

## BIOLOGY (BIOL)

PROFESSORS I'ANSON, HURD, SIMURDA,  
WIELGUS  
ASSOCIATE PROFESSORS CABE, HAMILTON,  
MARSH  
ASSISTANT PROFESSORS HUMSTON, WATSON  
INSTRUCTOR KRICORIAN

### MAJORS

The department offers a Bachelor of Arts major and a Bachelor of Science major. Students contemplating either of these should, during the first term of their first year, register for MATH 101 and a laboratory science course in the biology or chemistry departments.

A **major in biology** leading to a Bachelor of Science degree consists of 50 credits in science and mathematics, with at least 33 credits in biology. The major must include the following:

- BIOL 111 and 113, 220, 295; MATH 102; PHYS 112 and 114
- One course from BIOL 215\* or 215S\* or CHEM 242
- At least 25 additional biology credits not used to satisfy the above requirements. Must include at least two courses at the 300 level, at least one of which must be a laboratory course (indicated by \*) and at least one course from each of the four categories below. BIOL 401-403 and 422-424 may be used as non-laboratory courses toward any category, depending on the topic and by prior agreement with the instructor and department. No more than six credit hours of work at the 400 level may apply toward the major.
  - Molecules and Cells*: BIOL 215\* or 215S\*, 222\*, 310\*, 320, 321\*, 350, 365, 396
  - Diversity of Life*: BIOL 210, 230\*, 231\*, 235\*, 240\* or 240S\*, 241\*, 242\*
  - Ecology and Evolution*: BIOL 216\*, 243\*, 245\*, 246, 322, 325, 330\*, 332\*, 340 or 340S\*, 398
  - Structure and Function*: BIOL 211S\*, 225\*, 250, 255, 260\* or 260S\*, 265\*, 355\*, 362\*, 395, 397
- Completion of the Major Field Test (MFT) in biology.

Additional courses required as prerequisites for completion of the above include CHEM 111 and 112, and 241 or 241S, MATH 101, and PHYS 111 and 113.

Courses in statistics and computer programming are recommended strongly to all students preparing for graduate or professional school.

A **major in biology** leading to a Bachelor of Arts degree consists of 41 credits in science and mathematics, with at least 27 credits in biology, as follows:

- BIOL 111 and 113, 340 or 340S\*; CHEM 111 and 112
- At least 20 additional biology credits not used to satisfy the above requirements. Must include at

least two laboratory courses (indicated by \*) and at least one course from three of the four categories below. BIOL 401-403 and 422-424 may be used as non-laboratory courses toward any category, depending on the topic and by prior agreement with the instructor and department. No more than six credit hours of work at the 400 level may apply toward the major.

- Molecules and Cells*: BIOL 215\* or 215S\*, 222\*, 310\*, 320, 321\*, 350, 365, 396
  - Diversity of Life*: BIOL 210, 230\*, 231\*, 235\*, 240\* or 240S\*, 241\*, 242\*, 295 (in a relevant topic)
  - Ecology and Evolution*: BIOL 216\*, 243\*, 245\*, 246, 295 (in a relevant topic), 322, 325, 330\*, 332\*, 398
  - Structure and Function*: BIOL 211S\*, 225\*, 250, 255, 260\* or 260S\*, 265\*, 295 (in a relevant topic), 355\*, 362\*, 395, 397
- Three credits in mathematics, and an additional three credits chosen from BIOL 301, INTR 202, or Mathematics
  - Completion of the Major Field Test (MFT) in biology.

*The Marine Science Education Consortium with the Duke University Marine Laboratory.* This program makes it possible for W&L biology majors to spend Fall Term or Winter and Spring Terms at the Duke University Marine Laboratory in Beaufort, N.C. Usually this experience is during the junior or senior year. All credits successfully completed will apply toward the major in biology and the degree from Washington and Lee. See page 89 for more information.

*HONORS: An Honors Program in biology is offered for qualified students; see department head for details.*

### BIOL 101: Environmental Biology (3)

The impact of human activity on biological systems of the Earth. Examination of the environmental consequences of human population growth, including pollution, exploitation of biological resources, global climate change and loss of biodiversity. Open only to non-biology majors. Credit does not apply toward the biology major. (SC, GE5c) Kricorian.

*Spring*

### BIOL 104: Biological Illustration (4)

*Prerequisite: Permission of the instructors.* This course covers the classic illustration techniques of pen and ink, carbon dust, watercolor, and colored pencil. It then moves into the digital corollaries of those techniques using professional-grade hardware and software. Regular field trips are included to practice scientific observation, field sketching, and photography. Ober and Hurd.

*Spring*

### BIOL 105: Introduction to Behavioral Ecology (4)

How do animals experience the world? What are animal social systems like? How do animals choose mates, find places to live, decide when to help others? This course for non-majors focuses on both the mechanisms of animal behavior (genes, hormones,

sensory systems) and the adaptive value of behavior for survival and reproduction in nature. The laboratory includes field experiments and lab observations that test hypotheses using animals such as salamanders, cows, birds, and humans. Credit does not apply toward the biology major. Laboratory course. (SL, GE5a) *Marsh*.

*Fall 2009 and alternate years*

### **BIOL 111: Fundamentals of Biology (3)**

*Corequisite: BIOL 113.* An intensive investigation of scientific thought and communication applied to topics that vary among sections and terms. Specific subjects, chosen from within the scope of modern biological investigation according to the expertise of individual instructors, are examined in the context of major concepts such as evolution, regulation, growth, and metabolism. This course, and its companion laboratory, are prerequisites for all higher level biology courses. (SL, GE5a: BIOL 113 is a corequisite for students seeking laboratory science credits). *Staff*.

*Fall, Winter*

### **BIOL 113: Biology Laboratory (1)**

*Corequisite: BIOL 111.* A laboratory course to accompany BIOL 111. Students are trained in basic techniques of biological research by demonstrations and investigatory exercises, including data analysis and scientific communication. (SL, GE5a: see note above in BIOL 111). *Kricorian*.

*Fall, Winter*

### **BIOL 120 (CHEM 120): Atmospheric Science from the Ground Up (4)**

One of the most complex and important physical systems that scientists must understand is the climate. Predictions regarding climate change and the impact of human activity on that change are made based on our understanding of the complex interactions that drive atmospheric composition and the interaction of the atmosphere with the biosphere and the geosphere. Society asks critical questions—both global and local in reach—regarding the impact of climate change and the drivers behind that change. Answers to these questions may have significant impact on the world economy and choices we make locally, statewide, and nationally. Washington and Lee is located three miles from I-81, a major trucking route for interstate commerce. The atmospheric pollutants generated by the traffic on Interstate 81 have an impact on the atmosphere, watersheds (including Chesapeake Bay), plants, and soils. In this course, field and laboratory exercises include the analysis of atmospheric inputs from I-81 and their impacts on soil and plant concentrations of contaminants. Lectures provide background so that informed hypotheses may be made relating to the influences of highways on local and regional atmospheres and environmental contamination are tested. Credit does not apply toward the biology major. Laboratory course. (SL, GE5a) *Hamilton, Tuchler*.

*Spring 2010 and alternate years*

### **BIOL 210: Human Parasitology (4)**

*Prerequisites: BIOL 111 and 113.* A survey of the phenomenon of animal parasitism, including discussion of the chief distinguishing structures, life cycles, and functions of major pathogenic parasites infecting humans and other animals. *Simurda*.

*Spring*

### **BIOL 211S: Cell Structure and Function at St. Andrews (6)**

*Prerequisites: An average grade of at least 3.0 in BIOL 111 and 113, a 3.000 cumulative GPA, and permission of the Department of Biology.* An examination of the relationship between cell function (physiology) and microscopic structure (histology). This course concentrates on the cellular physiology and histology of humans, since all of our understanding of medical science is based on knowledge of the normal and abnormal structure and function of cells. No more than four credits may be counted toward the major in biology. Taught at the University of St. Andrews in Scotland with final grade assigned by W&L biology faculty. Laboratory course. *Staff*.

*Fall*

### **BIOL 215: Biochemistry of the Cell (4)**

*Prerequisites: BIOL 111 and 113 and CHEM 241 or 241S. Not open to students with credit for CHEM 341 (Biochemistry).* A study of the molecular basis of cell structure and function. Topics include biomolecular structure and chemistry, enzyme kinetics and inhibition, bioenergetics, intermediary metabolism and its regulation, membrane structure and transport, membrane receptors and signal transduction, and the endomembrane system. The laboratory stresses techniques for use in current biochemical research. Laboratory course. *Wielgus*.

*Winter*

### **BIOL 215S: Biochemistry at St. Andrews (6)**

*Prerequisites: CHEM 241 or 241S, an average grade of at least 3.0 in BIOL 111 and 113, a 3.000 cumulative GPA, and permission of the Department of Biology.* This course may not be taken for credit by students who have completed CHEM 341. This course gives a solid background in mainstream biochemistry to students from a variety of backgrounds. The laboratory focuses on a variety of basic techniques and on experimental design. No more than four credits may be counted toward the majors in biology or neuroscience. Taught at the University of St. Andrews in Scotland with final grade assigned by W&L biology faculty. Laboratory course. *Staff*.

*Winter*

### **BIOL 216: Tropical Ecology (4)**

*Prerequisites: BIOL 111 and 113, permission of the instructor, and approval of the International Education Committee.* Course participants visit sites of biological interest in the neotropics. The specific sites vary from year to year, but may include rain forest, high altitude forest, and/or the Galapagos Islands. Students gain firsthand experience with plant and animal communities that have distinctive scientific and historical importance, while learning about ecological and evolutionary processes responsible for patterns of biological diversity in the tropics. No more than five credits may count toward the major in biology. Laboratory course. *Staff*.

*Spring*

### **BIOL 220: Genetics (3)**

*Prerequisites: BIOL 111 and 113.* A study of the three main branches of modern genetics: 1) Mendelian genetics, the study of the transmission of traits from one generation to the next; 2) molecular genetics, a study of the chemical structure of genes and how they operate at

the molecular level; and 3) population genetics, the study of the variation of genes between and within populations. This course is a prerequisite to most 300-level courses in biology. (SL: BIOL 221 is a corequisite for students seeking laboratory science credits) *Cabe*.

*Winter*

#### **BIOL 221: Genetics Laboratory (1)**

*Corequisite: BIOL 220.* Techniques in modern molecular genetics. (SL: see note above in BIOL 220) *Cabe*.

*Winter*

#### **BIOL 222: Animal Development (4)**

*Prerequisites: BIOL 111 and 113.* This course investigates cellular and molecular mechanisms that regulate invertebrate and vertebrate development. Topics include fertilization, cleavage, gastrulation, axis specification, patterning, organogenesis, morphogens, and stem cells. Students examine research strategies used to understand the basic principles underlying development, such as gene function, cell signaling, and signal transduction during embryogenesis. Laboratory sessions focus on experimental manipulations of early invertebrate and vertebrate embryos and emphasize student-designed research projects. Laboratory course. *Watson*.

*Fall 2009 and alternate years*

#### **BIOL 225: Plant Biology (4)**

*Prerequisites: BIOL 111 and 113 or permission of the instructor.* An introduction to the study of plant form and function. Lectures cover plant cell biology, biochemistry, physiology, genetics, and interactions with the environment. The laboratory includes modern plant biology techniques ranging from molecular to organismal. Laboratory course. *Hamilton*.

*Winter*

#### **BIOL 230: Field Biogeography and Species Conservation (4)**

*Prerequisites: BIOL 111 and 113 or permission of the instructor. Corequisite: English 294.* This course emphasizes the patterns of diversity encountered during visits to different regional plant communities where we use professional floristic works to identify vascular plants. In addition, evolutionary and ecological explanations for patterns of distribution and extinction, and the lessons these teach for conservation, are explored. (SL, GE5a) Laboratory course. *Staff*.

*Spring*

#### **BIOL 231: Field Entomology (4)**

*Prerequisites: BIOL 111 and 113 and permission of the instructor. Departmental permission is also required as enrollment is limited.* A study of the diversity, classification and ecology of insects. This course consists primarily of fieldwork in Virginia (first four weeks) and Central America (last two weeks). Students become familiar with the major insect groups, make a synoptic collection, and compare diversity between temperate Virginia and tropical Central America. No other course may be taken concurrently. No more than five credits may be counted toward the major in biology. Laboratory course. (SC, GE5c) *Hurd*.

*Spring 2011*

#### **BIOL 235: Plant Diversity (4)**

*Prerequisites: BIOL 111 and 113.* An examination of the major groups of algae, fungi, bryophytes, and vascular plants of the world. In the laboratory, students will collect and study representatives of these groups from our local environment. Laboratory course. (SC, GE5a) *Staff*.

*Fall*

#### **BIOL 240: Zoology (4)**

*Prerequisites: BIOL 111 and 113.* Form and function of animals with emphasis on evolution and ecology of major invertebrate and vertebrate groups. Laboratory course. (SC, GE5c) *Hurd*.

*Winter*

#### **BIOL 240S: Animal Diversity at St. Andrews (6)**

*Prerequisites: An average grade of at least 3.0 in BIOL 111 and 113, a 3.000 cumulative GPA, and permission of the Department of Biology.* A study of zoology with emphasis on the evolution of diversity through adaptive radiation and strategies for existence among the major animal groups, from simplest to most complex forms. No more than four credits may be counted toward the major in biology. Taught at the University of St. Andrews in Scotland with final grade assigned by W&L biology faculty. Laboratory course. (SC, GE5c) *Staff*.

*Fall*

#### **BIOL 241: Field Ornithology (4)**

*Prerequisites: BIOL 111 and 113.* This course integrates studies of bird biology with field observation and identification of local bird species. Topics covered include anatomy, taxonomy, reproduction, vocalization, migration, ecology, and evolution. Field trips to a variety of areas throughout Virginia emphasize identification skills and basic field research techniques. No other course may be taken concurrently. No more than five credits may be counted toward the major. Laboratory course. *Cabe*.

*Spring 2011 and alternate years*

#### **BIOL 242: Field Biology of Amphibians and Reptiles (4)**

*Prerequisites: BIOL 111 and 113.* The southern Appalachians region has an exceptionally high diversity of amphibians and reptiles. This course focuses on the behavior, ecology, and evolution of these animals through field research projects and trips to a number of habitats in the mountains and piedmont of Virginia. Students also examine current threats to the health of endangered amphibian and reptile populations. No more than five credits may be counted toward the major in biology. Laboratory course. *Marsh*.

*Spring*

#### **BIOL 243: Animal Behavior (4)**

*Prerequisites: BIOL 111 and 113.* An introduction to the scientific study of animal behavior, including exploration of the evolutionary basis of behavior and examination of how animals choose mates, defend territories, find food, and avoid predators. Field and laboratory exercises focus on testing hypotheses through experiments with a variety of animals, including fish, amphibians, birds, and humans. Laboratory course. *Marsh*.

*Fall*

**BIOL 245: Ecology (4)**

*Prerequisites:* BIOL 111 and 113. An introduction to the study of interactions between organisms and their environments. Topics are arranged hierarchically: a) evolution and elementary population genetics; b) population dynamics and regulation; c) interspecific competition, predation, parasitism and symbiosis; d) community structure, energy and material flux in ecosystems. Laboratory is field oriented and investigative. Laboratory course. *Hurd.*

*Fall*

**BIOL 246: Biological Diversity: Patterns and Processes (3)**

*Prerequisites:* BIOL 111 and 113 or permission of the instructors. How are plants and animals distributed on Earth, and how do important biogeographical patterns reflect ecological and evolutionary processes? The answers to these questions are crucial to conservation efforts and to predicting changes in "biodiversity" during a time of unprecedented, rapid global environmental change. (SC, GE5c) *Hurd, Staff.*

*Winter*

**BIOL 250: Vertebrate Endocrinology (3)**

*Prerequisites:* BIOL 111 and 113. A study of the chemoregulatory mechanisms of the vertebrates; emphasis is on biochemical and cellular, as well as physiological aspects of hormone action. *Wielgus.*

*Not offered in 2009-2010*

**BIOL 255: Reproductive Physiology (3)**

*Prerequisites:* BIOL 111 and 113. An examination of sex as a biological phenomenon with consideration of the genetic (chromosomal), embryological, endocrine, and neurological bases of sexual development, differentiation, and identity. *l'Anson.*

*Fall*

**BIOL 260: Anatomy and Physiology (4)**

*Prerequisites:* BIOL 111 and 113. An introduction to the structure, function, and homeostasis of the major organ systems of humans. Laboratory exercises include basic histology, dissection of the cat with comparisons to human anatomy, and physiology of the cardiovascular, respiratory, and urinary systems. Laboratory course. *Wielgus.*

*Fall*

**BIOL 260S: Human Systems Physiology at St. Andrews (6)**

*Prerequisites:* An average grade of at least 3.0 in BIOL 111 and 113, a 3.000 cumulative grade-point average, and permission of the Department of Biology. An introduction to the control and regulation of important physiological processes in humans. Emphasis is placed on how the structure and function of cells, tissues, organs and organ systems are interrelated and how this integration of function is required for human survival. Changes associated with disease are discussed in the context of control systems that no longer operate as intended. No more than four credits may be counted toward the major in biology. Taught at the University of St. Andrews in Scotland with final grade assigned by W&L biology faculty. Laboratory course. *Staff.*

*Winter 2011*

**BIOL 265 (ENGN 265): Integrative Science: Cardiovascular Disease (4)**

*Prerequisite:* BIOL 111 or PHYS 112. This course integrates biology, physics, engineering and mathematical modeling through the study of the cardiovascular system and cardiovascular disease. A variety of cardiovascular disease states are used to reinforce basic mechanical and electrical principles of cardiovascular physiology. Treatments using these physiological and/or engineering principles are also considered, such as cardiovascular drugs and drug delivery systems, heart and blood vessel transplantation, defibrillators and heart monitors, etc. Laboratories provide an opportunity to investigate fluid dynamics, cardiovascular monitoring using physiological transducers, computer heart/vessel modeling software, diagnostic imaging (ultrasound/MRI), etc. Speakers and site visits highlight cardiovascular medicine (clinical and/or veterinary), epidemiology, FDA medical device approval and testing, vascular stent design, etc., to provide a wider relevance to our discussions. Laboratory course. *l'Anson.*

*Offered when interest is expressed and departmental resources permit.*

**BIOL 270S: Comparative Biology at St. Andrews (6)**

*Prerequisites:* An average grade of at least 3.0 in BIOL 111 and 113, a 3.000 cumulative GPA, and permission of the Department of Biology. An examination of the comparative biology of animals and plants, focusing on the problems encountered by organisms in different habitats and with different lifestyles, and of the different structural, physiological and ecological solutions they have evolved. An analysis of fundamental design differences between plants and animals, between organisms of different sizes and biophysical effects of scaling, and between the stresses of aquatic and terrestrial lifestyles. Integration of ecology, physiology and behavior is a major theme. No more than four credits may be counted toward the major in biology. Taught at the University of St. Andrews in Scotland with final grade assigned by W&L biology faculty. Laboratory course. *Staff.*

*Winter*

**BIOL 280: Neural Imaging (4)**

*Prerequisite:* BIOL 113, 220 or permission of the instructor. This course examines how the architecture of specific types of neurons affect the neuron's ability to receive, process, and transmit synaptic information. In particular, we examine how some of the important dendritic differentiation cues can transmit arborization signals to the developing neurons. Topics also include neurogenesis, axonal pathfinding, and synaptogenesis. Students conduct original research in the laboratory and acquire skills with various imaging techniques and analytical tools. *Watson.*

*Spring*

**BIOL 295: Topics in Biology (1)**

*Prerequisites:* BIOL 111 and 113, junior standing or departmental permission. Seminar topics vary with instructor and term. Sample topics include: genetics, molecular genetics, virology, evolutionary biology, history of medicine, biology of aging, ecology, cancer, reproductive strategies, neuroendocrinology, microbiology and immunology. These are in-depth studies of restricted

topics within the broad areas indicated by the titles, involving critical review of literature, discussion and oral and/or written presentation. One such seminar is required of each major pursuing a Bachelor of Science degree, and no more than two may be counted toward the 30 credits in biology required for the major. May be repeated for degree credit with permission and if the topics are different. *Staff.*

*Fall, Winter, Spring*

### **BIOL 301: Statistics for Biology and Medicine (3)**

*Prerequisites: BIOL 111 and 113.* This course examines the principles of statistics and experimental design for biological and medical research. The focus is on the practical and conceptual aspects of statistics, rather than mathematical derivations. Students completing this class will be able to read and understand research papers, to design realistic experiments, and to carry out their own statistical analyses using computer packages. *Marsh.*

*Winter*

### **BIOL 310: Microbiology (4)**

*Prerequisite: BIOL 215 or 220 or CHEM 341.* A broadly based course in the study of microorganisms, specifically: prokaryotic cells, microbial diversity, and the effects of microbes in the world, in society and in the bodies of animals and plants. It concerns the central role of microbiology as a basic biological science that enhances our understanding of the biology of higher organisms. Laboratory course. *Simurda.*

*Winter*

### **BIOL 320: Modern Genetic Analysis (3)**

*Prerequisite: BIOL 220.* An examination of DNA sequence-based information and its uses in molecular biology, medicine, and evolutionary studies. Includes technologies and approaches of sequencing, genome sequencing projects, analysis of sequence data, location of and identification of genes linked to disease, and using data to establish evolutionary histories of genes and species. *Cabe.*

*Fall 2010 and alternate years*

### **BIOL 321: Advanced Genetics Laboratory (3)**

*Prerequisites: BIOL 221 and permission of the instructor.* A research-based practicum on the acquisition and analysis of DNA sequence data. Students pursue lab-based independent projects to gain proficiency in DNA sequencing, and practice analyzing and comparing the DNA sequence data obtained. Laboratory course. *Cabe.*

*Spring*

### **BIOL 322: Conservation Genetics (3)**

*Prerequisite: BIOL 220 or permission of the instructor.* A study of the central issues of population genetics and their application to species preservation and conservation. Topics include genetic surveys of rare or threatened species; population structure and dispersal; inferring population histories from genetic data; phylogenetics of threatened species' groups; hybridization between species; the use of genetic data in captive breeding programs and the prosecution of endangered species legislation; and the use of biotechnologies, such as cloning. *Cabe.*

*Fall 2009 and alternate years*

### **BIOL 325: Ecological Modeling and Conservation Strategies (4)**

*Prerequisites: MATH 101 or higher and BIOL 111 and 113, or permission of the instructor.* This course is an intensive introduction to foundational methods in ecological modeling and their application, with emphasis on the dynamics of exploited or threatened populations and developing strategies for effective conservation. Topics include managing harvested populations, population viability analysis, individual based models, and simulation modeling for systems analyses. *Humston.*

*Spring*

### **BIOL 330: Experimental Botany: Global Climate Change (4)**

*Prerequisite: BIOL 220 or permission of the instructor.* Lectures focus on the major impacts of global climate change (elevated atmospheric carbon dioxide and elevated temperatures) on plant function (photosynthesis and respiration) and plant communities. Additional topics include global carbon budgets, plant carbon sequestration, and agricultural impacts. Participants review the pertinent primary literature and conduct a term-long laboratory research project. Laboratory course. *Hamilton.*

*Fall*

### **BIOL 332: Plant Functional Ecology (4)**

*Prerequisites: BIOL 111 and 113 and 295, a review of pertinent literature in the previous winter term.* The emphasis and location of the study area differs from year to year. Information regarding the specific course topic and field trip schedule is made available in the fall. Through novel research projects in a variety of field settings (e.g., on-campus, Appalachian and Blue Ridge Mountains, The Greater Yellowstone Ecosystem), this field-based laboratory course covers topics which investigate the vital roles that plants play in shaping Earth's ecosystems. Topics focus on the responses of native plants to environmental stresses, such as global climate change (elevated temperature and carbon dioxide and drought), herbivory, and invasive species. Field and laboratory exercises focus on testing hypotheses through experiments using a variety of species from intact plant communities. A review of the pertinent literature is used to develop and conduct a term research project. Laboratory course. *Hamilton.*

*Spring*

### **BIOL 340: Evolution (3)**

*Prerequisites: BIOL 111 and 113 or permission of the instructor.* An examination of the evidence for evolution and the mechanisms by which evolution occurs. *Staff.*

*Winter*

### **BIOL 340S: Evolutionary Biology at St. Andrews (6)**

*Prerequisites: An average grade of at least 3.0 in BIOL 111 and 113, a 3.000 cumulative GPA, and permission of the Department of Biology.* An introduction to the theory and processes of evolution, emphasizing the scientific approach to the study of evolutionary phenomena. Topics include the significance of character variation within and between species, basic evolutionary genetics, speciation, evolution in predator-prey systems, evolution of sex, behavioral systems, and human evolution. No more than four credits may be counted toward the major in biology.

Taught at the University of St. Andrews in Scotland with final grade assigned by W&L biology faculty. Laboratory course. *Staff*.

*Fall*

#### **BIOL 350: Immunology (4)**

*Prerequisites: Senior standing and one course chosen from BIOL 215S, 220, or CHEM 341.* A study of the structural and functional aspects of the immune system from the perspective of cellular and developmental biology; the biochemical and structural properties of antibodies and the possible origins of their diversity; and immunopathology. *Simurda*.

*Fall*

#### **BIOL 355: Microanatomy (4)**

*Prerequisite: BIOL 220.* A study of the normal microscopic structure of the mammalian body with emphasis placed on structural and functional correlations. Laboratory work includes the study of prepared tissue and the preparation of tissues for microscopy. Laboratory course. *l'Anson*.

*Fall*

#### **BIOL 362: Animal Physiology (4)**

*Prerequisite: BIOL 220.* A comparative study of functional processes of animals, primarily vertebrates, and their environmental interactions. Laboratory emphasis is on functional adaptations and the use of physiological instrumentation in measuring functional processes. Laboratory course. *l'Anson*.

*Winter*

#### **BIOL 365: Developmental Biology (3)**

*Prerequisite: BIOL 220.* An examination of the goals, practices, and accomplishments of contemporary developmental biology. Topics include gametogenesis, fertilization, cleavage, gastrulation, organogenesis, genetic control of cell differentiation, transgenic procedures, cloning, embryo manipulation, and stem cells. Lectures, discussions of the developmental literature, and electronic media are utilized. Laboratory sessions focus on experimental manipulations of early invertebrate and vertebrate embryos and emphasize student-designed research projects. *Watson*.

*Winter*

#### **BIOL 395: Selected Topics in Structural and Functional Biology (3)**

*Prerequisites: BIOL 220, junior standing and permission of the instructor.* Topics include physiology, neurobiology, developmental biology and immunology. May be repeated for degree credit with permission and if the topics are different. *Staff*.

*Offered when interest is expressed and departmental resources permit.*

#### **BIOL 396: Selected Topics in Cellular and Molecular Biology (3)**

*Prerequisites: BIOL 220, junior standing and permission of the instructor.* Topics include genetics, virology, cell biology and microbiology. May be repeated for degree credit with permission and if the topics are different. *Staff*.

*Offered when interest is expressed and departmental resources permit.*

#### **BIOL 397: Neuroendocrinology (4)**

*Prerequisites: BIOL 220, junior standing and permission of the instructor.* The study of the interaction between the nervous system and the endocrine system, with special reference to regulation and communication in the mammal. Topics may include neuroendocrine regulation of development, the role of the adrenal axis in stress, metabolic regulation of reproduction, or biological rhythms. May be repeated for degree credit with permission and if the topics are different. *l'Anson*.

*Spring*

#### **BIOL 398: Selected Topics in Ecology and Evolution (3)**

*Prerequisites: BIOL 220, junior standing and permission of the instructor.* Topics include ecology, behavior, evolution, and natural history of selected taxonomic groups. May be repeated for degree credit with permission and if the topics are different. *Staff*.

*Offered when interest is expressed and departmental resources permit.*

#### **BIOL 401, 402, 403: Directed Individual Study (1,2,3)**

*Prerequisite: Permission of the instructor.* Reading in the primary research literature on a selected topic under the direction of a faculty member, by prior mutual agreement and according to departmental guidelines (available from biology faculty). May be repeated for degree credit with permission and if the topics are different. No more than six credit hours of work at the 400 level may apply toward the major. *Staff*.

#### **BIOL 422, 423, 424: Directed Individual Research (2,3,4)**

*Prerequisite: Permission of the instructor.* Each student conducts primary research in partnership with a faculty member, by prior mutual agreement and according to departmental guidelines (available from biology faculty). Consult the department Web page or individual faculty for a description of current research areas. May be repeated for degree credit with permission and if the topics are different. No more than six credit hours of work at the 400 level may apply toward the major. *Staff*.

#### **BIOL 442: Honors Thesis Proposal (2)**

*Prerequisite: Honors candidacy.* Writing a proposal for honors thesis research, including a clear statement of the problem being studied, a literature review, and a feasible, detailed plan for the research. Taken no later than the winter term of the junior year. No more than six credit hours of work at the 400 level may apply toward the major. *Staff*.

#### **BIOL 492, 493, 494, 495, 496: Honors Thesis (2,3,4,5,6)**

*Prerequisites: Honors candidacy and BIOL 442.* Laboratory and/or field research resulting in an honors thesis. A total of six credits is required. No more than six credit hours of work at the 400 level may apply toward the major. *Staff*.