

# Biology (BIO)

The Department of Biology offers a major in Biology that emphasizes the development of scientific skills and competencies necessary for understanding living systems and critical analysis of scientific claims.

In five foundation courses (BIO 150, 212, 214, CHEM 123 and 124 which should be completed in the first four semesters) students are introduced to hypothesis testing, experimental design, data analysis and interpretation while investigating ecology, evolution, genetics, cell biology, and the chemical foundations of life. They will engage with current scientific literature and learn to communicate scientific information in written and oral formats. To enroll in Bio 214, students must have earned a C or better in BIO 212 and have completed CHEM 123. Students select from a diverse array of upper division courses to build upon this foundation. Finally, all majors will take BIO 400, an upper division core course that relies upon and enhances their foundational knowledge and skills as they investigate questions in evolutionary and integrative biology.

Our faculty values a liberal arts education and encourages our majors to pursue other academic interests, including study abroad and biology-linked programs listed below. Graduates will be well prepared to pursue a graduate or professional degree or seek a job in a biology-related field.

Students majoring in Biology are also eligible to complete the Program in Neuroscience or the Emphasis in Computational Science. The program in Neuroscience is an interdisciplinary examination of the nervous system and its regulation of behavior. It is administered by both the departments of Biology and Psychology. Many of the required courses will apply to both fields of study. The Neuroscience (<http://catalog.wofford.edu/archive/2017-2018/courses-programs-departments/neuroscience>) portion of the *Catalog* houses the program requirements. The Emphasis in Computational Science is an interdisciplinary field which applies computer science and mathematics to biology and other natural sciences. For requirements, see the *Catalog* section on Computational Science (<http://catalog.wofford.edu/archive/2017-2018/courses-programs-departments/computer-science>).

Students in the Teacher Education Program who are seeking to complete secondary education licensure requirements to teach biology should refer to the *Teacher Education Handbook* and consult with the chairs of the Departments of Biology and Education to develop a curricular plan that will meet the requirements for both fields of study.

## *Honors Courses and In-Course Honors*

The Department of Biology encourages its students to undertake honors work. For further information, the student is referred to the sections on Honors Courses (<http://catalog.wofford.edu/archive/2017-2018/academics/academic-honors/honors-courses>) and In-Course Honors (<http://catalog.wofford.edu/archive/2017-2018/academics/academic-honors/honors-courses>) in the *Catalog*.

## Chair

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## Requirements for the Major in Biology

|  |   |         |
|--|---|---------|
| BIO 150  | Biological Inquiry (with lab)                           | 4       |
| CHEM 123   | General Chemistry I (with lab) <sup>1</sup>             | 4       |
| CHEM 124   | General Chemistry II (with lab) <sup>1</sup>            | 4       |
| BIO 212  | Introduction to Genetics & Molecular Biology (with lab) | 4       |
| BIO 214  | Introduction to Cellular Biology (with lab)             | 4       |
| BIO 400  | Evolutionary & Integrative Biology                      | 4       |
| Select three four-credit hour Biology (BIO) laboratory courses                     |   | 12      |
| Select three additional Biology (BIO) courses which may include laboratory courses |   | 9 to 12 |
| Total Hours  |   | 45-48   |

Students planning to major in Biology should take BIO 150 Biological Inquiry (with lab), BIO 212 Introduction to Genetics & Molecular Biology (with lab) and BIO 214 Introduction to Cellular Biology (with lab), CHEM 123 General Chemistry I (with lab), and CHEM 124 General Chemistry II (with lab) prior to enrolling in an upper-level (300 or above) course. The CHEM 123-124 sequence should be taken no later than the sophomore year, and students in good standing are encouraged to start the sequence in the Spring of the freshman year. Majors will need a cumulative GPA of 2.00 or greater in the five foundational courses to enroll in upper-level courses. BIO 400 must be taken in the junior or senior year. Majors are also encouraged to take coursework in statistics (MATH 140 Statistics and/or BIO 241 Introduction to Biostatistics) as early as possible.

### **BIO 150. Biological Inquiry (with lab). 4 Hours.**

Students in Biology 150 will advance their knowledge of biology (from the ecosystem level to the molecular level), learn and practice skills essential to biological inquiry, and integrate scientific ways of knowing into their development as liberally educated, engaged citizens. Individually and in teams, students will work with research organisms commonly used in the discipline, read the primary literature, and develop their observational and analytical, and quantitative (especially statistical) skills. Students will also develop oral and written communication skills through informal discussions, oral presentations, and written reports of their experimental work, which will benefit from the peer-review process.

### **BIO 151. Biological Development (with lab). 4 Hours.**

An introduction to the multi-dimensional nature of structure, function, and timing of development and evolution in plants and animals. Building upon skills from BIO 150, Biological Inquiry, students will study the development of model organisms typically used in research. They will continue to develop the observational, analytical, and presentation skills necessary to be active participants in a scientific community. In addition, they will continue their development as liberally educated, engaged citizens.

**Prerequisite:** BIO 150 with a minimum grade of D.

**BIO 212. Introduction to Genetics & Molecular Biology (with lab). 4 Hours.**

Study of heredity and the roles of DNA and other macromolecules in the function of cells and organisms. This course will focus on inheritance at biochemical, organismal, and population levels. The laboratory portion of this course includes classic genetic crosses using model organisms (e.g., fruit flies), molecular techniques to analyze DNA, and bioinformatic analysis of DNA sequences. Lab reports will be used to assess students' understanding of the laboratory exercises.

**Prerequisite:** BIO 150 with a minimum grade of D.

**BIO 214. Introduction to Cellular Biology (with lab). 4 Hours.**

Study of biochemical, metabolic, structural & functional aspects of cells & cellular systems. The lab consists of modules introducing quantitative and qualitative data collection techniques, open-ended research projects to test student-generated hypotheses, and written and/or oral scientific presentations. This course is typically taught only in the spring semesters.

**Prerequisite:** BIO 212 with a minimum grade of C and CHEM 123 with a minimum grade of D.

**BIO 241. Introduction to Biostatistics. 3 Hours.**

General introduction to statistical procedures in the Biological Sciences. Topics include: describing and displaying data, descriptive statistics, sampling distributions, experimental design, hypothesis testing, categorical data analysis, ANOVA, and linear regression analysis. Students will use the statistical software package JMP to analyze data from studies in ecology, evolutionary biology, medicine and genetics.

**Prerequisite:** BIO 212 with a minimum grade of D or ENVS 203 with a minimum grade of D.

**BIO 250. Introduction to Research. 0 to 4 Hours.**

Projects designed to introduce students to research and to critical reading of original research.

**BIO 275. Introduction to Bioinformatics. 3 Hours.**

An introduction to the basic computational methods used to analyze biological data with an emphasis on algorithms used in genomics. Other topics may include methods for storage, retrieval, analysis, and display of biological data.

**Prerequisite:** BIO 212 with a minimum grade of D and COSC 235 with a minimum grade of D.

**BIO 280. Selected Topics in Biology. 1 to 4 Hours.**

Selected topics in Biology at the introductory or intermediate level. Courses with this designation are typically newly designed and are being explored for possible adoption as a regular addition to the curriculum.

**BIO 301. Medical Terminology. 1 Hour.**

This course is designed to fill the requirement of many "allied health" graduate schools for a course in medical terminology. This will be a guided self study. Each week a chapter of the textbook will be assigned, and there will be a 50' quiz at the following class meeting.

**Prerequisite:** BIO 342 with a minimum grade of D.

**BIO 303. Introduction to Public Health. 3 Hours.**

Effective public health systems require the application of biological knowledge to prevent and treat disease and improve the health of communities. In this course students will study the disciplinary foundations of public health and epidemiology. Then, using real examples and cases involving infectious and chronic diseases, students will investigate the biological and social factors that affect the health of human communities from the local to global levels. This course is open to all majors, but students must have junior or senior standing.

**BIO 305. Conservation Biology. 3 Hours.**

This course will provide an introduction to the discipline of conservation biology. Topics covered will include patterns of biodiversity and extinction, threats to biodiversity, biological principles guiding conservation, and strategies for protecting and restoring biodiversity.

**Prerequisite:** BIO 212 with a minimum grade of D or ENVS 203 with a minimum grade of D.

**BIO 310. Seminar in Ecology and Evolutionary Biology. 3 Hours.**

This seminar is designed to refine and extend student fluency (both verbal and written) in evolutionary and ecological topics and techniques through the dissection and discussion of research papers.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 311. Seminar in Genetics and Genomics. 3 Hours.**

Designed to refine and extend student fluency (both verbal and written) in current genetics and genomics topics and techniques through critical reading and analysis of primary research articles.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 313. Plants & Ecosystems. 3 Hours.**

Designed for students interested in plants and the environment. Study of the structure and function of vascular plants, with an emphasis on flowering plants. Also, an introduction to major ecological principles, especially species-species interactions, community ecology, and ecosystem ecology. Special emphasis on how plants benefit humans and on sustainability.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 314. Plant & Ecosystems (with lab). 4 Hours.**

Identical to BIO 313 with a lab component.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 322. Biology of the Vertebrates. 3 Hours.**

This course explores the biology, natural history and diversity of vertebrates, and the evolution of form and function within this group.

**Prerequisite:** BIO 212 with a minimum grade of D or ENVS 203 with a minimum grade of D.

**BIO 323. Biology of the Vertebrates (with lab). 4 Hours.**

Identical to BIO 322 with a lab component that focuses on developing and conducting an original research project centered on vertebrate biology. Over the course of the semester students will gain experience in preparing a primary literature review, producing a grant proposal, learn sound experimental design and data analysis, conduct an original research project, and prepare results for written and oral presentation.

**Prerequisite:** BIO 212 with a minimum grade of D or ENVS 203 with a minimum grade of D.

**BIO 324. Microbiology (with lab). 4 Hours.**

Study of the biology of microorganisms, with emphasis on bacteria and viruses. Laboratory work includes techniques for handling, culturing and identifying bacteria, identification of unknown bacterial species and development of epidemiological models for the spread of infectious diseases.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 331. Developmental Biology. 3 Hours.**

Study of the biological mechanisms driving organismal development, the process by which complex organisms are formed from single cells. Includes a description of early embryonic development from fertilization through formation of the nervous system.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 332. Developmental Biology (with lab). 4 Hours.**

Identical to BIO 331 but has a laboratory component. that focuses on a research project in which students explore the recent literature and practice the laboratory techniques used in this field.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 333. Nutrition. 3 Hours.**

An integrated overview of nutrition to include the physiology of digestion and absorption, basic nutrients and their utilization, vitamins and minerals, additives, healthy diets and lifestyle, cultural and social influences on diet, weight control and life-cycle nutrition.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 342. Human Physiology (with lab). 4 Hours.**

Study of the concepts of physiology with emphasis on negative feedback mechanisms responsible for homeostasis in humans. In lab, physiological phenomena such as nerve conduction velocity, muscle properties, electrocardiograms, pulmonary function tests, and urinalysis are recorded and analyzed from live animals and human subjects. Case studies are also integrated into the laboratory experience.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 344. Mammalian Histology (with lab). 4 Hours.**

Microscopic study of the cellular structure of tissues and organs. In lab, students examine prepared microscope slides while consulting their text-atlas before reviewing digital images of histological material. Learning in this course is greatly enhanced by student-organized group study outside the regularly-schedule class meetings and lab sessions.

**Prerequisite:** BIO 342 with a minimum grade of D.

**BIO 351. Research Methods & Communication, Neurobiology (with lab). 4 Hours.**

Projects designed to engage students in original neurobiological research, in critical reading of published research, and in oral and written communication of research findings leading to possible conference presentation and publication.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 352. Research Methods & Communication, Ecology & Evolution (with lab). 4 Hours.**

Projects designed to engage students in research methods in critical reading of the primary literature, and in oral and written communication of original research in this topic area.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 353. Research Methods & Communication, Organismal Biology (with lab). 4 Hours.**

Projects designed to engage students in research methods, in critical reading of the primary literature, and in oral and written communication of original research in this topic area.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 354. Research Methods & Communication, Genetics & Genomics (with lab). 4 Hours.**

Projects designed to engage students in research methods, in critical reading of the primary literature, and in oral and written communication of original research in this topic area.

**Prerequisite:** BIO 212 with a minimum grade of D and BIO 214 with a minimum grade of D.

**BIO 355. Research Methods & Communications, Cell & Molecular Biology (with lab). 4 Hours.**

Projects designed to engage students in research methods, in critical reading of the primary literature, and in oral and written communication of original research in this topic area.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 360. Current Topics in Biology. 3 Hours.**

An in-depth examination of selected topics, considered from biological, historical, philosophical and sociopolitical perspectives. Possible topics include: human embryonic stem cell research, AIDS, the environment, eugenics and human genetics, human experimentation, teaching evolution, emerging viruses, psychotropic drugs, world population, international public health, and biological warfare.

**Prerequisite:** BIO 212 with a minimum grade of D.

**BIO 365. Analysis & Presentation of Scientific Literature. 1 Hour.**

Students will learn to analyze and interpret scientific research papers, with emphasis on developing and enhancing presentation skills. Specific topics will be chosen each semester by the instructor.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 370. Field Biology (with lab). 4 Hours.**

Introduction to the identification and natural history of arthropods, animals and selected groups of non-vascular "plants." Lecture emphasis is on the identification of specimens using dichotomous keys and other print/web resources. During the laboratory time, students are typically in the field practicing the skills to identify organism by sight recognition.

**Prerequisite:** BIO 212 with a minimum grade of D or ENVS 203 with a minimum grade of D.

**BIO 372. Field Botany (with lab). 4 Hours.**

Introduction to the vascular plants and plant communities of South Carolina, including ecology and natural history, use of dichotomous keys in identification, and field recognition of plants and plant communities.

This course is open to all majors, but students must have junior or senior standing.

**BIO 382. Ecology (with lab). 4 Hours.**

Scientific study of the interactions that determine the distribution and abundance of living organisms. Ecological principles are discussed at the level of the organism, the population, the community, and the ecosystem. Students explore the current research literature in ecology and complete a team-designed research project and a report.

**Prerequisite:** BIO 212 with a minimum grade of D.

**BIO 383. Ecotoxicology. 3 Hours.**

Ecotoxicology examines the effect of environmental contaminants on individuals, populations, communities, and ecosystems. The course also examines how special interests influence toxicological issues facing the nation and world today and in the future.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 385. Marine Biology. 3 Hours.**

The course explores the physical and biological components of marine ecosystems with an emphasis on the diversity of organisms and their ecological adaptations to the sea. The course also examines issues that significantly impact the environmental and ecological stability of ocean communities.

**Prerequisite:** BIO 214 with a minimum grade of D or ENVS 203 with a minimum grade of D.

**BIO 386. Freshwater Biology (with lab). 4 Hours.**

The course explores the physical attributes and biological communities of freshwater ecosystems. It also examines how and why many freshwater systems may be over-exploited and ill-used and the subsequent impact on our water resources. Lab includes travel to explore local/regional streams and lakes.

**Prerequisite:** BIO 214 with a minimum grade of D or ENVS 203 with a minimum grade of D.

**BIO 391. Animal Behavior. 3 Hours.**

Students will explore the diverse science of animal behavior. Students will examine research studies and theories that attempt to answer the ultimate evolutionary causes of animal behavior, which unify the whole field of ethology. This exploration will extend to the internal mechanisms (such as genes and hormones) that influence the expression of behavior as animals respond to complex, environmental stimuli.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 392. Animal Behavior (with lab). 4 Hours.**

Identical to BIO 391 with a lab component in which students will apply the methods of ethology in field and laboratory conditions and conduct an original research project centered on animal behavior.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 399. Evolution. 3 Hours.**

Introduction to the facts and theories of biological evolution. Topics include a historical overview, the evidence for evolution, adaptation and natural selection, the evolution of diversity, the fossil record, extinction, evo-devo, genomics, and evolutionary genetics.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 400. Evolutionary & Integrative Biology. 4 Hours.**

An advanced study of evolutionary biology and an exploration of complex biological questions and 21st century societal issues in biology from an integrative perspective.

**Prerequisite:** BIO 214 with a minimum grade of C.

**BIO 421. Human Genetics Seminar (with lab). 4 Hours.**

The study of genes and their function, concentrating on human genes and genetics. The lab portion will include both bioinformatics, and a student-led seminar which analyzes and presents current scientific literature relating to human genetics.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 423. Immunology. 3 Hours.**

A concise but comprehensive and up-to-date introduction to the mechanisms of immune system function. The course concentrates on the mammalian immune system and includes case studies of immunological disorders.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 424. Immunology (with lab). 4 Hours.**

Identical to BIO 423 with a laboratory component through which students practice the research techniques used in this field.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 433. Cellular Biochemistry. 3 Hours.**

Study of the mechanisms of life on the cellular level. Topics may include cell metabolism, enzyme mechanisms and regulation, cell-cell communication, and errors of metabolism. Special attention will be focused on applications of biochemistry to health and disease.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 436. Molecular Biology & Genomics (with lab). 4 Hours.**

Study of the mechanisms of life on the molecular level, as well as the use of large computer databases of DNA sequence data to study those mechanisms. In the laboratory, students will use modern technologies including PCR and DNA sequencing. The laboratory will also include bioinformatics tools to analyze DNA.

**Prerequisite:** BIO 214 with a minimum grade of D and CHEM 203 with a minimum grade of D.

**BIO 440. Comparative & Human Anatomy (with lab). 4 Hours.**

A system-by-system approach to understanding vertebrate anatomy and evolution. Human anatomy is studied in detail and students explore it compared to cat and the anatomy of representative 'ancestral vertebrates' with a focus on evolutionary and developmental origins of structures'. Laboratory and classroom activities include model construction, extensive dissection, and comparative morphology of extant species. Students also explore current research in this field.

**Prerequisite:** BIO 342 with a minimum grade of D.

**BIO 445. Neurobiology. 3 Hours.**

Study of the structure and function of the nervous system from subcellular to systems levels with emphasis on the experimental foundation of modern principles.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 446. Neurobiology (with lab). 4 Hours.**

Identical to Biology 445 with a laboratory component. The lab includes cellular and physiological studies using fly larvae as a model system, comparative anatomical studies using sheep brain as a model, and student generated hypothesis testing in the areas of sensation and perception, learning, and/or cognition. Students also explore complimentary research in this field, and assessments include written and oral presentations of their work.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 447. Cellular Neurobiology. 3 Hours.**

Study of the structure and function of the nervous system emphasizing the subcellular, electrochemical, and signaling properties of neurons that establish the foundation for functional neural circuits and neuronal plasticity. This course places special emphasis on the experimental foundation of modern principles.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 448. Systems Neurobiology. 3 Hours.**

Study of the structure, function, and anatomical organization of neural circuits comprising the sensory and motor circuits of the nervous system with special emphasis on sensory/ motor integration leading to behavior and cognition. This course places special emphasis on the experimental foundation of modern principles.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 449. Cancer Biology. 3 Hours.**

This course studies the fastest growing and changing field in biology and medicine today: Oncology. We will study the function of cancer cells in depth and learn about the advances in molecular biology, genomics, cell biology and immunology that are revolutionizing the clinical battle against the myriad forms of cancer.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 450. Research. 1 to 4 Hours.**

Original research in an area of student's interest.

**Prerequisite:** BIO 250 with a minimum grade of D.

**BIO 480. Advanced Topics in Biology. 0 to 4 Hours.**

Selected topics in Biology at the advanced level. Courses with this designation are typically newly designed and are being explored for possible adoption as a regular addition to the curriculum.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 491. Case Studies In Human Disease. 3 Hours.**

A survey of all of the broad disease categories: genetic and congenital abnormalities, inflammatory/autoimmune diseases, environmentally linked diseases, forensic pathology, infectious disease, and neoplasia/cancer. Discussion of case studies will be used to reinforce disease concepts.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 493. Case Studies in Public Health. 3 Hours.**

Using a case study format and self-directed learning, students in this course will consider important local, national, and international public health issues. Community and or campus service projects may be incorporated.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 495. Case Studies in Biomedicine. 3 Hours.**

Study of the biology of human disease through patient-oriented problem solving and self-directed learning under the guidance of a mentoring physician. Discussions of readings on medically related topics (e.g., art of diagnosis, impact of technology on medicine, mortality and medicine) and a patient-interview exercise complement the case studies sessions.

**Prerequisite:** BIO 214 with a minimum grade of D.

**BIO 497. Case Studies in Environmental Issues. 3 Hours.**

The course challenges students to consider environmental issues that confront us locally, nationally and globally. A case study format will be used to provide students with a practical approach to environmental problems. This course is open to all majors, but students must have junior or senior standing.

**BIO 500. Honors Course. 3 Hours.**

At the discretion of the faculty, students may undertake a six-hour independent course of study in the senior year in order to broaden their educational experience within their major area of study. Students must meet specific GPA standards and arrange a faculty sponsor. The honors course criteria are outlined in the Academic Honors portion of the catalog.

**Prerequisite:** BIO 214 with a minimum grade of D.