
Provides a foundation in the science and practice of ecological restoration. Students will learn to identify dominant species of regional plant communities, threats to these communities and techniques to manage and reestablish them. Students will develop landscape and restoration plans for the 700+ acre UW-Parkside campus and outlying properties. Three-hour lecture; three-hour lab.

336 Conservation Biology ............................................. 3 cr
Prereq: BIOS 102 or 104; and BIOS 210. Freq: Occasionally.
An introduction to the biological and social aspects of conservation. Includes a history of the conservation movement with emphasis on modern techniques for monitoring and maintaining biological diversity on the Earth. Course will focus on relating material to local and regional conservation problems. Three-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.

342 Mammalian Physiology Laboratory ........................... 1 cr
Prereq: BIOS 341; or concurrent registration in BIOS 341, or consent of instructor. Freq: Fall.
Uses models, computer programs, and experiments to examine major mammalian organ systems and their role in homeostasis. Three-hour lab.

344 Plant Physiology ..................................................... 3 cr
Prereq: BIOS 2100, 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 2100, or consent of instructor. Freq: Occasionally.
A study of the genetic and molecular mechanisms underlying the broad disease spectrum. 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.

403 Applications in Aquatic and Public Health .................. 4 cr
Prereq: BIOS 203, 303. Freq: Occasionally.
Develops practical knowledge and provides experience evaluating microbial impact on aquatic environments and potential human health risks. Eight-hour lecture/lab.

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.

411 Microbial Physiology and Diversity ......................... 3 cr
Prereq: BIOS 303 or consent of instructor. Freq: Alternate years.
Explores diverse molecular mechanisms of microbial physiology. Topics include microbial regulation of gene expression, metabolism, behavior, symbiosis, and applications to biotechnology. Three-hour lecture/discussion.

414 Molecular Evolution ................................................ 3 cr
Prereq: BIOS 309 or 314; or consent of instructor. Freq: Occasionally.
Examines the evolution of nucleic acids and proteins. Considers five major topics: 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 of Nucleic Acids ....... 4 cr  
Prereq: BIOS 260, 309, and consent of instructor. Freq: Fall.  
Covers techniques and theory of nucleic acid isolation (DNA and RNA)  
and analysis including laboratory and computational methods. Includes  
common laboratory methods for isolating and characterizing nucleic  
aacids. Eight-hour lecture/lab.

455 Protein Biochemistry and Bioinformatics  ...................... 4 cr  
Prereq: BIOS 260, 309, and consent of instructor. Freq: Spring.  
Practical experience in protein expression, purification, and  
characterization with emphasis on enzymology and use of computer  
programming for development of relevant bioinformatics applications.  
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: Occasionally.  
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, 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.