BIOLOGICAL SCIENCES 2013–2014

Why study biology at the University of Denver?

The department of biological sciences provides opportunities for graduate training at the doctoral (PhD) or master’s (MS) level. Students earn a degree in biological studies with a concentration in either cell and molecular biology or ecology and evolution. Both program tracks involve a combination of course work, lab or field research and a defended thesis. Students begin their thesis research under the direction of a faculty member during the first year. All students are expected to present their work at scientific meetings and publish their work in peer-reviewed scientific journals. Students also have the opportunity to participate in teaching undergraduate courses.

Research Areas:
The PhD and MS programs are centered on primary research that coincides with faculty experience and expertise. Students will conduct their research in a university environment using state-of-the-art techniques and facilities. The current research emphases of the department are:

- Cell and molecular biology (biophysics, neuroscience, cell signaling and physiology, developmental biology, aging, molecular forensics and molecular evolution) is supported by major research facilities that include automated DNA sequencers, real-time PCR instruments, a DNA WAVE HPLC, a Hitachi transmission electron microscope and an Olympus Fluoview 1000 confocal microscope.

- Ecology and evolution (biogeochemistry, conservation biology, restoration ecology, molecular evolution) takes advantage of unique field study sites that include an alpine research station on Mt. Evans in the Arapaho National Forest and collaborative research opportunities with the Denver Botanic Gardens and the Rocky Mountain Center for Conservation Genetics and Systematics.
Master of Science and Doctor of Philosophy

Graduate studies in the department of biological sciences provide graduate students with a set of structured core classes that establish a strong foundation of basic knowledge in cell and molecular biology or ecology and evolution and that allow the knowledge to be built upon in subsequent specialized courses and independent research. Research areas are usually linked to the interest of the supervising faculty member. The department’s current research strengths center around the two areas: cell and molecular biology (biophysics, neuroscience, neuroendocrinology, cell signaling and physiology, developmental biology, aging, molecular forensics and molecular evolution) and ecology and evolution (biogeochemistry, conservation biology, restoration ecology, molecular evolution). To complete research commitments, MS students generally work with a major professor of choice in the laboratory and/or field for about two years, while PhD students generally work for five years.

PhD in Biological Sciences with a concentration in Cell and Molecular Biology

The major requirements for completion of the PhD degree are 90 quarter hours of graduate course work and research credit, completion of all candidacy exams, and successful defense of the PhD dissertation. The course work includes the 20-credit graduate core curriculum: Advanced Cell Biology (BIOL 4211), Advanced Molecular Biology (BIOL 4212), Advanced Cell Signaling (BIOL 4213), Foundations in Literature: Cell and Molecular Biology (BIOL 4310), Biostatistics (BIOL 4080/4090), and Responsible Conduct in Research (BIOL 4231). The remainder of the credit hours required for the degree may be taken as Independent Study (BIOL 4991) or Independent Research (BIOL 4995) and/or courses that the dissertation committee judges to complement the student’s major field. Additional requirements are attendance at all departmental seminars, a thesis based on a research project approved by the thesis committee and a successful oral defense of the thesis.

Master of Science in Biological Sciences with a concentration in Cell and Molecular Biology

The major requirements for completion of the MS degree are 45 quarter hours of course work and research credit, and successful defense of the MS thesis. The course work includes the 16-credit graduate core curriculum: Advanced Cell Biology (BIOL 4211), Foundations in Literature: Cell and Molecular Biology (BIOL 4310), Biostatistics (BIOL 4080/4090), and Responsible Conduct in Research (BIOL 4231). The remainder of the credit hours required for the degree may be taken as Independent Study (BIOL 4991) or Independent Research (BIOL 4995) and/or courses that the thesis committee judges to complement the student’s major field. Additional requirements are attendance at all departmental seminars, a thesis based on a research project approved by the thesis committee and a successful oral defense of the thesis.

PhD in Biological Sciences with a concentration in Ecology and Evolution

The major requirements for completion of the PhD degree are 90 quarter hours of graduate course work and research credit, completion of all candidacy exams, and successful defense of the PhD dissertation. The course work includes the 16-credit graduate core curriculum: Graduate Seminars: Ecology and Evolution (BIOL 4220), Biostatistics (BIOL 4080/4090), Research Methods (BIOL 4091), Foundations in Literature: Ecology and Evolution I, II and III (BIOL 4330, BIOL 4331, BIOL 4332), Grant preparation (BIOL 4150), and Responsible Conduct in Research (BIOL 4231). The remainder of the credit hours required for the degree may be taken as Independent Study (BIOL 5991) or Independent Research (BIOL 5995) and/or courses that the dissertation committee judges to complement the student’s major field. Additional requirements are attendance at departmental seminars, passing performance in the qualifying examination and the research proposal examination, presentation of one departmental seminar per year, completion of a research dissertation of publishable quality, and successful oral defense of the dissertation.
Master of Science in Biological Sciences with a concentration in Ecology and Evolution
The major requirements for completion of the MS degree are 45 quarter hours of course work and research credit, and successful defense of the MS thesis. The course work includes the 12-credit graduate core curriculum: Graduate Seminars: Ecology and Evolution (BIOL 4220), Biostatistics (BIOL 4080/4090), Research Methods (BIOL 4091), Foundations in Literature: Ecology and Evolution I, II and III (BIOL 4330, 4331, 4332), and Responsible Conduct in Research (BIOL 4231). The remainder of the credit hours required for the degree may be taken as Independent Study (BIOL 4991) or Independent Research (BIOL 4995) and/or courses that the thesis committee judges to complement the student’s major field. Additional requirements are attendance at all departmental seminars, a thesis based on a research project approved by the thesis committee, and a successful oral defense of the thesis.

Molecular and Cellular Biophysics
Molecular and Cellular Biophysics is an interdepartmental PhD degree program at the University of Denver. See the molecular and cellular biophysics bulletin at http://www.du.edu/learn/graduates/degreeprograms/bulletins/molcelbiophysics/index.html for more specific details.
Joseph Angleson  
Associate professor and chair  
PhD, Biochemistry  
Baylor College of Medicine  
Cell Physiology: intracellular signaling and vesicle transport

Scott Barbee  
Assistant professor  
PhD, Cell and Developmental Biology  
University of Colorado School of Medicine  
Developmental Neurobiology: mRNPs in neurons

Todd Blankenship  
Assistant professor  
PhD, Molecular Biology  
Princeton University  
Developmental Biology: epithelial tissue architecture

Phillip Danielson  
Professor  
PhD, Biology  
University of Denver  
Molecular Biology: forensic science

Robert Dores  
Professor PhD, Zoology  
University of Minnesota  
Neuroendocrinology: hormone/receptor interactions and hormone biosynthesis

James Fogleman  
Professor PhD, Genetics  
Cornell University  
Genetics: neurodegenerative disorders and forensic science

John Kinnamon  
Professor  
PhD, Biology  
University of Georgia  
Neuroscience: sensory system neurobiology

Daniel Linseman  
Assistant professor  
PhD, Pharmacology University of Michigan  
Neuroscience: oxidative stress and apoptosis in neurodegeneration

Shannon Murphy  
Assistant professor  
PhD, Ecology and Evolutionary Biology  
Cornell University  
Ecology and Evolution: plant/insect interactions

Scott Nichols  
Assistant professor  
PhD, Integrative Biology  
UC Berkeley  
Molecular Biology and Evolution: evolution of multicellular life

David Patterson  
Professor  
PhD, Microbiology  
Brandeis University  
Neuroscience: metabolomics, Down Syndrome, aging and neurodegenerative disorders

James Platt  
Professor PhD, Biology  
University of Colorado at Boulder

Martin Quigley  
Associate professor  
PhD, Botany  
Louisiana State University  
Ecology: landscape ecology, restoration and urban ecology

Thomas Quinn  
Professor  
PhD, Biology  
Queen’s University, Kingston, Ontario  
Molecular Biology: conservation genetics and transposable elements in the avian genome

Susan Sadler  
Associate professor  
PhD, Pharmacology  
University of Colorado School of Medicine  
Cell Biology: meiotic cell division, membrane fluidity and membrane domains
Anna Sher
Associate professor
PhD, Biological Sciences
University of New Mexico
Ecology: plant conservation biology

Robin Tinghitella
Assistant professor
PhD, Biology
University of California, Riverside
Ecology: behavioral ecology in rapid adaptive evolution
BIOL 3010 Evolution and Speciation (4 qtr. hrs.)
Theories and supporting evidence explaining evolution from origin of universe to complex interrelationships of species. Prerequisites: BIOL 1010/1011 and BIOL 2510.

BIOL 3020 Aquatic Ecology (4 qtr. hrs.)
An introduction to the ecology of fresh-water and marine organisms including aquatic adaptations, community organization, food chains, nutrient cycling and man’s impact on aquatic ecosystems. Prerequisite: BIOL 2010 or instructor’s permission.

BIOL 3030 Alpine Ecology (4 qtr. hrs.)
Ecology of alpine and subalpine regions of Colorado; organization and distribution of communities and populations, succession, energy flow, nutrient cycling, population adaptations in life-history physiology, behavior and morphology. Prerequisite: BIOL 2010.

BIOL 3035 Invasive Species Ecology (4 qtr. hrs.)
This course investigates those plants and animal species that have dramatically expanded their ranges and cause ecological harm. Topics covered include the mechanisms of ecological impacts across the globe, how invasive species are used to test basic ecological theory, the application of this research for managing real species, and related issues such as the debate within the scientific community about the term "invasive." We use a case-study approach, and students will have the opportunity to go into the field as a class to observe the real invasions and learn sampling methods.

BIOL 3044 Coral Reef Ecology (3 qtr. hrs.)
Ecology of coral reefs; organization and distribution of reefs; review of reef organisms and their interactions with each other and their physical environment; threats to coral reef reef conservation. Prerequisite: BIOL 2010 or BIOL 2050.

BIOL 3045 Coral Reef Ecology Lab (1 qtr. hrs.)
Ecology of coral reefs laboratory to supplement lecture material; travel to the Caribbean over spring break to observe coral reefs firsthand; introduction to research methods. Prerequisite: SCUBA certification and permission of instructor.

BIOL 3055 Ecology of the Rockies (4 qtr. hrs.)
A week in residence at the Mt. Evans Field Station prior to the start of fall quarter includes field projects dealing with ecology and environmental issues. On campus classes involve data analysis and interpretation and formal scientific communication. Themes include terrestrial and aquatic ecosystems, taxonomic groups ranging from conifer stands to aquatic insects and mountain goats. Lab fee associated with this course. Prerequisite: BIOL 2010 or permission of instructor.

BIOL 3060 Tropical Ecology (0 or 3 qtr. hrs.)
Biological composition of tropical ecosystems; biodiversity, biogeochemistry; causes and biological consequences of tropical deforestation; ecologically based approaches toward sustainable tropical forest use. Includes laboratory. Prerequisite: BIOL 2010.

BIOL 3070 Ecological Field Methods (4 qtr. hrs.)
Series of field exercises for students to learn principles and procedures of field methodology, data analysis and technical writing in ecology; problems drawn from population, community and ecosystem ecology. Lab fee associated with this course. Prerequisite: BIOL 2010.

BIOL 3100 Histology: Medical Microanatomy (4 qtr. hrs.)
Microscopic organization of tissues and organs; correlation of organization of organs with functions and pathologies; emphasis on mammalian systems. Includes laboratory. Lab fee associated with this course. Prerequisite: BIOL 2120.

BIOL 3110 Special Topics: Biology (1 to 5 qtr. hrs.)
Topics of special interest to teaching/research faculty of department presented as needed to complement and expand existing curriculum. May be repeated for credit.

BIOL 3120 General Microbiology (0 or 4 qtr. hrs.)
Fundamental principles of microorganisms in the world and in disease; role of bacteria in biological phenomena. Includes laboratory. Lab fee associated with this course. Prerequisite: BIOL 2120.
BIOL 3130 Molecular Evolution (4 qtr. hrs.)
Evolution of macromolecules and reconstruction of evolutionary history of genes and organisms. Prerequisite: BIOL 2510.

BIOL 3135 Topics in Cell Motility (4 qtr. hrs.)
Fibrous elements of the cytoskeleton and associated proteins and their role in cellular motility will be examined in detail. The physical forces involved in cellular motile function will be applied in understanding cellular motile behavior. Prerequisite: BIOL 2120.

BIOL 3150 Intracellular Dynamics (4 qtr. hrs.)
Focuses on spatial and temporal control of intracellular processes with an emphasis on neuronal and endocrine cells. Topics include vesicular traffic, protein targeting, dynamics and spatial organization of signaling complexes. Emphasis on modern techniques of cell and molecular biology with examples from primary literature. Prerequisite: BIOL 2120.

BIOL 3160 Biophysics: Ion Channels & Disease (3 qtr. hrs.)
Examines ion channel structure and function and the ways in which this information provides insight into human disease. The focus is on the use of biophysical techniques in combination with molecular and genetic analysis of channel genes. General Physics recommended. Prerequisite: BIOL 2120.

BIOL 3200 Invertebrate Evolution (4 qtr. hrs.)
Introduction to remarkable diversity of invertebrate life, both in terms of numbers of species, novel body plan and physiological adaptations. Includes laboratory. Prerequisites: BIOL 1010/1011.

BIOL 3250 Human Physiology (0 or 5 qtr. hrs.)
Functional relationships of human organ systems with coordinated laboratory activities and experiments that demonstrate and test physiological principles. Lab fee associated with this course. Prerequisites: BIOL 1010/1011.

BIOL 3260 Nutrition (3 qtr. hrs.)
From physiological and biochemical perspectives, this course explores the relationships of energy metabolism, nutrients, vitamins and minerals to human health. Prerequisite: BIOL 3250.

BIOL 3300 Biodiversity-Flowering Plants (4 qtr. hrs.)
Basic techniques and principles of systematics with application to the origin, evolution, radiation, classification and biodiversity of flowering plants (angiosperms). Lab fee associated with this course. Prerequisites: BIOL 1010/1011 or GEOG 1201/1202/1203 or instructor’s permission.

BIOL 3400 Ornithology (4 qtr. hrs.)
Biology of birds with emphasis on ecology and behavior; field and laboratory work to stress bird identification and ecological relationships of birds. Lab fee associated with this course. Prerequisites: BIOL 1010/1011.

BIOL 3410 Animal Behavior (4 qtr. hrs.)
Diversity of animal behaviors and how they enable animals to live in the natural world; the structure, control, and function of behaviors, and some of the factors that shape behaviors. Lab fee associated with this course. Prerequisites: BIOL 1010/1011.

BIOL 3560 Molecular Biology Laboratory (0 or 4 qtr. hrs.)
Laboratory based course that covers techniques in gene excision, cloning and reinsertion and gene sequencing. Lab fee associated with this course. Prerequisite: BIOL 2510.

BIOL 3570 Proteins in Biological Systems (3 qtr. hrs.)
Proteins considered in their biological setting; protein synthesis and degradation; survey of protein functions in vivo; evolution of proteins; introduction to protein biotechnology. Prerequisites: BIOL 2120, CHEM 2451, CHEM 2452 and CHEM 2453.

BIOL 3610 Developmental Biology (4 qtr. hrs.)
Processes and mechanisms of development, exemplified by higher animal embryogenesis, with consideration of microbial model systems. Prerequisite: BIOL 2510.

BIOL 3620 Vertebrate Embryology (4 qtr. hrs.)
Development processes in placental mammals; analysis of vertebrate cyto-differentiation and morphogenesis. Laboratory on embryonic anatomy of amphibians, birds and mammals. Prerequisites: BIOL 1010/1011 and BIOL 2120.
COURSE DESCRIPTIONS (CONTINUED)

BIOL 3630 Cell Biology of Development (4 qtr. hrs.)
Every organism has a stereotypical shape, but how does this shape arise? This course examines the cellular and molecular mechanisms that direct the forming of body and tissue shape. Prerequisite: BIOL 2120.

BIOL 3640 Introductory Neurobiology (4 qtr. hrs.)
Organization and function of vertebrate central nervous system; nature of action potential, biochemistry of neurotransmitters, neuropeptides, functional anatomy of nervous system, phylogeny of nervous system. Prerequisite: BIOL 2120.

BIOL 3641 Systems Neuroscience (4 qtr. hrs.)
Structure and function of the brain and spinal cord, emphasis on functional systems including sensory perception, motor control and consciousness. Prerequisite: BIOL 3640.

BIOL 3642 Neuropharmacology (4 qtr. hrs.)
How psychoactive drugs exert their effects on the nervous system; drugs of abuse and drugs used in the treatment of psychotic and neurodegenerative disorders. Prerequisite: BIOL 2120.

BIOL 3643 Developmental Neurobiology (4 qtr. hrs.)
This course investigates the mechanisms involved in the maturation of neurons, and signals that direct neurons to their proper position in the central nervous system. Prerequisite: BIOL 3640.

BIOL 3644 Neuromuscular Pathophysiology (4 qtr. hrs.)
Cellular and molecular basis for normal nerve and muscle functions and the alteration of these functions by toxins, trauma and diseases of the brain, nerves and muscles; how specific insults produce clinical symptoms and pathology. Prerequisite: BIOL 2120. Recommended: BIOL 3640 or BIOL 3250.

BIOL 3646 Seminar: Cognitive Neuroscience (2 qtr. hrs.)
This seminar is the capstone course for the neuroscience portion of the cognitive neuroscience program. Seminar topics will include but are not limited to neurological disorders, model systems in neuroscience and sensory systems.

BIOL 3650 Endocrinology (4 qtr. hrs.)
Mechanisms of hormone action, evolution of vertebrate endocrine systems, analysis of function integration of hormonal responses in maintenance of homeostasis. Prerequisite: BIOL 2120.

BIOL 3655 Molecular Neuroendocrinology (4 qtr. hrs.)
Advanced laboratory course that uses anatomical/immunological, biochemical and molecular approaches to analyze neuroendocrine pathways in the hypothalamus/pituitary system. Lab fee associated with this course. Prerequisites: BIOL 3650 and instructor's permission.

BIOL 3670 Molecular Immunology (4 qtr. hrs.)
Organs, cells and molecules that underlie mammalian immune response; relationship of immune system to disease. Prerequisite: BIOL 2510.

BIOL 3680 Advanced Techniques in Cell Biology (4 qtr. hrs.)
Advanced laboratory course that covers current techniques used in cell biology research. Lab fee associated with this course. Prerequisite: BIOL 2120.

BIOL 3700 Topics in Ecology (1 to 4 qtr. hrs.)
Topics vary; may include plant, animal, biochemical, alpine or aquatic; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: one quarter of undergraduate ecology and/or instructor's permission.

BIOL 3701 Topics in Genetics (1 to 4 qtr. hrs.)
Topics vary; may include genetic methods, molecular genetics, human genetics, chromosomes or population genetics; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: BIOL 2510 and/or instructor's permission.

BIOL 3702 Advanced Topics in Regulatory Biology (1 to 4 qtr. hrs.)
Topics vary; may include endocrinology, physiology or immunology; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: varies with topic and instructor; instructor's permission usually required.
COURSE DESCRIPTIONS (CONTINUED)

BIOL 3703 Advanced Topics in Developmental Biology (1 to 4 qtr. hrs.)
Topics vary; may include gene expression in development, developmental immunogenetics, developmental biochemistry or aging; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: instructor’s permission.

BIOL 3704 Advanced Topics in Cell Biology (1 to 4 qtr. hrs.)
Topics vary; may include supramolecular structure, microscopy, membranes and techniques. May be repeated for credit. Taught from original literature. Prerequisites: varies with course and instructor; instructor’s permission usually required.

BIOL 3705 Advanced Topics in Molecular Biology (1 to 4 qtr. hrs.)
Topics vary; may include biochemistry, supramolecular structure and function, molecular genetics, membrane biology. May be taken more than once for credit. Taught from original literature. Prerequisites: varies with course and instructor; instructor’s permission usually required.

BIOL 3706 Topics in Evolution (1 to 4 qtr. hrs.)
Topics vary, but may include molecular evolution, plant evolution and animal evolution. Prerequisite: instructor’s permission.

BIOL 3707 Advanced Topics in Conservation Biology (1 to 4 qtr. hrs.)

BIOL 3800 Human Molecular Biology (4 qtr. hrs.)
Molecular basis of heredity and genetic control, using in-vitro systems and microbial and eukaryotic models; molecular basis of heredity and genetic regulation considering in-vitro systems as well as prokaryotic and eukaryotic models. Prerequisite: BIOL 2510.

BIOL 3910 Viruses & Infectious Human Diseases (3 qtr. hrs.)
Organization of viruses at the molecular level with consideration of diseases that these agents cause in humans. The mechanism of action of viruses is a major theme of the course. Prerequisite: BIOL 2510. BIOL 3800 recommended.

BIOL 3950 Undergraduate Research (1 to 10 qtr. hrs.)
Participation in faculty research programs by agreement between student and faculty member. Maximum of 5 quarter hours of BIOL 3950 and/or BIOL 3991 may be applied to the 45-quarter-hour requirement for a major in biological sciences.

BIOL 3991 Independent Study (1 to 10 qtr. hrs.)
Topic in biology studied under faculty supervision. Student’s responsibility to identify faculty supervisor before registering for class. Maximum of 5 quarter hours of BIOL 3991 and/or BIOL 3950 may be applied toward the 45-quarter-hour requirement for a major in biological sciences.

BIOL 3992 Directed Study (1 to 10 qtr. hrs.)

BIOL 3995 Independent Research (1 to 10 qtr. hrs.)

BIOL 4010 Cellular Motile Function (2 qtr. hrs.)
Current literature in area of cell motility; role of cytoskeletal elements as motile agents.

BIOL 4020 Microbial Genetic Model Syst (2 qtr. hrs.)

BIOL 4030 Current Concepts in Evolution (2 qtr. hrs.)
New ideas and theories in field of evolutionary biology.

BIOL 4040 Current Concepts-Animal Phys (2 qtr. hrs.)
Selected topics in animal physiology.

BIOL 4050 Topics in Plant Biology (2 qtr. hrs.)
Varying topics; areas of plant-animal interactions, co-evolution, plant ecology, plant biochemistry/physiology.

BIOL 4060 Gene Expression-Development (2 qtr. hrs.)
Varying aspects of gene control in developing systems, a different aspect each time course is offered.
COURSE DESCRIPTIONS (CONTINUED)

BIOL 4070 Hormone-Receptor Interaction (2 qtr. hrs.)
Series of lectures; understanding molecular, cellular basis of hormone action; experimental analysis of binding of hormones with their receptors; structure-function relationships of hormone-receptor interactions; nature and action of mediators generated by hormone-receptor interaction.

BIOL 4080 Biological Membranes (2 qtr. hrs.)

BIOL 4085 Accelerated Biostatistics (2 qtr. hrs.)
This is an accelerated online statistics course for graduate students in Biology. Basic probability and hypothesis testing is the foundation of teaching applied statistics, including simple statistics (t-tests, f-tests, and chi square) and more advanced procedures (regression, correlation, analysis of variance). In addition, students learn more complex tools (multiple regression, multi-classification ANOVA, Student-Newman-Keuls tests), including non-parametric Tests (Mann-Whitney U, Sign test, Wilcoxon Rank Sum).

BIOL 4090 Biostatistics (4 qtr. hrs.)
Statistical on biological research; emphasis on procedures, applications of regression, correlation, analysis of variance, and nonparametric tests. Include instruction on computer-aided (Mac and PC) statistical analysis and presentation of results.

BIOL 4091 Ecology and Evolution Research Methods (1 qtr. hrs.)
This course builds upon the concepts in BIOL 4090, Biostatistics, by covering in more detail and specificity issues involved in designing one's experiment to adequately test the hypotheses or describe the data of interest. Students bring and discuss their specific research projects as case studies to maximize the utility of the course.

BIOL 4100 Microbial Structure & Function (2 qtr. hrs.)

BIOL 4110 Essentials of Immunology (2 qtr. hrs.)

BIOL 4120 Hmn Chromosomes & Mutagenesis (2 qtr. hrs.)

BIOL 4130 Microevolution (2 qtr. hrs.)
Microevolution, the change of gene frequencies within populations; examination of forces that cause it, evaluation of its contribution to process of speciation.

BIOL 4140 Protein Biosynthesis (2 qtr. hrs.)
Processes of protein synthesis in cells; emphasis on posttranslational modifications that occur to secretory proteins prior to secretion.

BIOL 4150 Special Topics in Adv Biology (1 to 4 qtr. hrs.)
Topics of special interests to teaching and research faculty presented as needed to complement and expand existing curriculum. May be taken more than once for credit.

BIOL 4190 Biometry (3 qtr. hrs.)

BIOL 4210 Grad Sem: Cell Biology (2 qtr. hrs.)
A series of student presentations focusing on varied topics involving cell biology. May be taken more than once for credit.

BIOL 4211 Advanced Cell Biology (3 qtr. hrs.)
Students study the subcellular structure and organization of the cell. Organelle structure and function are examined in detail as well as biogenesis and degradation (turnover) of these subcellular structures. Cytoskeletal dynamics are also a major focus. Specific topics covered include cell division, macromolecular synthesis, membrane transport, cell-matrix and cell-cell communication, cell migration, cell differentiation, and mechanisms of cell death. The course follows a lecture format in conjunction with selected journal article presentations and discussions by the students.

BIOL 4212 Advanced Molecular Biology (3 qtr. hrs.)
This course focuses on a detailed analysis of regulated gene expression. The topics include lectures and readings of relevant literature in areas covering gene regulation at multiple steps, including transcription, RNA processing, and translation. In particular, the logic of experimental design and data analysis are emphasized.
BIOL 4213 Advanced Cell Signaling (3 qtr. hrs.)
Students in this course investigate a large array of cellular signal transduction cascades. Specific signaling pathways to be covered include growth factor receptors, cytokine receptors, steroid receptors, integrin-extracellular matrix, heterotrimeric G-protein coupled receptors, monomeric G-proteins, transcription factors, lipids, cytoskeleton, cell cycle, and apoptosis. Each of these topics is examined in the context of normal cell physiology as well as their roles in specific disease processes. The course follows a lecture format in conjunction with selected journal article presentations and discussions by the students.

BIOL 4220 Grad Sem: Ecology & Evolution (2 qtr. hrs.)
A series of student presentations focusing on varied topics involving ecology and evolution. May be taken more than once for credit.

BIOL 4230 Grad Sem: Molecular Biology (2 qtr. hrs.)
A series of student presentations focusing on varied topics involving ecology and evolution. May be taken more than once for credit.

BIOL 4231 Responsible Conduct in Rsrch (1 qtr. hrs.)
This course covers several topics regarding guidelines for ethical practices in research. Topics include: data ownership, conflict of interest and commitments, human subjects, animal welfare, research misconduct, authorship, mentoring, peer review, and collaboration. The course includes an online training component and meets one hour each week to discuss these topics.

BIOL 4300 Fall Graduate Reviews in Biol (1 qtr. hrs.)
Students will participate in a required review session that precedes selected departmental seminar presentations by faculty and outside speakers, and will participate in a discussion session with the seminar speaker.

BIOL 4302 Sprg Graduate Reviews in Biol (1 qtr. hrs.)
Students will participate in a required review session that precedes selected departmental seminar presentations by faculty and outside speakers, and will participate in a discussion session with the seminar speaker.

BIOL 4303 Reviews in Biology (1 qtr. hrs.)
The experience is built around the departmental seminar series offered every quarter.

BIOL 4310 Foundations in Literature: Cell and Molecular Biology (2 qtr. hrs.)
Students participate in a weekly discussion group that focuses on recent papers from the primary literature in Cell and Molecular Biology.

BIOL 4311 Wntr Selected Top: Reg Bio (2 qtr. hrs.)
Students will participate in a weekly discussion group that will focus on recent papers from the primary literature in regulatory biology.

BIOL 4312 Sprg Selected Top: Reg Bio (2 qtr. hrs.)
Students will participate in a weekly discussion group that will focus on recent papers from the primary literature in regulatory biology.

BIOL 4322 Selected Tpcs: Molecular Biol (2 qtr. hrs.)
The syllabus for the Selected Topics series will vary each quarter. Each quarter a faculty member will set the theme for the quarter and identify a set of review articles to introduce the topic. The instructor will lead the first session and provide important background material on the topic. Students will select a paper from the primary literature to present to the class on the topic designated for the quarter.

BIOL 4330 Foundations in Literature: Ecology and Evolution I (2 qtr. hrs.)
Students participate in a weekly discuss group that focuses on recent papers from the primary literature in Biodiversity, Ecology, and Evolution.

BIOL 4331 Foundations in Literature: Ecology and Evolution II (2 qtr. hrs.)
Students participate in a weekly discussion group that focuses on recent papers from the primary literature in Biodiversity, Ecology, and Evolution.
BIOL 4332 Foundations in Literature: Ecology and Evolution III (2 qtr. hrs.)
Students participate in a weekly discussion group that focuses on recent papers from the primary literature in Biodiversity, Ecology, and Evolution.

BIOL 4440 Current Concepts-Animal Phys (2 qtr. hrs.)

BIOL 4610 Developmental Biology (4 qtr. hrs.)
The processes and mechanisms of development, exemplified by higher animal embryogenesis, with consideration of simpler model systems. Laboratory sessions use live materials; course finishes with individual projects. Prerequisite(s): BIOL 2510 or equivalent

BIOL 4700 Human Molecular Biology (4 qtr. hrs.)
Molecular basis of heredity and genetic control, using in-vitro systems and microbial and eukaryotic models; molecular basis of heredity and genetic regulation considering in-vitro systems as well as prokaryotic and eukaryotic models. Restricted to MBA Bioenterprize students.

BIOL 4710 Endocrinology: Chemical Communication Systems (4 qtr. hrs.)
Mechanisms of hormone action, evolution of vertebrate endocrine systems, analysis of function integration of hormonal responses in maintenance of homeostasis. Restricted to MBA Bioenterprize students.

BIOL 4720 Neuropharmacology (4 qtr. hrs.)
How psychoactive drugs exert their effects on the nervous system; drugs of abuse and drugs used in the treatment of psychotic and neurodegenerative disorders. Restricted to MBA Bioenterprize students.

BIOL 4730 Molecular Lab Techniques (4 qtr. hrs.)
Techniques in gene excision, cloning and reinsertion; gene sequencing. Restricted to MBA Bioenterprize students.

BIOL 4731 Cell and Molecular Techniques (4 qtr. hrs.)
Analysis of neuroendocrine systems using a multidisciplinary approach. Anatomical/immunological, biochemical and molecular approaches used to analyze neuroendocrine pathways in the hypothalamus/pituitary system. Restricted to MBA Bioenterprize students.

BIOL 4740 Microbiology (4 qtr. hrs.)
Fundamental principles; role of bacteriology in biological phenomena. Includes laboratory. Restricted to MBA Bioenterprize students.

BIOL 4750 Immunology (4 qtr. hrs.)
Organs, cells and molecules that underlie mammalian immune response; relationship of immune system to disease. Restricted to MBA Bioenterprize students.

BIOL 4760 Advanced Cell Biology (4 qtr. hrs.)
Focuses on spatial and temporal control of intracellular processes with an emphasis on neuronal and endocrine cells. Topics include vesicular traffic, protein targeting, dynamics and spatial organization of signaling complexes. Emphasis on modern techniques of cell and molecular biology with examples from primary literature. Restricted to MBA Bioenterprize students.

BIOL 4850 Laboratory Skills for Forensic Serological Analysis (5 qtr. hrs.)
This course is designed to provide students with two major educational skills. First, is a thorough understanding of the fundamental science behind the identification and serological analysis of biological evidence in a forensic context. Second, is a rigorously developed set of practical hands-on proficiencies with the major commercial assay systems used by forensic laboratories for the identification of blood, saliva, semen, and other biological material with potential probative value to a criminal investigation.

BIOL 4860 Laboratory Skills for Forensic Genetic Analysis (4 qtr. hrs.)
This course is designed to provide students with two major educational skills. First, is a thorough understanding of the fundamental science behind the molecular genetic analysis of biological evidence in a forensic context. Second, is a rigorously developed set of practical hands-on proficiencies with the major commercial assay systems and software used by forensic laboratories for the determination and analysis of DNA profiles.

BIOL 4991 Independent Study (1 to 17 qtr. hrs.)

BIOL 4992 Directed Study (1 to 10 qtr. hrs.)

BIOL 4995 Independent Research (1 to 17 qtr. hrs.)
BIOL 5991 Independent Study (1 to 17 qtr. hrs.)

BIOL 5995 Independent Research PhD (1 to 18 qtr. hrs.)

For More Information
A complete description of the program’s official offerings and requirements is available from the department at http://www.du.edu/nsm/departments/biologicalsciences/.

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