BACHELOR OF ARTS IN BIOLOGY: PRE-MED STUDENTS

Biology is the most popular major for students intending to enter medical school both at WVU and nationwide. A biology degree provides the student with all the preparation necessary for medical school and the medical school entrance exam—the MCAT. The B.A. in Biology with the curriculum prescribed below has been found to improve both performance and confidence of students attending medical school.

Students intending to graduate with a B.A. in Biology with a premedical emphasis must meet the requirements of the Biology B.A., including a minimum of fourteen hours of upper-division courses with one upper-division lab course. Students wishing to be admitted to competitive medical programs should consider the following:

- **Neuroscience Area of Emphasis (AOE):** Students interested in completing an area of emphasis in Neuroscience must complete the requirements as outlined on in the Area of Emphasis section.

- **Independent Research:** Students with aspirations to attend top-rank medical schools should include at least three hours of independent research (BIOL 386 or BIOL 486) in their program of study if they are to be competitive. The three semester, BIOL 486, may be counted as the Biology Capstone in place of BIOL 321. Four hours of BIOL 386 and BIOL 486 may be used to satisfy upper division electives. One semester of BIOL 386 or BIOL 486 will satisfy the lab course.

- **MCAT:** Students who will take the MCAT in 2015 or later should take PSYC 101, SOCA 101, SOCA 105 and one further course in Psychology and Sociology in order to be prepared for the new social sciences section of the MCAT - consult with your adviser for more detailed information.

- **Note:** The course of study outlined below is recommended for students interested in attending medical school. However, admission requirements will vary from one medical school to another, so a review of specific requirements for each school of interest is recommended.

- **Calculation of the Grade Point Average (GPA) in the Biology major:** A GPA of 2.0 in Biology course work is required for graduation. All attempts at the following courses will be used to calculate the GPA in the Biology major: BIOL 115, BIOL 117, BIOL 219, BIOL 221, BIOL 321, BIOL 327, and all upper-division courses counted as BIOL electives. If BIOL 101-104 are substituted for BIOL 115, they will be excluded from the GPA calculation, and no other 100- or 200-level Biology courses will be used to satisfy elective requirements nor will they be used in the calculation of the Biology GPA.

- **Writing Course Requirement:** The General Education Curriculum requires the successful completion of a writing course ("W"), preferably in the major. Biology majors can complete BIOL 312, BIOL 321, BIOL 351, BIOL 352, or BIOL 363.

- **Capstone Requirement:** The General Education Curriculum requires the successful completion of a Biology capstone course (BIOL 321). The three semester, BIOL 486, may be counted as the Biology Capstone Experience in place of BIOL 321. Two hours of BIOL 486 will be counted as part of the core requirements (replacing BIOL 321).

- **Benchmarks expectations:** By the end of their third semester into the major, students are expected to have completed BIOL 115, BIOL 117, and CHEM 115 with a 2.0 GPA in these courses and a 2.0 GPA overall. In addition, students must meet with their Biology adviser every semester. Students who do not meet their benchmarks may be removed from their major.

### General Requirements

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<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>BIOL 310</td>
<td>Adv Cellular/Molecular Biology</td>
</tr>
<tr>
<td>BIOL 436</td>
<td>General Animal Physiology</td>
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<td>BIOL 440</td>
<td>Comparative Anatomy</td>
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### Biochemistry Requirement

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>AGBI 410</td>
<td>Introduction to Biochemistry</td>
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<tr>
<td>BIOL 339</td>
<td>Intro To Biochemistry</td>
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### Electives

Select two of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIOL 302</td>
<td>Biometry</td>
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<tr>
<td>BIOL 312</td>
<td>Introduction To Virology</td>
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<td>BIOL 313</td>
<td>Molecular Basis of Cell Growth</td>
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<tr>
<td>BIOL 316</td>
<td>Developmental Biology</td>
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<tr>
<td>BIOL 324</td>
<td>Molecular Genetics</td>
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<td>BIOL 335</td>
<td>Cell Physiology</td>
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<td>BIOL 336</td>
<td>Vertebrate Embryology</td>
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<td>BIOL 337</td>
<td>Physiological Psychology</td>
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<td>BIOL 338</td>
<td>Behavioral Ecology</td>
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<td>BIOL 348</td>
<td>Neuroscience 1</td>
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<td>Course Code</td>
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<tr>
<td>BIOL 386</td>
<td>Undergraduate Research</td>
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<td>BIOL 410</td>
<td>Cell/Molecular Biology Methods</td>
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<td>BIOL 411</td>
<td>Intro To Recombinant DNA</td>
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<td>BIOL 413</td>
<td>Molecular Endocrinology</td>
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<td>BIOL 415</td>
<td>Epigenetics</td>
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<td>BIOL 425</td>
<td>Developmental Genetics</td>
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<td>BIOL 426</td>
<td>Molecular Biology of Cancer</td>
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<td>BIOL 438</td>
<td>Animal Behavior</td>
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<tr>
<td>BIOL 441</td>
<td>Vertebrate Microanatomy</td>
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<tr>
<td>BIOL 453</td>
<td>Molecular Basis of Disease</td>
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<td>BIOL 454</td>
<td>Immunology</td>
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<tr>
<td>BIOL 455</td>
<td>Evolution-Infectious Diseases</td>
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<td>BIOL 456</td>
<td>Microbial Symbiosis</td>
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<td>BIOL 461</td>
<td>Principles of Evolution</td>
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<tr>
<td>BIOL 464</td>
<td>Populatn/Quantitative Genetics</td>
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<td>BIOL 486</td>
<td>Honor Investigation &amp; Thesis</td>
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<tr>
<td>AEM 341</td>
<td>General Microbiology</td>
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<tr>
<td>AEM 401</td>
<td>Environmental Microbiology</td>
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* Seniors with at least a 3.00 GPA may take a 500-level biochemistry course if they obtain departmental and college permission.

**COURSES**

**BIOL 101. General Biology. 3 Hours.**
PR or CONC: BIOL 103. Introductory course in biology: cellular, organismal, and population genetics, including reproduction, growth and development, and evolution.

**BIOL 102. General Biology. 3 Hours.**
PR or CONC: BIOL 104. Introductory biology: energetics and physiology of cells, organisms, and populations, including regulation and control of multicellular organisms.

**BIOL 103. General Biology Laboratory. 1 Hour.**
PR or CONC: BIOL 101. Experiments in biology: genetics and evolution; reproduction, growth, and development of cells, organisms, and populations.

**BIOL 104. General Biology Laboratory. 1 Hour.**

**BIOL 105. Environmental Biology. 3 Hours.**
( Intended for non-biology majors. ) Population growth and human impacts on the environment, including ecosystem destruction, biological diversity, pollution, and global climate change are explored to obtain the concepts necessary to understand complex environmental issues of our time.

**BIOL 106. Environmental Biology Lab. 1 Hour.**
CoReq: BIOL 105. Field and laboratory exercises explore fundamental ecological concepts and environmental problems, such as biodiversity, pollution, and natural resource utilization.

**BIOL 107. Biotechnology and Society. 3 Hours.**
An overview of the use of biotechnology to solve agricultural, medical, and environmental problems. Bioethical concerns and societal impacts of the use of the technologies will be discussed.

**BIOL 115. Principles of Biology. 4 Hours.**
An introductory course presenting basic principles of modern biology. This course represents the first in a four-course, integrated sequence required of biology majors. Topics include ecology and evolution, organismal biology, and cellular/molecular biology.

**BIOL 117. Introductory Physiology. 4 Hours.**
PR: BIOL 115 or BIOL 101 and BIOL 102 AND BIOL 103 AND BIOL 104. Continuation of BIOL 115. The diversity of reproductive, developmental, functional, and integrative mechanisms in plants and animals.

**BIOL 122. Human Sexuality. 3 Hours.**
A study of biological, behavioral and societal aspects of sexuality. Issues considered include changing fecundity, social-legal implications, sex roles, sexually transmitted diseases, populations, erotica, aging, dysfunctions, and decision-making skills for sex related issues.

**BIOL 124. The Human Environment. 3 Hours.**
An examination of several aspects of current worldwide environmental deterioration caused by the actions of humans. Public policies and alternative mitigative strategies are also presented.
BIOL 215. Cell-Biology for Pre-Pharmacy. 3 Hours.
PR: BIOL 115 and BIOL 117 and (CHEM 115 or CHEM 117). Structure, function and diversity of cells with an emphasis on gene expression and cellular phenotype including cell chemistry, energetics, and regulation of cell activities. This course is offered only to Pre-Pharmacy majors.

BIOL 219. The Living Cell. 4 Hours.
PR: (CHEM 115 or CHEM 117) and BIOL 117. Continuation of BIOL 117. Structure, function and diversity of cells with an emphasis on gene expression and cellular phenotype including cell chemistry, energetics, and regulation of cell activities.

BIOL 221. Ecology And Evolution. 3 Hours.

BIOL 235. Human Physiology. 3 Hours.
PR: BIOL 101 and BIOL 102 and BIOL 103 and BIOL 104. (Intended for non-biology majors.) An introductory course in the function of the human.

BIOL 236. Human Phys:Quantitative Lab. 1 Hour.
PR: MATH 156 and CHEM 116 and BIOL 115 and PR or CONC: BIOL 235. Optional lab for BIOL 235 incorporating engineering concepts, such as mass and energy balances, circuit theory, and chemical kinetics to quantify and help understand many aspects of human physiology.

BIOL 293A-Z. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

BIOL 298A-Z. Honors. 1-3 Hours.
PR: Students in the Honors Program and consent by the honors director. Independent reading, study, or research.

BIOL 301. History Of Biology. 3 Hours.
PR: (BIOL 101 and BIOL 103 and BIOL 102 and BIOL 104) or BIOL 115. History of development of biological knowledge with philosophical and social backgrounds.

BIOL 302. Biometry. 3 Hours.
PR: STAT 211. Application of quantitative methods and statistics to biological data with emphasis on hands-on hypothesis construction, experimental design, data analysis and biological interpretation of statistical results.

BIOL 310. Adv Cellular/Molecular Biology. 3 Hours.

BIOL 311. Adv Cellular/Molecular Biol Lab. 2 Hours.
PR or Conc: BIOL 310. Experimental approaches to the study of cellular systems.

BIOL 312. Introduction To Virology. 3 Hours.

BIOL 313. Molecular Basis of Cell Growth. 3 Hours.
PR: BIOL 219. Study of the integration of internal and external influences as they regulate the division, growth, and differentiation of cells. Topics include hormones as cell effectors, cancer, and stem cells.

BIOL 316. Developmental Biology. 3 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219. A molecular genetic analysis of the mechanisms by which multicellular organisms develop from single cells.

BIOL 317. Developmental Biology Lab. 1 Hour.
PR: BIOL 219. CoReq: BIOL 316. Experimental approaches to the genetic analysis of the mechanisms by which multicellular organisms develop from single cells.

BIOL 318. Writing Appalachian Ecology. 3 Hours.
This course encouraged students to think about the long-term future of our planet. What could our world be like in 200 years? How will current environmental problems change the future? How will relationships with the natural world change? Students address questions like these in creative nonfiction essays they write about research being conducted at the Fernow Experimental Forest in WV.

BIOL 321. Total Science Experience Lab. 2 Hours.
PR or Conc: BIOL 221. Biological research experience incorporating diverse learning experiences that take place in the process of being a research scientist; including writing grant proposals, manuscripts, and presentation of results in a public forum.

BIOL 324. Molecular Genetics. 3 Hours.
PR: BIOL 219. Theoretical and practical knowledge in genetics as a field of study and as an approach for investigating biological problems.

BIOL 325. Molecular Genetics Laboratory. 1 Hour.
PR: BIOL 219. CoReq: BIOL 324. The laboratory is a logical sequence of experiments providing actual research experience in molecular genetics. Must be taken at the same time as BIOL 324.

BIOL 327. Professional Development. 1 Hour.
PR: BIOL 219. This course provides an overview of opportunities for students graduating with degrees in the biological sciences. An assessment test will help identify strengths and weaknesses within the field.
BIOL 335. Cell Physiology. 3 Hours.
PR: BIOL 117. Emphasis on the unity and diversity of cells; membrane structure and function; and the role that intracellular compartments, cytoskeleton, and extracellular matrix play in cell physiology.

BIOL 336. Vertebrate Embryology. 4 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219 and BIOL 221. An experimental and descriptive analysis of vertebrate development.

BIOL 337. Physiological Psychology. 3 Hours.
PR: PSYC 301 and junior or senior standing. Advanced study of the physiological mechanisms of behavior. Topics include neural and endocrine mechanisms of behavior and issues, methods, and findings in behavioral neuroscience. (Also listed as PSYC 426.)

BIOL 338. Behavioral Ecology. 3 Hours.
PR: BIOL 221. Consideration of the influences of environmental factors on short-and long-term regulation, control, and evolution of the behavior of animals.

BIOL 339. Animal Communication. 3 Hours.
PR: BIOL 221 or consent. Communication mediates most interactions between individuals and the brain dedicates much of its resources to generating and processing these signals. This course examines why and how animals communicate, the physiological mechanisms involved in generating/ sensing communication signals, how evolution shapes communication, and how communication signals can influence decision making.

BIOL 340. Invertebrate Zoology. 4 Hours.
PR: BIOL 219 and BIOL 221. The evolution of animals without vertebral columns. The laboratory includes field trips, including one that takes an entire weekend. (Dissection kit required.).

BIOL 341. Ichthyology. 4 Hours.
Study of the internal and external structure of fishes, their systematic and ecological relationships, and their distribution in time and space. (Dissection kit required.).

BIOL 348. Neuroscience 1. 3 Hours.
PR: BIOL 219. An introduction to neuroscience, including basic neuroanatomical neuropysiology, and the relationship between the central nervous system, physiology, and behavior.

BIOL 349. Neuroscience 2. 3 Hours.
PR: BIOL 348. An introductory systems level course on organization of the nervous system, from an evolutionary to a clinical perspective. Topics include development and functional organization of sensory, motor, autonomic and cognitive systems. The evolutionary history and human health concerns associated with these systems will be addressed, through lecture, discussion, and readings in the primary literature.

BIOL 350. Plant Physiology. 4 Hours.
PR: CHEM 115 and CHEM 116 and ((BIOL 101 and BIOL 103) or BIOL 117). Physiochemical processes of plants.

BIOL 351. Plant Diversity. 4 Hours.
PR: (BIOL 101 and BIOL 102 and BIOL 103 and BIOL 104) or BIOL 115. Evolution, morphology, life cycles, ecology, and uses of cyanobacteria, lichens, algae, bryophytes, ferns, gymnosperms, and angiosperms. Laboratory emphasizes comparing living specimens with local field trips.

BIOL 352. Plant Anatomy/Development. 4 Hours.
PR: BIOL 117 or PLSC 206. How plants (especially angiosperms) develop, stand up, defend themselves, transport food and water, and reproduce; also evolution and uses of wood and bark. Students observe development from spores, seeds, and cuttings. (Two local field trips.).

BIOL 353. Flora Of West Virginia. 3 Hours.
PR: (BIOL 101 and BIOL 103 and BIOL 102 and BIOL 104) or BIOL 115. Identification of local woody and herbaceous seed plants, with emphasis on common native and introduced species. Conducted primarily through field trips to nearby areas with the use of dichotomous keys to determine the scientific names of observed specimens.

BIOL 361. Plant Ecology. 4 Hours.
PR: BIOL 221. Introduction to the four divisions of plant ecology, including physiological ecology, population ecology, community ecology and ecosystem ecology.

BIOL 362. Limnology. 4 Hours.
PR: (BIOL 101 and BIOL 103) or BIOL 115 or WMAN 224 or consent. Physical, chemical, and biological characteristics of inland waters with emphasis on the structure and function of stream ecosystems. (Also listed as WMAN 446.).

BIOL 363. Plant Geography. 3 Hours.
PR: BIOL 221. World-wide distribution patterns of plants and factors related to these distributions, including dispersal. Limiting factors, climate, isolation, evolutionary history, plate tectonics, pleistocene glaciations, and human activities. Plant communities and soils of polar, temperate, and tropical biomes are discussed.

BIOL 384. Marine EcoSystems Topics. 3 Hours.
Three-week field-based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of six-hours counts toward the biology major.
BIOL 384A. Marine EcoSystems Topics. 3 Hours.
Three-week field-based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of 6 hours counts toward the biology major.

BIOL 384B. Marine EcoSystems Topics. 3 Hours.
Three-week field-based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of 6 hours counts toward the biology major.

BIOL 384C. Marine EcoSystems Topics. 3 Hours.
Three-week field based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of 6 hours counts toward the biology major.

BIOL 386. Undergraduate Research. 1-4 Hours.
PR: Written consent of chair and a 2.7 grade point average in biology. (May be repeated for a maximum of 6 credit hours.) Individual laboratory or field experiments supervised by a faculty member.

BIOL 393A-Z. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

BIOL 410. Cell/Molecular Biology Methods. 3 Hours.
PR: BIOL 219. Introduction to the theory, application, ethic and economics of biotechnologies.

BIOL 411. Intro To Recombinant DNA. 4 Hours.
PR: BIOL 219. An introductory course covering the basic principles and techniques of recombinant DNA technology, includes molecular cloning, isolation of plasmid DNA, agarose/acylamide gel electrophoresis, restriction enzyme mapping, nucleic acid hybridization, and DNA sequencing.

BIOL 413. Molecular Endocrinology. 3 Hours.
PR: BIOL 219. Hormonal action is discussed at the cellular and molecular levels. Topics include hormone production and regulation, receptor kinetics and activation, and receptor output.

BIOL 414. Molecular Endocrinology - Lab. 1 Hour.
CoReq: BIOL 413. Experimental techniques used to study hormones and receptors.

BIOL 415. Epigenetics. 3 Hours.
PR: BIOL 219 or consent. Explore molecular mechanisms, phenotypic phenomena and current application of epigenetics and the study of how genetic information is used and maintained.

BIOL 420. Genomics. 3 Hours.
PR: BIOL 219. Advanced elective examining biology and evolution on a genome-wide scale. Topics include fields of study and methods of DNA sequence acquisition and annotation, including exploration of the human genome and its contribution to disease discovery.

BIOL 424. Protein Structure & Function. 4 Hours.
PR: BIOL 219 and (CHEM 231 or CHEM 233). Explores fundamentals of the protein structure; methods of structure determination; features of globular, membrane, and fibrous proteins; and approaches to protein classification.

BIOL 425. Developmental Genetics. 3 Hours.
PR: BIOL 219. This course covers the mechanisms by which genetics instructs the process of development. The complex interactions between cells, the environment, and the genome are presented.

BIOL 426. Molecular Biology of Cancer. 3 Hours.
PR: BIOL 219. Exploration of molecular pathways leading to the development of cancer with emphasis on gene expression, cell cycle regulation, and signaling pathways targeted in conventional therapies.

BIOL 430. Bioinformatics. 3 Hours.
PR: BIOL 219 or Consent. An introduction to algorithms and tools for analysis of genetic and genomic data in an evolutionary context.

BIOL 432. Forensic Biology. 4 Hours.
PR: BIOL 219. A lecture and laboratory course focusing on the latest advances in forensic identification technologies, including advantages and limitations of different approaches. Students can gain extensive hands-on experience in the isolation, qualification, and analysis of DNA.

BIOL 433. Herpetology. 3 Hours.
Investigation into the biology, ecology, and evolution of reptiles and amphibians, emphasizing North American species especially those found in the state of West Virginia. (One field exercise outside of regular time is required.).

BIOL 436. General Animal Physiology. 3 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 119 and BIOL 221. In-depth, current treatment of physiological principles which operate at various levels of biological organization in animals of diverse taxonomic relationships. Understanding is developed from background lectures and student analyses in discussion sessions of research literature.

BIOL 438. Animal Behavior. 4 Hours.
PR: BIOL 221 and (BIOL 101 and BIOL 102 and BIOL 103 and BIOL 104 or BIOL 115). Introduction to animal behavior (ethology) emphasizing the ecology and evolution of individual and social behaviors. Laboratory includes independent investigation of behavioral phenomena. (Offered in even numbered years.).
BIOL 439. Neuroethology. 3 Hours.
PR: BIOL 348. Explores the way sensory systems process information to mediate behavior in a wide variety of animals in order to understand similarities and differences in neural mechanisms.

BIOL 440. Comparative Anatomy. 4 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219 and BIOL 221 or consent. A functional and evolutionary study of vertebrate structure. (Dissection kit required.)

BIOL 441. Vertebrate Microanatomy. 5 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219 and BIOL 221. Structural and functional approach to the study of tissues and organs of vertebrates.

BIOL 450. Plant Systematics. 4 Hours.
PR: (BIOL 101 and BIOL 103 and BIOL 102 and BIOL 104) or BIOL 117. Study of the taxonomy of flowering plants worldwide and related topics in angiosperm classification and evolution. Laboratories emphasize characteristics of selected families of monocotyledons and dicotyledons using living and herbarium material.

BIOL 451. Plant Development. 4 Hours.
PR: BIOL 221 and (CHEM 235 or AGBI 410). Experimental studies of plant growth and development.

BIOL 453. Molecular Basis of Disease. 3 Hours.
PR: BIOL 219. Examine medical, ethical, and legal/regulatory issues emerging from the Human Genome Project and its applications to personalized medicine.

BIOL 454. Immunology. 3 Hours.
PR: BIOL 219. Explores the fundamental principles and practices of immunology including how the immune system is organized, how it functions to keep us healthy, and how it can cause allergies and autoimmune disease.

BIOL 455. Evolution-Infectious Diseases. 3 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 221. The application of phylogenetics, microbiology, immunology, and epidemiology towards understanding the evolution of infectious diseases. Students will develop a fundamental understanding of the significance of evolution and ecology in infectious disease emergence and control.

BIOL 456. Microbial Symbiosis. 3 Hours.
PR: BIOL 221. An understanding of the significance of microbial symbioses towards ecological and health processes will be developed. Molecular techniques used towards identifying the composition and functions of microbial communities will be discussed.

BIOL 461. Principles of Evolution. 3 Hours.
PR: BIOL 221. Introduction to the study of evolution, including genetics of evolutionary change, speciation and adaptation, molecular evolution, the history of life, extinction, co-evolution, and the origins of humans.

BIOL 463. Global Ecology. 3 Hours.
PR: BIOL 221. The Earth viewed as a changing biogeochemical system. Topics include the structure, composition and dynamics of the ecosphere, nutrient cycles, changing atmospheric composition, climate change, ozone depletion, land-use change, biological invasions, and changes in biodiversity.

BIOL 464. Population/Quantitative Genetics. 3 Hours.
PR: BIOL 221. Relationship of gene and genotype frequencies in populations of diploid organisms and the effects of mutation, selection, and non-random mating in relation to single gene pairs. Application of these concepts to multigenic inheritance of quantitative traits.

BIOL 477. CNS Evolution and Development. 3 Hours.
PR: BIOL 348. Origin and evolution of the central nervous system, focusing on development and genetic mechanisms underlying structural modifications that serve as the basis for the evolution of animal behavior.

BIOL 478. Sensory Neural System/Behavior. 3 Hours.
PR: BIOL 348. This course explores how brains acquire information about the external world and process this information to produce sensory perceptions. Students gain a deep understanding of sensory transduction and neural processing at the cellular, network, and systems levels. Additional class is aimed at enhancing science communication.

BIOL 479. Current Topics-Neuroscience. 3 Hours.
PR: BIOL 348. Fundamental principles of nervous system organization with an emphasis on interactions between neurons and the consequences for behavior. There will be a focus on recent advances in our understanding of each organizational principle.

BIOL 486. Honor Investigation & Thesis. 1-4 Hours.
(May be repeated for credit; max credit 12 hr.) PR: Second semester of junior year, recommendation of advisor, biology majors only. Permission required. Supervised readings, investigation, and study.

BIOL 490. Teaching Practicum. 1-3 Hours.
PR: Consent. (May be repeated for a maximum of 9 credit hours.) Teaching practice as a tutor or assistant.

BIOL 491. Professional Field Experience. 1-18 Hours.
PR: Consent. (May be repeated up to a maximum of 18 hours.) Prearranged experiential learning program, to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development.
BIOL 492A-Z. Directed Study. 1-3 Hours.
Directed study, reading, and/or research.

BIOL 493A-Z. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

BIOL 494A-Z. Seminar. 1-3 Hours.
PR: Consent. Presentation and discussion of topics of mutual concern to students and faculty.

BIOL 495. Independent Study. 1-6 Hours.
Faculty supervised study of topics not available through regular course offerings.

BIOL 496. Senior Thesis. 1-3 Hours.
PR: Consent.

BIOL 497. Research. 1-6 Hours.
Independent research projects.

BIOL 498A-Z. Honors. 1-3 Hours.
PR: Students in Honors Program and consent by the honors director. Independent reading, study or research.