

Prerequisite and/or restriction: Biology 311. Chemistry 330. Chemistry 335 (may be taken concurrently).

Taught: Annually, 1 semester credit.

BCMB 496 BIOCHEMISTRY/MOLECULAR BIOLOGY SENIOR RESEARCH

Staff

Content: In-depth laboratory inquiry into a question relevant to biochemistry/molecular biology. Students develop a thesis proposal in association with a faculty mentor, conduct extensive experimental work to address their hypothesis, and present their analysis of their findings in a written thesis.

Prerequisite and/or restriction: By invitation only.

Taught: Annually, 4 semester credits each semester of the senior year.

BCMB 499 INDEPENDENT STUDY

Staff

Content: Participation in a faculty-supervised research project at Lewis & Clark or another research institution. Further information available from biochemistry/molecular biology program faculty members.

Prerequisite and/or restriction: Approval of project proposal by program and supervising faculty member.

Taught: Each semester, 2-4 semester credits.

Biology

CHAIR: KELLAR AUTUMN

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 them 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.

THE MAJOR PROGRAM

The biology curriculum at Lewis & Clark is built around a core of three investigative courses, each of which offers an opportunity for students to learn in depth about one important way in which biologists study living organisms. These three courses focus on ecology and environmental science, genetics and evolutionary biology, and cellular and molecular biology. By delving in depth into particular subdisciplines of biology, students can 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 43 semester credits in biology, plus courses in chemistry and mathematics, distributed as follows:

- Departmental core courses: 141, 151, and 200.
- Chemistry 110 and 120.
- Mathematics 131 or 255, or Computer Science 171.
- Six additional courses, at least four of which must have a laboratory component, at least four of which must be at the 300 or 400 level, and at least four of which must be taken at Lewis & Clark. Chemistry 330 and/or 335 may be used as nonlab biology courses toward meeting this requirement, and Chemistry 330 and 336 or Chemistry 335 and 336 may be used as lab courses. The two semesters of senior thesis may be used as one lab course, but only if no more than one semester of biochemistry is also being used.

Majors are strongly encouraged to take additional courses in chemistry, mathematics and computer science, and physics.

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 as a practicum (Biology 244) if the student works under the close guidance of a faculty member; up to 4 hours per semester may be earned for independent study (Biology 499) if the student has sufficient familiarity with research to work fairly independently on the design, execution, and interpretation of experiments.

For students with interests linking biology with other disciplines, two interdisciplinary majors are available: in biochemistry/molecular biology and in environmental studies. Both programs are described elsewhere in this catalog.

HONORS

Biology majors who have distinguished themselves academically by earning a GPA of at least 3.500 in the major and overall 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 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 and who complete the program successfully in the judgment of the department faculty receive honors in biology on graduation.

RESOURCES FOR NONMAJORS

Students majoring in other subjects may enroll in Biology 100, 107, or 115, which have no prerequisites, or Biology 114. These courses are designed to meet one of the General Education requirements in scientific and quantitative reasoning. 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 pre-health 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. Areas near campus such as Tryon Creek State Natural Area offer convenient sites for field studies.

FACULTY AND STAFF

Kellar Autumn, professor. Physiology, biomechanics, evolution of animal locomotion.

Paulette F. Bierzychudek, William Swindells Sr. Professor of Natural Sciences. Evolution, ecology, conservation biology, especially of plants and insects.

Greta J. Binford, associate professor. Invertebrate zoology, biodiversity, evolution of spider venoms.

Kenneth E. Clifton, associate professor. Animal behavior, marine biology, ecology of coral reefs.

Greg J. Hermann, associate professor. Developmental genetics and cell biology.

Peter Gault Kennedy, assistant professor. Relationships of plants and fungi.

Deborah E. Lycan, professor. Molecular biology, cell biology, ribosome biogenesis in eukaryotic cells, yeast genetics.

Wendy McLennan, instructor and laboratory coordinator.

C. Gary Reiness, professor. Cell biology, neurobiology, development of the vertebrate nervous system.

BIO 100 PERSPECTIVES IN BIOLOGY

Staff

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.

Prerequisite and/or restriction: None.

Taught: Each semester, 4 semester credits.

BIO 107 FIELD PALEONTOLOGY OF OREGON

Staff

Content: Survey of fossil forms of organisms with emphasis on animals and evaluation of the diversity of known taxa. Introduction to field paleontological methods and procedures with a focus on the study of the local fauna over geologic time. Lecture, laboratory, and field trips (including required weekend field trips). Lecture, discussion, laboratory. May not be applied toward the biology major.

Prerequisite and/or restriction: None.

Taught: Summer, 4 semester credits.

BIO 114 THE ORIGINS OF LIFE IN THE UNIVERSE

Clifton, Loening, Safran, Tufte

Content: Processes of stellar evolution and planet formation that set the stage for life on Earth. Theories and evidence from diverse scientific disciplines on the origins of life and how physical and chemical aspects of the environment contributed to the emergence and transformations of life-forms. Scientific evaluation of the possibility of extraterrestrial life. Attention is devoted both to the processes and content of scientific discovery. Lecture, discussion, laboratory. Cross-listed with Chemistry 114, Geology 114, and Physics 114. May not be applied toward the biology major.

Prerequisite and/or restriction: Mathematics 055 or equivalent.

Taught: Alternate years, 4 semester credits.

BIO 115 EXPLORATIONS IN REGIONAL BIOLOGY

Staff

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. May not be applied toward the biology major.

Prerequisite and/or restriction: None.

Taught: On Australia and Kenya study programs, 4 semester credits.

BIO 141 INVESTIGATIONS IN ECOLOGY AND ENVIRONMENTAL SCIENCE

Bierzchudek, Clifton, Kennedy

Content: An introduction to principles underlying the distribution and abundance of species. Examination of how these principles can inform understanding of issues like overpopulation, climate change, invasive species, pollution, species extinction. Introduction to the methods of scientific investigation through laboratory and field studies that describe ecological phenomena and test hypotheses. Lecture and laboratory.

Note: This course is part of the biology department's core curriculum and is intended for biology majors, potential biology majors, and environmental studies majors. The curriculum is challenging and requires a significant time commitment. Therefore, nonmajors are encouraged to fulfill their general education requirements by enrolling in one of the perspectives courses in the natural sciences.

Prerequisite and/or restriction: Mathematics 055.

Taught: Annually, 5 semester credits.

BIO 151 INVESTIGATIONS IN GENETICS AND EVOLUTIONARY BIOLOGY

Autumn, Binford, Reiness

Content: For majors. Introduction to the fundamental principles of Mendelian genetics, population genetics, and evolution. Principles of genetic analysis in eukaryotes, including introduction to gene function, mutations, and the origin of variability in populations. Overview of evolutionary processes. Laboratory focus on genetic projects. Lecture and laboratory.

Prerequisite and/or restriction: Mathematics 055.

Taught: Annually, 5 semester credits.

BIO 200 INVESTIGATIONS IN CELL AND MOLECULAR BIOLOGY

Hermann, Lycan

Content: Introduction to the biochemistry and molecular biology of cells. Structure and function of biomolecules. Introduction to metabolism and photosynthesis in the context of the cell structures in which these processes occur.

Introduction to gene expression and protein localization in the context of genetically modified foods and HIV infection. Project-based laboratories on enzyme kinetics, molecular cloning, and cell structure introduce students to experimental design and data analysis in these areas.

Prerequisite and/or restriction: Biology 151 (may be taken concurrently). Chemistry 110.

Taught: Annually, 5 semester credits.

BIO 211 LAND VERTEBRATES

Clifton

Content: Terrestrial vertebrate diversity. Ecological and evolutionary processes that promote and maintain patterns of form, function, and behavior of birds, mammals, reptiles, and amphibians. Lecture, discussion, laboratory; field trips to explore local patterns of diversity in natural settings.

Prerequisite and/or restriction: Biology 141 and 151. Mathematics 115 or equivalent.

Taught: Alternate years, 5 semester credits.

BIO 212 INVERTEBRATE ZOOLOGY

Binford

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.

Prerequisite and/or restriction: Biology 141 and 151.

Taught: Alternate years, 5 semester credits.

BIO 221 MARINE BIOLOGY

Clifton

Content: Physical, chemical, and biological processes that promote and maintain marine biodiversity. Ecological and evolutionary mechanisms at work within marine environments, with emphasis on natural selection processes that produce specific physiological adaptations, body types, and behavioral strategies. Lecture, discussion, laboratory; field trips to coastal habitats.

Prerequisite and/or restriction: Biology 141 and 151. Mathematics 115 or equivalent.

Taught: Alternate years, 5 semester credits.

BIO 223 PLANT BIOLOGY

Kennedy

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; two weekend field trips.

Prerequisite and/or restriction: Biology 141 and 151.

Taught: Annually, 5 semester credits.

BIO 244 PRACTICUM

Staff

Content: Supervised practical experience in lab and/or field techniques at Lewis & Clark or another Portland-area institution. Consult department faculty for further information.

Prerequisite and/or restriction: Consent of supervising faculty member.

Taught: Annually, 2 semester credits, credit-no credit.

BIO 252 INTRODUCTION TO NEUROSCIENCE

Reiness, Watson, Zhang

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. Students may not receive credit for both Biology 252 and Psychology 280.

Prerequisite and/or restriction: Biology 151 and Psychology 100, or one of these and permission of instructor.

Taught: Annually, 4 semester credits.

BIO 311 MOLECULAR BIOLOGY

Lycan

Content: Advanced study of the structure and function of genes. Detailed analysis of the regulation of gene expression in prokaryotic and eukaryotic organisms, with emphasis on the molecular mechanisms underlying such biological problems as iron homeostasis, HIV infection, and sex determination. Discussions of original research papers focus on experimental design and data analysis.

Prerequisite and/or restriction: Biology 151. Biology 200 or consent of instructor. Chemistry 120. Concurrent enrollment in Biology 312.

Taught: Annually, 4 semester credits.

BIO 312 MOLECULAR BIOLOGY LAB

Lycan

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.

Prerequisite and/or restriction: Biology 151. Biology 200 or consent of instructor. Chemistry 120. Concurrent enrollment in Biology 311.

Taught: Annually, 2 semester credits.

BIO 320 HUMAN GENES AND DISEASE

Lycan

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.

Prerequisite and/or restriction: Biology 151, 200, or consent of instructor.

Taught: Alternate years, 4 semester credits.

BIO 335 ECOLOGY

Bierzchudek

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.

Prerequisite and/or restriction: Biology 141, 151, and 200. Mathematics 131, Mathematics 255, or Computer Science 171. Chemistry 120.

Taught: Annually, 5 semester credits.

BIO 337 ENVIRONMENTAL PHYSIOLOGY

Autumn

Content: How major environmental parameters such as respiratory gases, pressure, temperature, and radiation have influenced short-term (acclimatization) and long-term (evolutionary) alterations in the physiology of animals.

Lecture only.

Prerequisite and/or restriction: Biology 141, 151, and 200. Chemistry 120.

Taught: Alternate years, 4 semester credits.

BIO 338 ENVIRONMENTAL PHYSIOLOGY LAB

Autumn

Content: Introduction to experimental methods in environmental physiology and the scientific process. Students work on open-ended experiments using modern transducers and computer data acquisition, develop strong science writing skills by producing two short scientific papers, and present results of an independent project at an in-class symposium.

Prerequisite and/or restriction: Biology 141, 151, and 200. Chemistry 120.

Concurrent enrollment in Biology 337.

Taught: Alternate years, 1 semester credit.

BIO 343 MICROBIOLOGY

Kennedy

Content: The biology of microbial organisms, particularly bacteria, viruses, and fungi. Emphasis on key aspects of microbial life, including growth and physiology, reproduction and dispersal, and interactions with the environment and other organisms. Laboratory focuses on using a variety of cultivation methods and molecular-based techniques to assess microbial diversity. One weekend field trip required.

Prerequisite and/or restriction: Biology 141, 151, and 200. Chemistry 120.

Taught: Alternate years, 5 semester credits.

BIO 352 ANIMAL BEHAVIOR

Clifton

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.

Prerequisite and/or restriction: Biology 141, 151, and 200. Mathematics 131, Mathematics 255, or Computer Science 171. Chemistry 120.

Taught: Annually, 5 semester credits.

BIO 361 CELL BIOLOGY

Hermann, Reiness

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.

Prerequisite and/or restriction: Biology 151. Biology 200 or consent of instructor. Chemistry 120.

Taught: Annually, 5 semester credits.

BIO 375 COMPARATIVE PHYSIOLOGY

Autumn

Content: How different kinds of animals work and why they have evolved to work the way they do. Body size, metabolism, muscle, respiration, cardiovascular function, acid-base balance, temperature, osmoregulation. Common physiological principles that transcend differences in evolutionary history. Physiological adaptations to environmental challenges. Constraints on physiological evolution. Emphasis on recent experimental discoveries and unanswered questions. Intended for biology, biochemistry, and environmental studies majors. Lecture and laboratory.

Prerequisite and/or restriction: Biology 141, 151, 200, or consent of instructor. Mathematics 131 or Computer Science 171 or Physics 141 recommended.

Taught: Annually, 5 semester credits.

BIO 390 EVOLUTION

Bierzychudek, Binford

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.

Prerequisite and/or restriction: Biology 141, 151, and 200. Mathematics 131, Mathematics 255, or Computer Science 171. Chemistry 120.

Taught: Annually, 4 semester credits.

BIO 408 PHYLOGENETIC BIOLOGY

Binford

Content: Advanced study of methods and models of reconstructing patterns of evolutionary history. Use of phylogenies to test hypotheses of evolutionary processes including adaptation, evolutionary constraints, evolutionary rates, biogeography, and coevolution.

Prerequisite and/or restriction: Biology 141, 151, and 200. Biology 390 recommended. Mathematics 131, Mathematics 255, or Computer Science 171.

Taught: Alternate years, 5 semester credits.

BIO 412 DEVELOPMENTAL BIOLOGY

Hermann

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 molecular, cellular, and genetic mechanisms underlying development. Discussion of current research literature with critical analysis of experimental design and data. Lecture and laboratory. Laboratory focuses on genetic control of development.

Prerequisite and/or restriction: Biology 311 or 361, or consent of instructor.

Taught: Alternate years, 5 semester credits.

BIO 422 NEUROBIOLOGY

Reiness

Content: The biology of the nervous systems of vertebrates and invertebrates, 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.

Prerequisite and/or restriction: Biology 151 and 200 or 361. Chemistry 120. Physics 142 recommended.

Taught: Alternate years, 5 semester credits.

BIO 462 IMMUNOLOGY

Reiness

Content: The cellular basis of the immune response, with emphasis on biochemical, molecular genetic, and cell biological approaches. Generation of antibody diversity. The functions of B lymphocytes, T lymphocytes, and antigen presenting cells. The structure and function of proteins encoded by the Major Histocompatibility Complex. Immunity to infection, autoimmunity, and cancer immunology. Lecture; reading and discussion of original scientific literature.

Prerequisite and/or restriction: Biology 151 and 311 or 361, or consent of instructor.

Taught: Alternate years, 4 semester credits.

BIO 490 SPECIAL TOPICS IN BIOLOGY

Staff

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.

Prerequisite and/or restriction: Biology 141, 151, 200, or consent of instructor.

Taught: Alternate years (contingent on student interest and faculty availability), 4 semester credits.

BIO 495 BIOLOGY SENIOR THESIS

Staff

Content: Yearlong field or laboratory research project designed and executed by a student with guidance from two faculty mentors.

Prerequisite and/or restriction: Senior standing. GPA of 3.500 in major and overall. Approval of research proposal by department and two supervising faculty members.

Taught: Annually, 3 semester credits each semester.

BIO 499 INDEPENDENT STUDY

Staff

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.

Prerequisite and/or restriction: Consent of instructor.

Taught: Each semester, 2-4 semester credits.

Chemistry

CHAIR: LOUIS Y. KUO

The Department of Chemistry curriculum serves four groups of students: chemistry and biochemistry/molecular biology majors; biology, engineering, and environmental studies majors; students planning to apply to professional schools in the health sciences; and nonscience majors satisfying their scientific and quantitative reasoning General Education requirement.

THE MAJOR PROGRAM

The Department of Chemistry provides a flexible, challenging curriculum to accommodate and encourage a diversified approach to the major. Following a core of required courses in general, organic, and physical chemistry, including laboratories, students select advanced courses from several electives.

In all chemistry courses, instructors encourage students to think for themselves and work independently. This is accomplished in some classes by having students work at the blackboard in small discussion groups to solve problems. In