

ASTRONOMY

The College offers an Astronomy Program within the Department of Physics and Astronomy in cooperation with Harvey Mudd College and the Joint Sciences Program of Claremont McKenna, Pitzer and Scripps Colleges. See the Physics and Astronomy Department section of the catalog.

BIOLOGY DEPARTMENT

Associate Professor Daniel Martinez, department chair

Professors Hoopes², Seligman, Telzer, Wright²

Associate Professors Becker, Cheney, Fowler, Hanzawa, Levin, Martínez, Parfitt

Assistant Professors Cavalcanti, Johnson, Karnovsky, Matsui

The Biology Major provides students with extensive training in a range of biological subject areas, principles and practices. The curriculum gives students a broad background in biology while providing for specialization in a particular sub-discipline such as environmental biology, organismal biology, plant biology or cell and molecular biology. Students also gain extensive experience in the processes of logical problem-solving and experimental design that characterize scientific investigation. Most biology majors pursue graduate work in biology or the health professions, but many enter careers in government, business, law, journalism, secondary school teaching, or with environmental consulting firms, conservation organizations or biotechnology companies. The department also offers a minor.

The faculty of the Biology Department believes strongly in the value of learning not just what is known about biology, but how biologists acquire that knowledge. Most courses include laboratories in which students gain first-hand experience with the processes of biological inquiry. Strong emphasis on learning to think scientifically is reflected in the department's senior exercise, in which each student develops an original biological investigation of a problem of his or her choice. The faculty also encourages students to spend a summer and one or more semesters involved in biological research, either working with a faculty member on campus or through one of many available research internship programs or biological field station programs. More information on faculty research interests, summer research programs and potential funding sources, is available on the department Web page at www.biology.pomona.edu. Students particularly interested in plant biology can take advantage of course and research offerings among all The Claremont Colleges (see <http://www.rsabg.org/research/botany/> for details).

The department is housed in the Richard C. Seaver Biology Building, an innovative and energy-efficient building certified by the U.S. Green Building Council and in the newly renovated Seaver South Building. Laboratories are equipped with advanced instrumentation for experimentation in all the major fields of biology, from molecular genetics and cell biology to physiology and ecology. Facilities include environmentally controlled greenhouses, walk-in warm and cold rooms and plant growth chambers. The local Robert J. Bernard Biological Field Station, owned by The Claremont Colleges, includes several natural habitats that serve courses in ecology, evolutionary and organismal biology and animal behavior. The department also uses the Pomona College-owned Herman Garner Ecological Preserve in Evey Canyon, Claremont and the Mildred Pitt Ranch in Monterey County for field research.

Three interdisciplinary majors are available for students who want to combine the study of biology with another discipline. The Molecular Biology Major combines chemical and biological approaches to the study of macromolecules, the Environmental Analysis

²On leave Spring 2010

Major integrates several fields focusing on sustainability and the management of environmental challenges and the Neuroscience Major combines approaches used in biology, psychology and other sciences. In addition, the joint Biology/Public Policy Analysis Major allows students to combine the study of how society formulates and implements policy with the core areas of the Biology Major. Interested students should consult with their biology advisors and the respective program coordinators.

Requirements for the Major in Biology

All courses for the Biology Major must be taken for a letter-grade.

1. 40, 41C, 41E
2. CHEM 1A,B or 51 and 110A,B
3. MATH 30, and either 31 or an approved statistics course such as MATH 58, PSYC 158 or HM BIOL 153. Students who place out of 31 must take MATH 32, 36 or an approved statistics course.
4. One upper-division laboratory or field course in organismal biology from 125, 131, 132, 140, 166, 169
5. Four additional upper-division biology courses, three of which must be laboratory or field courses
6. Senior Thesis: 191 or 194A,B

No more than one course credit from any combination of half-credit courses may be applied to the major. CHEM 115, NEUR 102, NEUR 103 and NEUR 130 may be substituted for upper-division biology courses.

Upper-level courses taken at the other Claremont Colleges may be eligible for major or minor credit with prior written permission from the department chair. One course credit may be obtained for appropriate upper-division biology coursework undertaken in a Study Abroad Program with prior written permission from the department chair. If a student chooses an upper-level biology course to fulfill the requirements of another major, that course cannot be used to fulfill a Biology Department major or minor requirement.

Senior Exercise. Seniors are required either to present a satisfactory research thesis based on original research in the laboratory or the field, completed over two semesters (194A,B), or to present a senior thesis in grant proposal format based on library research (191). Students are strongly encouraged to take a course in statistics before beginning the Senior Exercise.

Students who wish to pursue graduate study in biology are recommended to take a year of calculus and a year of physics, in addition to departmental requirements, because most graduate and professional schools require these for admission. Early consultation with an academic advisor in the Biology Department will ensure that the student's program of study satisfies departmental requirements and provides adequate preparation for career goals.

Requirements for a Minor in Biology

Courses required for the Biology Minor: 40, 41E and 41C, CHEM 1A,B (or 51) and two upper-division, laboratory or field, biology courses.

With permission from the department chair, a student may receive credit toward the minor for one upper-division course completed at another Claremont college or in a study abroad program. Upper-division biology courses taken to fulfill the requirement of any major cannot also be used for the Biology Minor.

First-year students

The department recommends that students interested in pursuing a major or minor in biology take the courses listed below in the first year.

Fall Semester

CHEM 1A or 51

MATH 30 or 31

ID 1

Foreign language or other

Gen Ed requirement

Spring Semester

CHEM 1B

MATH 31 (following MATH 30)

BIOL 40

Foreign language or other

Gen Ed requirement

This first-year schedule is also desirable for students contemplating majors in molecular biology, neuroscience or biology/public policy analysis.

Courses

Biology (BIOL) courses satisfy Area 4 of the Breadth of Study Requirements.

Introductory Courses

- 1A. Human Genetics for Non-Majors.** *Staff.* Principles and practices of human genetics and current problems and social issues related to genetic research. For non-majors. Cannot be taken if student has already taken Biology 40. Fall 2009.
- 1C. Biology of Garden Plants.** *Mr. Becker.* Topics include life cycle of flowering plants, plant structures and functions, nutrition, transport of materials, photosynthesis, mechanisms for sensing the environment, propagation methods and plant pests. Societal aspects of gardening and farming discussed. Laboratory-rich course includes much hands-on experience growing and assessing plants. Not intended for science majors. Spring 2010.
- 1D. Ecology for Non-Majors.** *Ms Hanzawa.* Introduction to the major concepts of population and community ecology. Topics include demography; factors governing population growth; predator-prey, competitive and mutualistic interactions; and the organization of communities. Integrates lecture, discussion and laboratory. One required field trip. Not intended for science majors. Spring 2011; offered alternate years.
- 1H. Cloning and Stem Cells (for non-majors).** *Ms Hoopes.* Reading and discussion on current issues in cloning of animals and humans and stem cell research; not for majors in biology and molecular biology. Fall 2009; offered alternate years.
- 2A. Biology, Gender and Society with Laboratory.** *Ms. Levin.* Explores the scientific method in the fields of genetics, endocrinology, physiology, development and evolution to see how biology informs our understanding of gender and identity. Discussion focuses on the uses and abuses of the information generated by biological research and how science changes as cultural values and the political climate shift. Fall 2010; offered alternate years.
- 40. Introductory Genetics with Laboratory.** *Staff.* Coverage of the principles of heredity. Topics include transmission genetics, population genetics and molecular genetics. Laboratory provides opportunities for students to apply a range of experimental approaches to ask and answer genetic questions in a variety of model organisms. Prerequisite: CHEM 1A or 51. Each spring.
- 41C. Introductory Cell Chemistry and Cell Biology with Laboratory.** *Staff.* Introduction to components of and processes that occur in living cells. Includes cell chemistry, intermediary metabolism, energy transduction and specialized topics, including protein trafficking, cellular motility and signal transduction. Prerequisites: BIOL 40; CHEM 1A,B or 51. Previously numbered 41M. Each fall.
- 41E. Introductory Ecological and Evolutionary Biology with Laboratory.** *Staff.* Introduction to the origins of and interactions among organisms in their natural environments. Includes evolutionary and population biology, behavioral and community ecology and conservation biology. Laboratory projects include field experiments and apply statistical treatments in data analysis. Prerequisite: 40. Each spring.

Upper-Division Courses

- 104. Conservation Biology.** *Mr. Fowler.* Biological approaches to the conservation of species and ecosystems. Topics include current problems in conservation at global through local scales, the origin and maintenance of biodiversity, population dynamics of rare or exploited species and the influence of human values on wildlife conservation. Prerequisites: 41E or Environmental Analysis (EA) 51. Each spring.
- 109. Molecular Evolution with Laboratory: The Tree of Life.** *Mr. Martínez.* Examines the major transitions in the evolution of life on Earth from a molecular perspective. Topics include the evolution of the eukaryotic nucleus, the evolution of mitochondria, the evolution of chloroplasts, the evolution of introns, the evolution of higher plants, the Cambrian explosion and the origin of animals, the evolution of tetrapods. Laboratory introduces students to a variety of molecular biology techniques. Computer lab emphasizes sequence assemblage, sequence alignment and phylogenetic reconstruction. Prerequisite: 41C or 41E. Each fall.
- 112. Advanced Animal Ecology with Laboratory.** *Ms. Karnovsky.* Covers population, community and ecosystem ecology of animals in terrestrial, freshwater and marine ecosystems. Topics include mechanisms that regulate population size, organize communities and the processes that characterize ecosystems. Students conduct their own studies in the field and laboratory. Field trips. Prerequisite: 41E. Fall 2010.
- 116. Ecology and Evolution of Plants with Laboratory.** *Ms. Hanzawa.* The ecology of plant populations, examined in an evolutionary context. Topics include population dynamics; ecology and evolution of interactions between plants and pollinators, herbivores and seed dispersers; evolution of plant structure; conservation of rare species. Prerequisite: 41E. Spring 2011; offered alternate years.
- 121. Insect Ecology and Behavior with Laboratory.** *Ms. Hanzawa.* Explores the interaction of insects with their biotic and physical environments from an evolutionary perspective. Topics include insect population ecology; mating, foraging and social behaviors; ecology of insect pollination, herbivory and parasitism; and insect diversity. Prerequisite: 41E. Fall 2009.
- 125. Animal Behavior with Laboratory.** *Ms. Levin.* Examines maintenance, reproductive and social behaviors of animals from evolutionary, ecological and mechanistic perspectives. Topics include behavioral ecology and sociobiology, behavioral genetics, behavioral endocrinology and neuroethology. Laboratory includes field observations of free-living animals. Prerequisite: 41E or permission of instructor. Spring 2010; offered alternate years, usually in fall.
- 131. Invertebrate Biology with Laboratory.** *Mr. Wright.* Explores the taxonomy, phylogeny and functional morphology of the major invertebrate phyla. Select topics include some of the most pervasive evolutionary questions: insect-plant co-evolution, the evolution and biomechanics of insect flight, host-parasite co-evolution and the Cambrian explosion. Laboratories explore comparative anatomy, physiology and ecology through a combination of experimental and observational projects and field trips. Prerequisite: 41C or 41E. Spring 2011; offered alternate years.
- 132. Vertebrate Biology with Laboratory.** *Ms. Karnovsky.* Vertebrate ecology, evolution and current conservation crises. Aspects of vertebrate anatomy and physiology will be covered to highlight strategies vertebrates use to meet challenges of metabolism, thermoregulation, locomotion, prey capture, predator avoidance, mating, reproduction and migration. Labs are focused on modern techniques for studying vertebrate populations. Field trips. Prerequisite: 41E. Fall 2009.
- 140. Animal Physiology with Laboratory.** *Mr. Wright.* The physiology of animals at the biochemical, cellular, organ and whole-animal level, stressing comparative solutions to common problems across animal groups. Prerequisite: 41C. Each fall.

- 144. Comparative Endocrinology.** *Mr. Fowler.* Examines the role of the endocrine system in regulating physiology and the maintenance of homeostasis in whole organisms. Topics include osmoregulation, digestion, reproduction, behavior and responses to environmental changes, as well as mechanisms of chemical communication. Prerequisite: 41C or 41E. Each fall.
- 147. Biochemistry: Metabolomics and Regulation with Laboratory.** *Ms. Hoopes.* The pathways of small-molecule interconversion to synthesize macromolecule subunits and macromolecular biosynthesis, with emphasis on regulation. Concentrations of most metabolites in the cell under specific conditions (metabolomic analysis) will be studied. Laboratory work will include affinity purification of an epitope-tagged protein kinase and gene-expressive analysis. Prerequisite: 41C. Fall 2009; offered alternate years.
- 163. Advanced Cell Biology with Laboratory.** *Mr. Telzer.* Discussion of the organization, function and biochemistry of the organelles and macromolecules of eukaryotic cells. Special emphasis will be given to cell membranes, protein synthesis and trafficking among organelles and intracellular motility. Prerequisite: 41C. Each spring.
- 164. Genetic Regulation in Eukaryotes with Laboratory.** *Ms. Hoopes.* Regulation of gene action in eukaryotic cells will be explored using research papers. Topics emphasize transcription factors and chromatin packaging, highlighting their roles in development and cancer. Students will discuss the assigned papers and a term paper will be required. Laboratory projects include microarrays and RTPCR analyses. Prerequisite (or concurrent): 40 and 41C. Spring 2010.
- 165A. Molecular Genetics of Cancer.** *Mr. Seligman.* This course examines the genetic changes that underlie the conversion of healthy cells to cancer cells. Emphasis will be placed on studies identifying key genes in humans, as well as research in model organisms that has enabled an understanding of how changes in these genes lead to cancers. This is a literature-based course that emphasizes oral presentations. Juniors and seniors only. Prerequisite: BIOL 40 and 41C or permission of the instructor. Fall 2009.
- 166. Plant Physiology with Laboratory.** *Mr. Becker.* The physiology and biochemistry unique to plants, with emphasis on mechanisms. Whole-plant processes such as mineral uptake and transport and water relations and intracellular processes such as photosynthesis, nitrogen metabolism, cell-wall synthesis and synthesis of secondary compounds. Mechanisms for coping with environmental stresses. Prerequisite: 41C. Spring 2010.
- 167. Microbial Genetics with Laboratory.** *Mr. Seligman.* Examines fundamental genetic processes such as DNA repair and mutagenesis, genetic exchange and recombination in prokaryotic organisms. Student-led discussions of primary research literature and laboratory featuring a combination of classical microbial genetic and modern molecular approaches. Prerequisite: 41C. Fall 2009.
- 169. Developmental Biology with Laboratory.** *Ms. Cheney.* The events and processes of animal development, including early development, organogenesis, signaling, developmental genetics, cloning, imprinting, stem cells and evolution of development. Includes both vertebrate and invertebrate embryos. Prerequisite: 41C. Each fall.
- 170. Drosophila Genomics with Laboratory.** *Ms. Hoopes.* Reading and discussion on DNA sequencing, finishing of DNA sequences and annotation, repeated sequences and chromosome structure. Laboratory work with Genomics Education Partnership at Washington University, finishing and annotating sequences from *Drosophila* dot chromosomes with co-authorship when published. Fall 2011; offered alternate years.
- 173. Genomics and Bioinformatics with Laboratory.** *Mr. Cavalcanti.* Introduction to prokaryotic and eukaryotic genomes, biological information systems and data analysis. Topics: comparative genomics, biological databases, sequence alignment, similarity searching, phylogenetic reconstruction, models of evolution, genome remodeling and molecular visualization. Laboratory incorporates computer-based exercises and student research projects. Prerequisite: 41C or 41E. Each fall.

- 178. Neurobiology with Laboratory.** *Ms. Parfitt.* Introduction to the biology of the nervous systems of vertebrates and invertebrates. Emphasis on cellular and molecular approaches. The ionic basis of electrical signaling in excitable cells, the physiology and biochemistry of synaptic transmission, the molecular mechanisms of learning and memory and selected topics in the field. Prerequisite: 41C. Each spring.
- NEUR 102. Neuroethology: Mechanisms of Behavior with Laboratory.** *Ms. Levin.* Prerequisites: BIOL 40 and either BIOL 41C or 41E. Spring 2010; offered alternate years.
- NEUR 103. Introduction to Neuropharmacology.** *Ms. Parfitt.* Prerequisite: BIOL 41C. Fall 2009; offered alternate years.
- NEUR 130. Vertebrate Sensory Systems with Laboratory.** *Mr. Johnson.* Prerequisite: BIOL. 41C. Each spring.

Other Courses for the Major

- 189. Selected Topics in Biology.** *Staff.* Seminars, discussions and/or laboratory exercises conducted as small discussion groups in specialized topics not offered in formal courses and of mutual interest to students and staff. Prerequisite: permission of instructor. Course or half-course. May be repeated. Each semester.
- 191. Senior Library Thesis.** *Staff.* Design of a research protocol to answer an original question. Written in the form of a grant proposal. Open to students whose preliminary written project proposals have been approved by the department. Preliminary proposals due one week prior to pre-enrollment in the preceding semester. Half-course. Each semester.
- 194A,B. Senior Experimental Thesis.** *Staff.* A two-semester laboratory or field project that addresses an original question. Open to students whose written preliminary project proposals have been approved by the department. Preliminary proposals due one week prior to pre-enrollment in the spring of the junior year. 194A, half-course, first semester; 194B, full-course, second semester.
- 198. Summer Reading and Research.** *Staff.* May consist of a reading program in a specific field of biology and/or a field or laboratory research project conducted under faculty member's supervision. Open to any student who receives faculty and departmental approval. Course or half-course.
- 199. Independent Study/Research in Biology.** *Staff.* Directed independent research under the supervision of a faculty member. Open to students whose written project proposals have been approved by the department; proposals due one week before pre-enrollment. Course or half-course. Each semester.

CHEMISTRY DEPARTMENT

Professor Edward J. (E.J.) Crane III, department chair

Professors Garza-López, Grieman, O'Leary, Oxtoby, Selassie

Associate Professors Crane, Jobal, Taylor

Assistant Professor Sazinsky

Visiting Assistant Professors Arora, Nevárez

Laboratory Coordinators Vasquez, Yu

Robbins Postdoctoral Fellow Lopez

Postdoctoral Fellow Moersch

The Chemistry Department provides its students with a thorough education in the fundamental processes of the chemical world to foster creative and critical thinking. The curriculum introduces students to an understanding of chemical phenomena, structure, properties and transformations at the atomic and molecular levels. A collegial and supportive environment distinguishes the student-faculty interaction in many contexts, including the class-