

# BIOLOGY

**Chair: Tammy Weissman-Unni**

**Administrative Coordinator: Rian Brennan**

Biologists examine life on our planet from many different perspectives, from molecules to ecosystems. At Lewis & Clark, students explore the many facets of biological science through a diverse and innovative curriculum that encourages original thinking and provides hands-on experience at all levels of biological inquiry. From their first course, biology majors are immersed in the process of discovery, developing the skills of logical problem-solving and rigorous methodology that characterize modern scientific investigation. Students are not only introduced to facts, but to the theoretical underpinnings that define a particular topic and its relevance in today's world. Thus, graduates leave the program prepared for a variety of careers. Some pursue graduate studies and go on to become researchers, teachers, or health professionals. Others enter careers in law, journalism, education, or business. The concern of many majors for the health of our planet leads to environmental careers in academia or with governmental agencies, businesses, or private foundations.

The faculty in the Department of Biology believe strongly in the value of learning through experience, and most courses include laboratory sections that support students as they develop their own investigations.

Students are encouraged to spend at least one summer gaining research experience, either by working with a Lewis & Clark faculty member or through one of the many available research internship programs at laboratories and field stations throughout the country.

## Special Programs

Biology majors may participate in research programs with biology faculty at Lewis & Clark or with research professionals at other local institutions. These opportunities are available to students who have a strong academic record. Two semester credits may be earned through BIO 244 Practicum if the student works under the close guidance of a faculty member; up to 4 hours per semester may be earned for BIO 499 Independent Study if the student has sufficient familiarity with research to work fairly independently on the design, execution, and interpretation of experiments.

Two interdisciplinary majors are available for students with interests linking biology with other disciplines: biochemistry/molecular biology and environmental studies. For more information, please refer to Biochemistry and Molecular Biology (<https://docs.lclark.edu/undergraduate/biochemmolebio/>) and Environmental Studies (<https://docs.lclark.edu/undergraduate/environmentalstudies/>) in this catalog.

## Resources for Nonmajors

Students majoring in other subjects may enroll in BIO 100 Perspectives in Biology or BIO 115 Explorations in Regional Biology, which have no prerequisites. These courses are designed to meet one of the General Education requirements in natural sciences (<https://docs.lclark.edu/undergraduate/graduationrequirements/generaleducation/#naturalsciencetext>). Nonmajors may also take other biology courses for which they have met the appropriate prerequisites, but priority for enrollment in these courses is given to prospective biology, environmental studies, or biochemistry and molecular biology majors and prehealth professions students.

## Facilities

Biology department resources used by students in classes and independent projects include DIC, fluorescence and time-lapse deconvolution microscopes, a climate-controlled greenhouse, and oxygen and carbon-dioxide gas-exchange analyzers. Molecular biology laboratories are equipped for gene cloning, polymerase chain reaction, tissue culture, and protein-separation activities. A high-performance computer cluster supports bioinformatics applications. Areas near campus such as Tryon Creek State Natural Area ([http://oregonstateparks.org/park\\_144.php](http://oregonstateparks.org/park_144.php)) offer convenient sites for field studies.

## The Major Program

The biology curriculum at Lewis & Clark is built around an introductory sequence of three courses, each of which introduces students to the principles and skills that are fundamental to all of biology. Through topics and examples centered on faculty expertise, students will learn to pose and answer questions about living systems—begin to function as biologists—very early in their college careers. In addition to the core courses in biology, majors are expected to complete at least a year's study of chemistry and a college-level course in calculus, computer science, or statistics because biology draws on the techniques and knowledge from these other scientific disciplines. Students complete the major by choosing, with the help of their faculty advisors, the upper-division courses in biology that best serve their personal interests.

## Major Requirements

A minimum of 40 semester credits in biology (or approved alternatives), plus courses in chemistry and mathematics, distributed as follows:

- BIO 110 Biological Investigations
- BIO 201 Biological Core Concepts: Systems
- BIO 202 Biological Core Concepts: Mechanisms
- CHEM 110 General Chemistry I
- CHEM 120 General Chemistry II
- One of the following:
 

MATH 123	Calculus & Statistics for Modeling the Life Sciences
MATH 131	Calculus I
MATH 132	Calculus II
MATH 255	Statistical Concepts and Methods
CS 171	Computer Science I
- Six additional courses, at least four of which must have a laboratory component, and at least four of which must be taken at Lewis & Clark. CHEM 330 Structural Biochemistry and/or CHEM 335 Metabolic Biochemistry may be used as nonlab biology courses toward meeting this requirement, and CHEM 330 Structural Biochemistry and CHEM 336 Biochemistry Laboratory or CHEM 335 Metabolic Biochemistry and CHEM 336 Biochemistry Laboratory may be used as lab courses. CHEM 220 Organic Chemistry II may also be used as a lab course. The two semesters of senior thesis may be used as one lab course.

Biology majors may be able to substitute one of the following courses after consultation with the advisor and with permission of the biology chair.

MATH 123 Calculus & Statistics for Modeling the Life Sciences

MATH 255 Statistical Concepts and Methods

All Lewis & Clark courses intended to fulfill the requirements for the biology major must be taken for a letter grade with the exception of BIO 395 Biology Seminar, for which up to two credits may be applied to the biology major. Majors are strongly encouraged to take additional courses in chemistry, mathematics, computer science, and physics.

For students who have earned a 5 on the AP Chemistry examination, the CHEM 110 requirement and associated credits will be waived.

## Honors

Biology majors who have distinguished themselves academically by earning a GPA of at least 3.500 in the major are eligible to participate in the honors program. In the spring of their junior year, students work with a faculty advisor to develop a research proposal, which must be approved by the department. Students carry out the experimental work in their senior year, preparing a written thesis and an oral presentation for the faculty during the spring semester. The senior thesis may be used as one of the six upper-division biology courses required for the major. Students who maintain a GPA of at least 3.500 in the major and who complete the program successfully in the judgment of the department faculty receive honors in biology upon graduation.

## Faculty

Greta J. Binford. Professor of biology. Invertebrate zoology, biodiversity, evolution of spider venoms. PhD 2000 University of Arizona. MS 1993 University of Utah. BA 1990 Miami University.

Tracy Burkhard. Assistant professor of biology. Ecology, Animal Behavior. PhD 2021 University of Texas at Austin. BA 2011 University of California at Berkeley.

Lindy Gewin. Instructor in biology, biology laboratory coordinator. PhD, 2004, University of Washington.

Greg J. Hermann. Professor of biology. Developmental Genetics and Cell Biology. PhD 1998 University of Utah. BS 1992 Gonzaga University.

Heidi Liere. Assistant professor of biology. Insect Community Ecology, Urban Ecology and Agroecology. PhD 2011 University of Michigan-Ann Arbor. BS 2001 Universidad del Valle de Guatemala.

Margaret Rowan Metz. Associate professor of biology. Plant Community Ecology, Tropical Ecology, Disease Ecology. PhD 2007 University of California at Davis. AB 1998 Princeton University.

Sharon E. Torigoe. Assistant professor of biology. Molecular Biology, Biochemistry, Gene Expression Regulation. PhD 2013 University of California at San Diego. BA 2007 Scripps College.

Norma Velázquez Ulloa. Associate professor of biology, director of the biochemistry and molecular biology program, co-director of the neuroscience program. Behavioral Genetics, Neuroscience, Developmental Biology, Neurophysiology, Cell Biology. PhD 2009 University of California at San Diego. BS 2002 Universidad Nacional Autónoma de México.

Tammy Weissman. Professor of biology and department chair. Neurobiology. PhD 2004 Columbia University. BA 1992 Pomona College.

## Courses

### BIO 100 Perspectives in Biology

Content: For nonmajors. Selected current topics in biology used to illustrate the strengths and limitations of the process of science and the approaches biologists use to learn about living organisms. Emphasis changes from semester to semester, reflecting the expertise and interests of the faculty member teaching the course. For further information, consult the appropriate faculty member before registration. Lecture and laboratory. May not be applied toward the biology major.

Prerequisites: None.

Corequisites: Take BIO 100L.

Usually offered: Annually, fall and spring semester.

Semester credits: 4.

### BIO 110 Biological Investigations

Content: Introduction to scientific investigation through project-based studies of biological phenomena. Topics in this hands-on course introduce students to experimental design, data collection, data analysis, hypothesis testing, and scientific communication. Topics will vary according to faculty expertise. See department website for specific section details.

Prerequisites: QR 101 or equivalent.

Restrictions: Open to freshmen. Sophomores, juniors and seniors require instructor consent.

Usually offered: Annually, fall and spring semester.

Semester credits: 4.

### BIO 115 Explorations in Regional Biology

Content: For nonmajors. Offered in association with selected overseas programs. Selected biological principles using biomes and species native to the geographical location of the program. Emphasis on ecology and behavior of living organisms. Classroom and considerable field experience. Specific content varies from program to program; details available from Office of Overseas and Off-Campus Programs. Taught on the Australia, East Africa, Ecuador, and New Zealand study programs. May not be applied toward the biology major.

Prerequisites: None.

Restrictions: Acceptance to overseas program required.

Usually offered: Alternate Years, fall and spring semester.

Semester credits: 4.

### BIO 201 Biological Core Concepts: Systems

Content: An introduction to core principles that underlie all of biology, illustrated through evidence-driven examples centered on integrative organismal biology and organisms' interactions with the biotic and physical environment. We will explore the evolution of life, flow of information within and among individuals, the influence of structure on function at scales from individuals to ecosystems, the transformations of energy and matter in space and time, and the dynamic systems that characterize Earth and its inhabitants. Topics will vary according to faculty expertise. See department website for specific section details. Can be taken before or after BIO 202.

Prerequisites: BIO 110.

Restrictions: Open to freshmen and sophomores. Juniors and seniors require instructor consent.

Usually offered: Annually, fall and spring semester.

Semester credits: 4.

**BIO 202 Biological Core Concepts: Mechanisms**

Content: An introduction to core principles that underlie all of biology, illustrated through evidence-driven examples centered on interactions among molecules and cells within organisms. We will explore mechanisms of inheritance and mutation fundamental to the evolution of life, flow of information from DNA through proteins to cellular and organismal function, the relationship between structure and function at scales from molecules to individuals, the transformations of energy and matter through biochemical and physiological pathways, and the dynamic systems within and between cells. Topics will vary according to faculty expertise. See department website for specific section details. Can be taken before or after BIO 201.

Prerequisites: BIO 110. CHEM 120 (may be taken concurrently).

Restrictions: Open to freshmen and sophomores. Juniors and seniors require instructor consent.

Usually offered: Annually, fall and spring semester.

Semester credits: 4.

**BIO 244 Practicum**

Content: Supervised practical experience in lab and/or field techniques at Lewis & Clark or another Portland-area institution. Consult department faculty for further information. Credit-no credit. May be repeated for credit.

Prerequisites: None.

Restrictions: Sophomore standing and consent required.

Usually offered: Annually, fall and spring semester.

Semester credits: 2.

**BIO 252 Introduction to Neuroscience**

Content: Study of the biological basis of behavior. Gross anatomy of the brain, structure and function of neurons, synaptic transmission.

Exploration of learning and memory, vision, neurological and psychiatric diseases, addiction, and reproductive behavior. Cross-listed with PSY 252. Students may not receive credit for both BIO/PSY 252 and PSY 280.

Prerequisites: BIO 110 and PSY 100.

Restrictions: Sophomore standing required.

Usually offered: Annually, fall and spring semester.

Semester credits: 4.

**BIO 311 Molecular Biology**

Content: Advanced study of the structure, function, and expression of genes. Detailed analysis of the regulation of gene expression in prokaryotic and eukaryotic organisms, with an emphasis on how molecular mechanisms contribute to a variety of biological phenomena, such as cellular differentiation, metabolism, and homeostasis.

Discussions of primary literature, with a focus on experimental design and data analysis.

Prerequisites: BIO 110. BIO 202. CHEM 120. MATH 123, 131, 255 or CS 171. CHEM 220 recommended.

Restrictions: Sophomore standing required.

Usually offered: Annually, fall semester.

Semester credits: 4.

**BIO 312 Molecular Biology Lab**

Content: Introduction to molecular cloning techniques, including the polymerase chain reaction, plasmid construction, transformation, and DNA sequence analysis. Students carry out a semester-long project using these techniques to construct an expression vector that is used to answer student-generated questions.

Prerequisites: BIO 311.

Restrictions: Sophomore standing required.

Usually offered: Annually, fall semester.

Semester credits: 2.

**BIO 317 Invertebrate Zoology**

Content: The diversity of invertebrates, with emphasis on the arthropods. Introduction to their structure, development, behavior, natural history, and evolutionary relationships. Lecture, discussion, laboratory, field trips.

Prerequisites: BIO 110, BIO 201, and BIO 202. MATH 123, MATH 131, MATH 255, or CS 171.

Restrictions: Sophomore standing required.

Usually offered: Alternate Years, fall semester.

Semester credits: 5.

**BIO 320 Human Genes and Disease**

Content: The molecular and cellular basis of various genetic diseases, the role of genes in disease, how mutations arise, and approaches to therapy. Ethical issues surrounding gene therapy and DNA diagnostics. Lectures, discussion of papers from the primary literature, and seminars by visiting scientists. Students develop and present an oral seminar on a disease of their choice.

Prerequisites: BIO 110. BIO 202. MATH 123, MATH 131, MATH 255, or CS 171.

Restrictions: Sophomore standing required.

Usually offered: Alternate Years, spring semester.

Semester credits: 4.

**BIO 323 Plant Biology**

Content: Key concepts of plant biology, including morphology, physiology, adaptations to life on land, and ecological interactions with other organisms. Emphasis on the roles of plants in ecosystems and human lives. Key characteristics of major plant lineages in the context of how plants have become such a diverse and successful group of organisms. Students conduct independent research projects on various aspects of plant biology. Laboratory.

Prerequisites: BIO 110, BIO 201, and BIO 202. CHEM 120. MATH 123, 131, 255, or CS 171.

Restrictions: Sophomore standing required.

Usually offered: Annually, spring semester.

Semester credits: 5.

**BIO 325 Vertebrate Diversity**

Content: The study of vertebrate diversity. Ecological and evolutionary processes that distinguish, promote, and maintain patterns of form, function, and behavior of fish, amphibians, reptiles, birds, and mammals. Lecture, discussion, laboratory; field trips to explore local patterns of diversity in natural settings. May be taught as part of the East Africa biology-focused overseas program.

Prerequisites: BIO 110, BIO 201, and BIO 202. MATH 115 (or equivalent) or CS 171.

Restrictions: Sophomore standing required.

Usually offered: Every third year, fall semester.

Semester credits: 5.

**BIO 335 Ecology**

Content: Interactions between organisms and their physical and biological environment. Ecology of populations, communities, and ecosystems, theoretical and empirical approaches. Through reading original literature and designing their own studies, students learn to conduct ecological studies and interpret results. Applications of ecological principles to conservation issues and other environmental problems. Lecture and laboratory; weekend field trip.

Prerequisites: BIO 110, BIO 201, and BIO 202. MATH 123, MATH 131, MATH 255, or CS 171.

Restrictions: Sophomore standing required.

Usually offered: Annually, fall and spring semester.

Semester credits: 5.

**BIO 352 Animal Behavior**

Content: Animal behavior, from insects to marine mammals. How and why animals behave as they do. Focus on the adaptiveness of animal behavior using a strong ecological and evolutionary theme. Methods and results associated with animal behavior studies. Lecture, readings in original literature, laboratory, field trips.

Prerequisites: BIO 110, BIO 201, BIO 202. MATH 123, MATH 131, MATH 255, or CS 171. CHEM 120.

Restrictions: Sophomore standing required.

Usually offered: Annually, spring semester.

Semester credits: 5.

**BIO 361 Cell Biology**

Content: Application of the techniques of biochemistry, microscopy, genetics, and molecular biology to the study of cell structure, function, and physiology. Membrane structure and function; signal transduction; protein and organelle traffic within cells; cell growth, division, and death. Lecture and laboratory.

Prerequisites: BIO 110, BIO 202, CHEM 120. MATH 123, MATH 131, MATH 255, or CS 171.

Restrictions: Sophomore standing required.

Usually offered: Annually, fall and spring semester.

Semester credits: 5.

**BIO 369 Developmental Biology**

Content: Multidisciplinary study of the process by which multicellular organisms develop from a single fertilized egg. Fertilization, cleavage, gastrulation, early morphogenesis, and organogenesis studied with an emphasis on the genetic, molecular, and evolutionary mechanisms underlying development. Discussion of current research literature illustrating the questions, experimental approaches, and new insights in the study of organismal development. Lecture and laboratory. Laboratory focuses on genetic control of development in the nematode *C. elegans*.

Prerequisites: BIO 110, BIO 202, CHEM 120. MATH 123, MATH 131, MATH 255 or CS 171.

Restrictions: Sophomore standing required.

Usually offered: Every third year, spring semester.

Semester credits: 5.

**BIO 370 Disease Ecology**

Content: The ecology and evolution of disease in human, plant, and animal systems. Topics will include causes of disease emergence, host-pathogen interactions and co-evolution, interactions between disease and community diversity, and anthropogenic effects on disease, among others. We will use case studies, mathematical theory, and examples from the primary literature to understand the causes and consequences of host-pathogen interactions for populations, communities, and ecosystems. Intended for biology, biochemistry and molecular biology, and environmental studies majors.

Prerequisites: BIO 110, BIO 201, BIO 202. CHEM 120. MATH 123, 131, or 255.

Restrictions: Sophomore standing required.

Usually offered: Alternate Years, fall semester.

Semester credits: 4.

**BIO 375 Physiology**

Content: Study of how complex living systems work. Mechanisms underlying metabolism, neural function, muscle, respiration, cardiovascular systems, acid-base balance, renal function, osmoregulation, and response to exercise. Focus on animal physiology, general physiological principles and responses to system perturbations. Emphasis on recent experimental discoveries and unanswered questions. Intended for biology and biochemistry majors. Lecture and laboratory.

Prerequisites: BIO 110, BIO 202. MATH 123, 131, CS 171, or PHYS 141 recommended.

Restrictions: Sophomore standing required.

Usually offered: Annually, fall semester.

Semester credits: 5.

**BIO 377 Physiological Ecology of New Zealand Flora & Fauna**

Content: Study of mechanistic interactions between physiology and the physical environment (e.g., temperature, humidity, oxygen tension). The unique evolutionary history of New Zealand (NZ) species adds a phylogenetic constraint to the study of physiological adaptation. Global climate change, habitat loss, and invasion by introduced species bring relevance to the study of how NZ animals and plants interact with their environment, and how their evolutionary history has constrained them to adapt in particular (and peculiar) ways.

Prerequisites: BIO 110, 201, and 202. MATH 123, 131, or 255, or CS 171.

Usually offered: Every fourth year, spring semester.

Semester credits: 4.

**BIO 380 Behavioral Genetics**

Content: Study of the genetic control of behavior. Familiarization with strategies and techniques used by researchers in this field from information derived from different animal model systems, including humans. Exploration of genetic contribution to social behavior, drug addiction, circadian rhythms, learning and memory, and others. Lecture and lab.

Prerequisites: BIO 110, BIO 202, and CHEM 120. MATH 123, 131, 255, or CS 171. BIO 252, 311, 320, or 361 recommended.

Restrictions: Sophomore standing required.

Usually offered: Alternate Years, fall and spring semester.

Semester credits: 5.

**BIO 390 Evolution**

Content: Study of the mechanisms responsible for evolutionary change and of their results. History of evolutionary thought, evolution of single-gene and quantitative genetic traits, speciation, and molecular evolution. Role of evolutionary ideas in issues such as species conservation, medicine, science-religion conflicts. Lecture only.

Prerequisites: BIO 110, BIO 201, and BIO 202. MATH 123, MATH 131, MATH 255, or CS 171. CHEM 120.

Restrictions: Sophomore standing required.

Usually offered: Annually, fall and spring semester.

Semester credits: 4.

**BIO 391 Special Topics in Biology in Australia**

Content: Advanced study of current issues in biology centered in Australia, as determined by faculty interest. This course will be taught as part of the Australia Biology Focus overseas program.

Prerequisites: BIO 110, BIO 201, BIO 202. MATH 123, MATH 131, MATH 255, or CS 171.

Restrictions: Acceptance to Australia Biology Focus overseas program required.

Usually offered: Every third year, spring semester.

Semester credits: 4.



**BIO 393 Biogeography of Australia**

Content: Field-centered study of patterns of species diversity in the context of their geological and evolutionary history. The focus will include terrestrial and marine organisms spanning many regions on the Australian continent and Tasmania. Experts on geological history, ecological regions, and particularly interesting lineages will guest lecture.

Prerequisites: BIO 110, BIO 201, and BIO 202. MATH 123, MATH 131, MATH 255, or CS 171.

Restrictions: Acceptance to Australia biology focus overseas program required.

Usually offered: Every third year, spring semester.

Semester credits: 5.

**BIO 395 Biology Seminar**

Content: Selected topics in biology. Students will have the opportunity to hear research seminars from outside scientists. Students enrolled in the course will develop and present a research seminar of their own. All students taking this course for credit will be required to attend all seminar presentations, both by outside speakers and by their peers, and to participate in the question-and-answer session after the seminar.

Prerequisites: None.

Restrictions: Junior standing required.

Usually offered: Annually, fall semester.

Semester credits: 1.

**BIO 407 Venom Biology**

Content: Integrative analyses of venom as a phenotype. Focus includes the behavioral role of venom, methods of collecting and vouchering venomous animals, molecular and biochemical analyses of venom components, assays of bioactivity, evolutionary analysis of venom toxins, and clinical consequences of envenomation. Students will discuss primary literature and give an oral presentation on a topic of their choice.

Prerequisites: BIO 110, BIO 201, BIO 202; MATH 123, 131, 255, or CS 171.

Restrictions: Junior standing required.

Usually offered: Every third year, fall and spring semester.

Semester credits: 4.

**BIO 408 Phylogenetic Biology and Molecular Evolution**

Content: Advanced study of theory and methods of reconstructing hypotheses of evolutionary history. Modern phylogenetics relies heavily on models of molecular evolution, thus the course includes a foundation of molecular evolutionary theory. We discuss applications of phylogenies including analyses of gene family evolution, the emergence of infectious disease, biogeography, and coevolution. The lab centers on computational analyses.

Prerequisites: BIO 110, BIO 201, and BIO 202. MATH 123, MATH 131, MATH 255, or CS 171. BIO 390 is recommended.

Restrictions: Junior standing required.

Usually offered: Alternate Years, fall and spring semester.

Semester credits: 5.

**BIO 410 Biogeography and Evolution in New Zealand**

Content: Exploration of the model of continental drift, which provides a mechanism of vicariance, a process that divides the range of a species by imposing a barrier to dispersal. Course will cover global and local (within New Zealand) patterns and processes of geographic distribution of animals and plants.

Prerequisites: BIO 110, 201, and 202.

Usually offered: Every fourth year, spring semester.

Semester credits: 5.

**BIO 411 Chromosome Structure and Dynamics**

Content: Advanced study of how genomes are packaged into the nucleus of eukaryotes and the functions of those structures on cellular activities. Lectures and discussions of papers from the primary literature. Students develop and write a scientific grant proposal on a chosen area of chromatin research.

Prerequisites: BIO 311, BIO 320, BIO 361, BIO 369, BIO 380, BIO 422 or CHEM 330.

Restrictions: Sophomore standing required.

Usually offered: Alternate Years.

Semester credits: 4.

**BIO 422 Neurobiology**

Content: The biology of the nervous system, with emphasis on cellular and molecular approaches. Electrical signaling in excitable cells, the physiology and biochemistry of synaptic transmission, neuropharmacology. The biological bases of learning, memory, and some neurological disorders. Sensory systems and neuronal development.

Laboratory focus on student-designed projects. Lecture and laboratory.

Prerequisites: BIO 110. BIO 202 or BIO 361. MATH 123, MATH 131, MATH 255 or CS 171.

Restrictions: Junior standing required.

Usually offered: Alternate Years, fall and spring semester.

Semester credits: 5.

**BIO 437 Topics in Conservation Biology**

Content: This advanced course will examine important topics in the scientific practice of conservation biology that build on fundamental genetic, evolutionary, and ecological principles. Topics will include the effects of climate change, land-use change, and invasive species on ecological communities and population viability; biodiversity generation, extinction, and valuation; conservation genetics and evolvability.

Students will develop a deep understanding of the current state of research and practice in conservation biology through the use of primary scientific literature, case studies, and quantitative analyses.

Prerequisites: BIO 110, 201, and 202. CHEM 120. MATH 123, 131, 255, or CS 171; BIO 335 and 390 recommended.

Restrictions: Junior standing required.

Usually offered: Alternate Years, spring semester.

Semester credits: 4.

**BIO 490 Special Topics in Biology**

Content: Advanced study of current issues in biology, as determined by student and/or faculty interest. May extend existing areas of the curriculum or explore new subjects. Offering contingent on student interest and faculty availability.

Prerequisites: BIO 110, BIO 201, and BIO 202, and other courses determined by the instructor.

Restrictions: Sophomore standing required.

Usually offered: Alternate Years, fall and spring semester.

Semester credits: 4.

**BIO 491 Special Topics in Biology with Lab**

Content: Advanced study of current issues in biology, as determined by student and/or faculty interest. May extend existing areas of the curriculum or explore new subjects. Offering contingent on student interest and faculty availability. Lab component.

Prerequisites: BIO 110, BIO 201, and BIO 202. Other courses determined by the instructor.

Restrictions: Sophomore standing required.

Usually offered: Alternate Years.

Semester credits: 5.

**BIO 495 Biology Senior Thesis**

Content: Yearlong field or laboratory research project designed and executed by a student with guidance from two faculty mentors. A deferred grade will be issued for the first semester of the yearlong series. When the full sequence is completed, the given grade applies to both semesters.

Prerequisites: None.

Restrictions: Senior standing required. GPA of 3.500 in major and overall. Approval of research proposal by department and two supervising faculty members.

Usually offered: Annually, fall and spring semester.

Semester credits: 3.

**BIO 499 Independent Study**

Content: Participation in a faculty-supervised research or individual study project at Lewis Clark or another research institution. Requires approval of research proposal and a written report. Further information available on biology department website. May be repeated for credit.

Prerequisites: None.

Restrictions: Sophomore standing and consent required.

Usually offered: Annually, fall and spring semester.

Semester credits: 2-4.