

INTEGRATIVE BIOLOGY

Chair: Michael J. Greene

Program Assistants: Barbara Schmidt, Barbara McClure

Administrative Assistant: Jacki Craig

Undergraduate BS Program Director: Kimberly F. Regier

Graduate Program Director: Michael Wunder

Lab Coordinator: James Salmen, Munira Lantz, Kristen Baird, Sladjana Subotic

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Overview

Integrative Biology is the study of living organisms at different levels of organization, from molecular biology to biosphere ecology. Our undergraduate curriculum is designed to offer a firm foundation for understanding life processes, and a variety of biology electives to accommodate individual interests. Our courses prepare students to enter a wide variety of biological careers including health care, ecology, and bioengineering. Our graduates have the tools needed to think critically and to make informed decisions as citizens sharing the responsibility to take care of society and of Earth.

Departmental Honors

Departmental honors is only eligible for students who take classes for letter grades, with associated GPA values. Departmental honors is awarded to students based on their GPA in CU classes. The following minimum GPA must be met both for all overall CU GPA and for biology courses alone (biology GPA) to receive the following honors levels: *cum laude*, 3.500; *magna cum laude*, 3.700; *summa cum laude*, 3.900.

Biology Research Scholars

The biology faculty encourages students to pursue research as part of their undergraduate education. Students who excel in both course work and research will be recognized as CU Denver Biology Research Scholars or Research Associates.

To qualify for the **Research Scholars Program**, you must:

- achieve a minimum grade point average of 3.500 in all courses taken from CU Denver faculty, as well as in all CU Denver biology courses
- participate in a research project, consisting of a minimum of six credit hours of independent study (BIOL 2840 Independent Study, BIOL 3840 Independent Study, or BIOL 4840 Independent Study), taken over at least two semesters
- write a scientific paper describing the research
- present an oral or poster presentation summarizing your research

To qualify for the **Research Associates Program**, you must:

- achieve a minimum grade point average of 2.500 in all courses taken from CU Denver faculty, as well as in all CU Denver biology courses
- participate in a research project, consisting of a minimum of three credit hours of independent study (BIOL 2840 Independent Study, BIOL 3840 Independent Study, BIOL 4840 Independent Study or BIOL 4880 Directed Research), taken over at least two semesters
- write a scientific paper describing the research or present an oral or poster presentation summarizing your research

Students who wish to become involved in research should contact Dr. Christopher Phiel no later than their junior year, and preferably sooner.

Graduate Information

Please go to the Graduate (<http://catalog.ucdenver.edu/cu-denver/graduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/>) catalog to read about our graduate programs.

Programs

- Biology, BS (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biology-bs/>)
- Biology Minor (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biology-minor/>)
- Biotechnology Undergraduate Certificate (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biotechnology-certificate/>)
- Environmental Stewardship of Indigenous Lands Undergraduate Certificate (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/environmental-stewardship-indigenous-lands-undergraduate-certificate/>)

Faculty

Professors:

Michael J. Greene, PhD, Oregon State University

John G. Swallow, PhD, University of Wisconsin Madison

Diana F. Tomback, PhD, University of California, Santa Barbara

Associate Professors:

Laurel Hartley, PhD, Colorado State University

Christopher S. Miller, PhD, University of California Los Angeles

Annika Mosier, PhD, Stanford University

Christopher J. Phiel, PhD, Thomas Jefferson University

Gregory Ragland, PhD, University of North Carolina Chapel Hill

Timberley M. Roane, PhD, University of Arizona

Alan Vajda, PhD, University of Colorado Boulder

Michael Wunder, PhD, Colorado State University

Assistant Professors:

Sara Branco, PhD, University of Chicago

Carlos Infante, PhD, Harvard University

Micheal Moore, PhD, Case Western Reserve University

Senior Instructors:

Hannah Anchordoquy, PhD, University of Colorado Boulder

Laurel Beck, PhD, Michigan State University

Gene Brooks, DDS, University of Missouri

Erin Kelso, PhD, Indiana University

David Knochel, PhD, University of Colorado Boulder

Paul Le, PhD, University of Colorado Denver

Lisa Johansen, PhD, University of Alabama

Molly Nepokroeff, PhD, University of Wisconsin Madison

Kimberly F. Regier, EdD, University of Colorado Denver

Research Associate Professor:

Brian Buma, PhD, University of Colorado Boulder

Emeritus Faculty:

Gerald Audesirk, PhD, California Institute of Technology

Teresa E. Audesirk, PhD, University of Southern California

Leo P. Bruederle, PhD, Rutgers, the State University of New Jersey

Amanda Charlesworth, PhD, University College, London

Linda K. Dixon, PhD, University of Illinois

John H. Freed, PhD, Stanford University

Charles A. Ferguson, PhD, University of Colorado Boulder

Cheri A. Jones, PhD, University of Florida

Bradley J. Stith, PhD, Washington State University

Biology (BIOL)

BIOL 1111 - First Year Seminar (3 Credits)

Restriction: Restricted to Freshman level students. Term offered: fall. Max hours: 3 Credits.

Grading Basis: Letter Grade

Restriction: Restricted to Freshman level students

Typically Offered: Fall.

BIOL 1550 - Basic Biology: Ecology and the Diversity of Life (4 Credits)

Introduces the process of science, gene expression, biological diversity, evolution, and ecology. Highlights applications to contemporary issues.

Lecture and lab course. Note: For students who are not majoring in biology. Biology and health career majors should not take this course.

Students may not receive credit for this course if they have already received credit for BIOL 2010(2051) and BIOL 2020(2061). Term offered: fall, spring, summer. Max hours: 4 Credits. GT: Course is approved by the Colorado Dept of Higher Education for statewide guaranteed transfer, GT-SC1

Grading Basis: Letter Grade

Additional Information: Denver Core Requirement, Biol Phys Sci - Lec/Lab; GT courses GT Pathways, GT-SC1, Nat Phy Sci:Course w/Req Lab.

Typically Offered: Fall, Spring, Summer.

BIOL 1560 - Basic Biology: From Cells to Organisms (4 Credits)

Introduces the process of science, cell structure and function, survey of representative human and plant systems, and genetics. Highlights applications to contemporary issues. Lecture and lab course. Note: For

students who are not majoring in biology. Biology and health career majors should not take this course. Students may not receive credit for this course if they have already received credit for BIOL 2010(2051) and BIOL 2020(2061). Term offered: fall, spring, summer. Max hours: 4 Credits. GT: Course is approved by the Colorado Dept of Higher Education for statewide guaranteed transfer, GT-SC1.

Grading Basis: Letter Grade

Additional Information: GT courses GT Pathways, GT-SC1, Nat Phy Sci:Course w/Req Lab; Denver Core Requirement, Biol Phys Sci - Lec/Lab.

Typically Offered: Fall, Spring, Summer.

BIOL 2010 - Organisms to Ecosystems (Gen Bio) (3 Credits)

Introduces four major areas of study: (1) evolution,(2) animal structure and function, (3) plant structure and function and (4) ecology. Note: This class is intended for students planning to take upper division biology courses and for biology majors. Biology majors and pre-health career students must also take the accompanying laboratory BIOL 2011. No co-credit with BIOL 2030(2097) or BIOL 2061. Term offered: fall, spring, summer. Max hours: 3 Credits. GT: Course is approved by the Colorado Dept of Higher Education for statewide guaranteed transfer, GT-SC2.

Grading Basis: Letter Grade

Additional Information: Denver Core Requirement, Biol Phys Sci - Lec; GT courses GT Pathways, GT-SC2, Nat Phy Sci:Lec w/o Req Lab.

Typically Offered: Fall, Spring, Summer.

BIOL 2011 - Organisms to Ecosystems Lab (Gen Bio) (1 Credit)

Investigations, observations, and experiments in evolution, bioinformatics, ecology, and animal behavior, anatomy, and physiology; requires off-campus field work. Note: This class is intended for students planning to take upper division biology courses and for biology majors.

Students are strongly encouraged to take BIOL 2010 concurrently or before they take this course. No co-credit with BIOL 2031(2098) or BIOL 2081. Term offered: fall, spring, summer. Max hours: 1 Credits. GT: Course is approved by the Colorado Dept of Higher Education for statewide guaranteed transfer, GT-SC1.

Grading Basis: Letter Grade

Additional Information: Denver Core Requirement, Biol Phys Sci - Lab; GT courses GT Pathways, GT-SC1, Nat Phy Sci:Course w/Req Lab.

Typically Offered: Fall, Spring, Summer.

BIOL 2020 - Molecules to Cells (Gen Bio) (3 Credits)

Introduces four major areas of study: (1) the chemistry of biological systems; (2) the structure and function of the cell; (3) cellular energy transformations (photosynthesis and respiration); and (4) genetics (mitosis, meiosis, patterns of inheritance, molecular genetics). Note: This class is intended for students planning to take upper division biology courses and for biology majors. Biology majors and pre-health career students must also take the accompanying laboratory BIOL 2021. Prereq: BIOL 2010 (2061) or BIOL 2030 (2097) with a C- or higher. No co-credit with BIOL 2040(2095) or BIOL 2051. Term offered: fall, spring, summer. Max hours: 3 Credits. GT: Course is approved by the Colorado Dept of Higher Education for statewide guaranteed transfer, GT-SC2.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (2061) or BIOL 2030 (2097) with a C- or higher.

Additional Information: GT courses GT Pathways, GT-SC2, Nat Phy Sci:Lec w/o Req Lab; Denver Core Requirement, Biol Phys Sci - Lec.

Typically Offered: Fall, Spring, Summer.

BIOL 2021 - Molecules to Cells Lab (Gen Bio) (1 Credit)

Introduces the basic scientific approach through investigations, observations, and experiments in cell biology, basic biochemical techniques, genetics, molecular genetics and applications of biotechnology. Note: This class is intended for students planning to take upper division biology courses and for biology majors. Prereq: BIOL 2011 (2081) or BIOL 2031 (2098) with a C- or higher. No co-credit with BIOL 2041(2096) or BIOL 2071. Term offered: fall, spring, summer. Max hours: 1 Credit. GT: Course is approved by the Colorado Dept of Higher Education for statewide guaranteed transfer, GT-SC1.

Grading Basis: Letter Grade

Prereq: BIOL 2011 (2081) or BIOL 2031 (2098) with a C- or higher.

Additional Information: Denver Core Requirement, Biol Phys Sci - Lab; GT courses GT Pathways, GT-SC1, Nat Phy Sci:Course w/Req Lab.

Typically Offered: Fall, Spring, Summer.

BIOL 2030 - Honors Organisms to Ecosystems (Gen Bio) (3 Credits)
Honors level course limited to students in the BA/BS/MD, Denver Bound and UNHL programs. Introduces four major areas of study: evolution, animal structure/function, plant structure/function, and ecology.

Restriction: Restricted to Biology honors students within the College of Liberal Arts and Sciences. Instructor permission required. No co-credit with BIOL 2010(2061) or BIOL 2097. Term offered: fall. Max hours: 3 Credits.

Grading Basis: Letter Grade

Restriction: Restricted to Biology honors students within the College of Liberal Arts and Sciences

Typically Offered: Fall.

BIOL 2031 - Honors Organisms to Ecosystems Lab (Gen Bio) (1 Credit)
Honors level course limited to students in the BA/BS/MD, Denver Bound and UHL programs. Advanced study of evolution, plant and animal anatomy, developmental biology and includes two off-campus ecology field trips. Restriction: Restricted to Biology honors students within the College of Liberal Arts and Sciences. No co-credit with BIOL 2011(2081) or BIOL 2098. Term offered: fall. Max hours: 1 Credit.

Grading Basis: Letter Grade

Restriction: Restricted to Biology honors students within the College of Liberal Arts and Sciences

Typically Offered: Fall.

BIOL 2040 - Honors Molecules to Cells (Gen Bio) (3 Credits)
Honors level course limited to students in the BA/BS/MD, Denver Bound and UNHL programs. Four major topics covered: the chemistry of biological systems, the structure/function of the cell, cellular energy transformations and genetics. Prereq: BIOL 2010 (2061) or BIOL 2030 (2097) with a C- or higher. Restriction: Restricted to Biology honors students within the College of Liberal Arts and Sciences(student group BH01). Instructor permission required. No co-credit with BIOL 2020(2051) or BIOL 2095. Term offered: spring. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prerequisite: BIOL 2010 (2061) or BIOL 2030 (2097) with a grade of C- or higher Restriction: Restricted to Biology honors students within the College of Liberal Arts and Sciences(student group BH01)

Typically Offered: Spring.

BIOL 2041 - Honors Molecules to Cells Lab (Gen Bio) (1 Credit)
Honors level course limited to students in the BA/BS/MD, Denver Bound and UNHL programs. Introduces the basic scientific approach and report preparation through exercises and experiments in cell biology, basic biomedical techniques, genetics, molecular genetics and applications of biotechnology. Instructor permission required. Prereq: BIOL 2011(2081) or BIOL 2031 (2098) with a grade of C- or higher. Restriction: restricted to Biology honors students within the College of Liberal Arts and Sciences(student group BH01). No co-credit with BIOL 2021(2071) or BIOL 2096. Term offered: spring. Max hours: 1 Credit.

Grading Basis: Letter Grade

Prerequisite: BIOL 2011 (2081) or BIOL 2031 (2098) with a grade of C- or higher Restriction: Restricted to Biology honors students within the College of Liberal Arts and Sciences(student group BH01)

Typically Offered: Spring.

BIOL 2750 - Introduction to Molecular Research Techniques (2 Credits)
Designed to give background knowledge and hands-on experience for a person wanting to work in a molecular-research laboratory. Introduction to basic molecular techniques including micropipetting, making media, DNA and RNA isolation, restriction digest, RT-PCR, and gel electrophoresis. Max hours: 2 Credits.

Grading Basis: Letter Grade

BIOL 2840 - Independent Study (1-3 Credits)

Student will contribute to ongoing faculty or graduate student's lab or field-based investigation that makes an original intellectual or creative contribution to the discipline. Associated coursework includes scientific reading/writing/presentation(s). Note: registration by special processing form only. Prereq: Students must have completed one year of general biology with a grade of "C-" or higher and must submit a special processing form completely filled out and signed by the student and faculty member, describing the course expectations, assignments and outcomes, to the CLAS undergraduate advising office for approval. Term offered: fall, spring, summer. Repeatable. Max Hours: 9 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 9.

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

Typically Offered: Fall, Spring, Summer.

BIOL 2939 - Internship (1-3 Credits)

Experiences involving application of specific, relevant concepts and skills in supervised employment situations. Prereq: Students must have completed 15 hours of BIOL courses with a 2.75 GPA and must work with Experiential Learning Center advising to complete a course contract and gain approval. Term offered: fall, spring, summer. Repeatable. Max Hours: 9 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 9.

Prereq: 15 hours of BIOL courses with a 2.75 GPA in BIOL courses

Typically Offered: Fall, Spring, Summer.

BIOL 3010 - Biology Career and Professional Development Seminar (1 Credit)

Open to all science majors. This course develops a student's understanding of the breadth of biology careers, such as biotechnology, field research, and bench research. This course will also work to develop a student's resume and cover letter writing skills as well as interviewing and job searching skills. Guest speakers and UCD alumni from various biology fields and careers will share their insight. Meets weekly. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Max hours: 1 Credit.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030) and BIOL 2011 (or 2081/2098/2031) and BIOL 2020 (or 2051/2095/2040) and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

Typically Offered: Fall.

BIOL 3020 - Practical Laboratory Skills (1 Credit)

Designed for Students who are interested in working in a professional biology laboratory. Covers improvement of manual dexterity skills, understanding common laboratory apparatus and handling biological macromolecules and living cells. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031(or 2081), CHEM 2038(or 2088), CHEM 2061(or 2091) and 2068(or 2098) with a C- or higher. Max Hours: 1 Credit.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031(or 2081), CHEM 2038(or 2088), CHEM 2061(or 2091) and 2068(or 2098) with a C- or higher.

BIOL 3074 - Human Reproductive Biology (3 Credits)

Comprehensive study of anatomy and physiology of human reproduction. Embryogenesis of male and female reproductive systems and detailed analysis of contraception, world population growth, population control and implications of population growth are also covered. Note: Students will not receive credit for this class if they have already received credit for BIOL 4074. Prereq: BIOL 3611 with a C- or higher. Max hours: 3 Credits. Grading Basis: Letter Grade
Prereq: BIOL 3611 with a C- or higher

BIOL 3104 - Behavioral Genetics (3 Credits)

Interdisciplinary course on relationships between behavior and heredity, with emphasis on human behavioral genetics. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Cross-listed with PSYC 3104. Max hours: 3 Credits. Grading Basis: Letter Grade
Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

BIOL 3124 - Introduction to Molecular Biology (3 Credits)

Provides an understanding of the structure and function of genetic material, with respect to the regulation of gene expression and protein synthesis. Emphasizes eukaryotic systems and understanding the significance of contemporary laboratory-based research. Prereq: BIOL 3832 with a grade of C- or higher. Term offered: fall. Max hours: 3 Credits. Grading Basis: Letter Grade
Prereq: BIOL 3832 with a C- or higher
Typically Offered: Fall.

BIOL 3134 - Advanced Topics (1-8 Credits)

Periodic examination of current topics in the field of biology. (See Schedule Planner for current topics). Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Repeatable. Max hours: 9 Credits. Grading Basis: Letter Grade
Repeatable. Max Credits: 9.
Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.
Typically Offered: Fall, Spring.

BIOL 3137 - Advanced Special Topics with Lab (1-15 Credits)

Periodic examination of current topics in the field of biology. (See Schedule Planner for current topics). Prereq: BIOL 2010 (or 2061/2097/2030) and BIOL 2011 (or 2081/2098/2031) and BIOL 2020 (or 2051/2095/2040) and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Max hours: 15 Credits. Grading Basis: Letter Grade
Repeatable. Max Credits: 15.
Prereq: BIOL 2010 (or 2061/2097/2030) and BIOL 2011 (or 2081/2098/2031) and BIOL 2020 (or 2051/2095/2040) and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

BIOL 3225 - Human Physiology (4 Credits)

Human physiology is the study of how systems within the human organism operate, interact and are regulated in order to maintain a state of homeostasis. Upon completion of the course, a student should expect to have mastery of content material related to organ systems, for example the nervous system, skeletal muscle system, and reproductive system. Also upon completion of the course, a student should expect to improve professional competencies including their ability to apply systems and scientific thinking and communication related to physiology. Note: This is a combined lecture and lab course. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031 (or 2081), CHEM 2038 (or 2039/2088), CHEM 2061 (or 2091) and 2068 (or 2069/2098) with a C- or higher. Term offered: fall, spring. Max hours: 4 Credits. Grading Basis: Letter Grade
Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031 (or 2081), CHEM 2038 (or 2039/2088), CHEM 2061 (or 2091) and 2068 (or 2069/2098) with a C- or higher.
Typically Offered: Fall.

BIOL 3244 - Human Anatomy (5 Credits)

This course introduces structural aspects of the human body from a systems-based approach, in both lecture and laboratory. The systems addressed include the integument, skeletal, muscular, nervous, digestive, respiratory, circulatory, immune, renal, reproductive and endocrine systems. Anatomical models, microscope slides and human cadavers are used in lab. Note: This is a combined lecture and lab course. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Term offered: fall, spring. Max hours: 5 Credits. Grading Basis: Letter Grade
Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.
Typically Offered: Fall, Spring.

BIOL 3330 - Plant Diversity (3 Credits)

Surveys all major plant groups using evolutionary and ecological principles to interpret patterns of diversity in form and function. Topics include reproduction and life cycles, adaptations and ecological interactions, paleobotany and biogeography, classification and taxonomy and evolution. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Max hours: 3 Credits. Grading Basis: Letter Grade
Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

BIOL 3411 - Principles of Ecology (3 Credits)

A lecture course that examines the interrelationships between organisms and their environments. Subject matter includes organism, population and ecosystem levels of study and application to current environmental issues. The emphasis is on the underlying principles of ecology that involve all types of organisms. Note: Satisfies core ecology requirement for biology major. May not be used as upper division biology elective. No co-credit with BIOL 3412. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Term offered: fall, spring, summer. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

Typically Offered: Fall, Spring, Summer.

BIOL 3413 - Ecology Laboratory (2 Credits)

Provides hands-on experiences in ecology and appreciation for using research tools to study ecological systems. Students will learn a wide range of techniques and concepts related to population, community, ecosystem, urban, and physiological ecology. Prereq: Students must have completed BIOL 3411 (Principles of Ecology) with a C- or higher, or be concurrently enrolled in BIOL 3411 in order to enroll in this course. Max hours: 2 Credits.

Grading Basis: Letter Grade

Prereq or Co-req: BIOL 3411 with a C- or higher

BIOL 3445 - Introduction to Evolution (3 Credits)

Introduction to the processes and patterns of evolution. Topics include: history of evolutionary thought, origin of life, evidence for evolution, phylogenetics, evolutionary genetics, natural selection and other evolutionary forces, speciation and biodiversity, evolution of sexual reproduction and social organization. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Term offered: fall, spring, summer. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

Typically Offered: Fall, Spring, Summer.

BIOL 3521 - Vertebrate Biology (3 Credits)

The Subphylum Vertebrata consists of fish, amphibians, reptiles, birds and mammals—some of the most fascinating and most threatened species on earth. This course covers the evolution, taxonomy, anatomy, physiology, ecology and conservation of these organisms. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

BIOL 3525 - Parasitology (3 Credits)

This course is designed to provide a foundation in parasitology and to improve skills in scientific writing to students interested in biodiversity, veterinarian medicine, public health, & health care. Prokaryotes are addressed briefly; the focus of this course is the natural history of 'traditional' eukaryotic parasites. Topics include evolutionary associations of parasites with plants and animals (including humans), modes of transmission, and general life cycles. Subject matter includes basic anatomy, epidemiology, and physiology, with a brief introduction to immunology. Note: may be used as an upper-division biology elective. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

BIOL 3611 - General Cell Biology (3 Credits)

Covers the structure and function of the cell including bioenergetics, membranes, secretion, respiration and the cell cycle. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031 (or 2081), CHEM 2038 (or 2088), CHEM 2061 (or 2091) and 2068 (or 2098) with a C- or higher. Term offered: fall, spring, summer. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031 (or 2081), CHEM 2038 (or 2088), CHEM 2061 (or 2091) and 2068 (or 2098) with a C- or higher.

Typically Offered: Fall, Spring, Summer.

BIOL 3612 - Cell Biology Laboratory (3 Credits)

Laboratory course covering topics in cell and molecular biology, such as protein folding, membrane potential, organelle function, cell signaling and fertilization; as well as associated methods, including microscopy, cell culture and PCR. Basic skills are emphasized in recitation and laboratory. Prereq: General cell biology with a grade of "C-" or higher or permission of instructor. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

BIOL 3621 - Introduction to Immunology (3 Credits)

Provides an introduction to the basic concepts of immunology, including development of the immune system, innate immunity, aspects of the adaptive immune system, and the role of the immune system in disease, as well as allergies and autoimmunity. Prereq: BIOL 3611 and 3832 with a C- or higher. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 and 3832 with a grade of C- or higher

BIOL 3640 - Mammalogy (4 Credits)

Lecture, laboratory, and required field trips. This course provides a general overview of the biology of mammals, including their diversity, distribution, economic importance, and other characteristics that make them of special interest to humans. Coverage will be worldwide, with special emphasis placed on the mammals of Colorado. Note: Students will not receive credit for this class if they have already received credit for BIOL 4640. Prereq: BIOL 3411 with a grade of C- or higher. Max hours: 4 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3411 with C- or higher.

BIOL 3650 - General Microbiology (3 Credits)

Covers all aspects of the biology of microorganisms: their cellular structures and function, growth and metabolism, general and molecular genetics, diversity and interactions with other organisms and the environment (ecology). The objective is to provide students with a thorough introduction to microbiology including basic micro-biological laboratory techniques. Note: This is a combined lecture and lab course. No co-credit with BIOL 3654. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031(or 2081), CHEM 2038(or 2088), CHEM 2061(or 2091) and 2068(or 2098) with a C- or higher. Term offered: fall, spring. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) AND CHEM 2031(or 2081), CHEM 2038(or 2088), CHEM 2061(or 2091) and 2068(or 2098) with a C- or higher.

Typically Offered: Fall, Spring.

BIOL 3651 - General Microbiology Lab (2 Credits)

Covers all aspects of the biology of microorganisms: their cellular structures and function, growth and metabolism, general and molecular genetics, diversity and interactions with other organisms and the environment (ecology). The objective is to provide students with a thorough introduction to microbiology including basic micro-biological laboratory techniques. No co-credit with BIOL 3654. Prereq or Coreq: BIOL 3650. Term offered: fall, spring. Max hours: 2 Credits.

Grading Basis: Letter Grade

Prereq/Coreq: BIOL 3650.

Typically Offered: Fall, Spring.

BIOL 3763 - Biostatistics (4 Credits)

Introduces statistical thinking in biology. Emphasizes data exploration and probability-based inference methods including estimation, testing, and confronting models with data. Concepts and examples for general and applied biology, including ecology and the health sciences. Includes exposure to statistical software. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) and MATH 1109, or MATH 1110, or MATH 1120, or 1130, or 1401, or 2411, or 2421 or 2830 with a C- or higher. Term offered: fall, spring. Max hours: 4 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) and MATH 1109 or MATH 1110 or MATH 1120, or 1130, or 1401, or 2411, or 2421 or 2830 with a C- or higher.

Typically Offered: Fall, Spring.

BIOL 3804 - Developmental Biology (3 Credits)

Covers gamete development, fertilization, and embryo development including establishing body axes, tissue differentiation and organ formation. Note: Students will not earn credit for BIOL 3804 if they have earned credit for BIOL 4054 and will not earn credit for BIOL 4054 if they have earned credit for BIOL 3804. Prereq: General cell biology with a grade of "C-" or higher. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

BIOL 3832 - General Genetics (3 Credits)

Introduces molecular, classical, developmental and population genetics. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Term offered: fall, spring, summer. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

Typically Offered: Fall, Spring, Summer.

BIOL 3840 - Independent Study (1-3 Credits)

Student will contribute to ongoing faculty or graduate student's lab or field-based investigation that makes an original intellectual or creative contribution to the discipline. Associated coursework includes scientific reading/writing/presentation(s). Prereq: Students must have completed one year of general biology with a grade of "C-" or higher and must submit a special processing form completely filled out and signed by the student and faculty member, describing the course expectations, assignments and outcomes, to the CLAS undergraduate advising office for approval. Term offered: fall, spring, summer. Repeatable. Max hours: 6 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 6.

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

Typically Offered: Fall, Spring, Summer.

BIOL 3939 - Internship (1-3 Credits)

Approved internships will provide opportunities to apply classroom knowledge in a professional environment and expand the student's knowledge of biology. Associated coursework includes scientific reading/writing and presentation(s). Prereq: BIOL 2051 or 2095 and BIOL 2061 or 2097 with a C or higher AND have junior level standing with a 2.75 GPA. Term offered: fall, spring, summer. Repeatable. Max Hours: 9 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 9.

Prereq: BIOL 2051 or 2095 and BIOL 2061 or 2097 with a C or higher AND have junior level standing with a 2.75 GPA.

Typically Offered: Fall, Spring, Summer.

BIOL 4024 - Introduction to Biotechnology (3 Credits)

Introduces aspects of biotechnology within a historical context, including medical, forensic, agricultural and microbial biotechnology. Addresses principles behind state-of-the-field techniques in recombinant DNA technology, bioinformatics, proteomics and genomics. Biotechnology regulations and ethics will also be discussed. Prereq: BIOL 3832 with a C- or higher. Cross-listed with BIOL 5024. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3832 with a C- or higher

BIOL 4050 - Advanced Biology Topics (1-8 Credits)

Examines current topics in the field of biology. Topics vary from term to term. See Schedule Planner for current topics. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Cross-listed with BIOL 5050. Repeatable. Max Hours: 8 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 8.

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

BIOL 4052 - Advanced Ecology (3 Credits)

This combination seminar and lecture course focuses on state-of-field knowledge, current theories and recent models in selected areas of ecology, such as theoretical ecology, evolutionary ecology, population biology and ecosystems ecology. Prereq: Students must have completed BIOL 3411 (Principles of Ecology) with a C- or higher, in order to enroll in this course. Cross-listed with BIOL 5052. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3411 with C- or higher.

BIOL 4053 - Disease Ecology (3 Credits)

The study of the underlying principles that influence the spatio-temporal patterns of infectious disease in environments. Students will apply ecological theories about concepts such as biodiversity, trophic interactions, landscape structure, and nutrient cycling to the study of disease. Prereq: Students must have completed BIOL 3411 (Principles of Ecology) with a C- or higher, in order to enroll in this course. Cross-listed with BIOL 5053. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3411 with C- or higher.

BIOL 4055 - Virology (3 Credits)

This is an upper level undergraduate/graduate class providing an in-depth study of the history of virology, different types of viruses, viral disease, research to combat viral infections, and different uses of viruses in biotechnology. Note: Students will not earn credit for this course if they have already earned credit for BIOL 4051 or BIOL 5051. Prereq: BIOL 3611 with a grade of C- or higher. Cross-listed with BIOL 5055. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

BIOL 4064 - Cell Biology of Disease (3 Credits)

Builds on the foundations laid in the prerequisite courses. How alterations in membrane transport, autophagy, mitochondria, lysosomes, cilia, unfolded protein response and autophagy lead to major human diseases. A major emphasis is the control and integration of cellular activities. Prereq: General cell biology with a C- or higher. One semester of Biochemistry is strongly recommended for optimal student success. Cross-listed with BIOL 5064. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

BIOL 4125 - Molecular Biology Laboratory (3 Credits)

Provides hands-on experiences in molecular biology and an appreciation for using the tools of molecular biology to study biological systems. Emphasis is placed on DNA cloning, PCR, mRNA and protein detection in the context of gene editing. Experimental design and the theories underlying the techniques are also discussed. Prereq: BIOL 3124 with a C- or higher or Coreq: BIOL 3124. Cross-listed with BIOL 5125. Term offered: spring. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3124 with a C- or higher or Coreq: BIOL 3124

Typically Offered: Spring.

BIOL 4126 - Molecular Genetics (3 Credits)

Examines molecular techniques and their application to experimental genetics, specifically organization and mapping of genomes, application and model systems in defining hereditary components of disease, and mechanisms of identifying mutations and their implications for disease. Also addresses application of recombinant DNA technology. Prereq: Completion of Introduction to Molecular Biology with a C- or higher is required in order for students to enroll in this course. Cross-listed with BIOL 5126. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3124 with a C- or higher

BIOL 4128 - Topics in Molecular Biology (3 Credits)

Literature-based course examining the regulation of gene expression in eukaryotic systems, as well as contemporary recombinant DNA technology and applications of molecular cloning techniques. Prereq: BIOL 3124 with a C- or higher; biochemistry strongly recommended. Cross-listed with BIOL 5128. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3124 with a C- or higher

BIOL 4134 - Human Genetics (3 Credits)

Advanced survey of the current status of the field. Emphasis on understanding, diagnosis and treatment of genetic disease and on the impact of molecular biology on human genetics. Cross-listed with 5134. Prereq: General genetics with a grade of "C-" or higher. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3832 with a grade of C- or higher

BIOL 4144 - Medical Microbiology (3 Credits)

Provides an understanding of the relationship between pathogenic organisms and their host. Emphasis is placed on the area of medical bacteriology, with attention given to mechanisms of pathogenesis, genetics of disease, serology and treatment. Prereq: general microbiology with a grade of "C-" or higher. Cross-listed with BIOL 5144. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3654 with a grade of C- or higher

BIOL 4154 - Conservation Biology (3 Credits)

Basic concepts and theories in ecology, population biology and genetics as they apply to issues relating to the preservation of biodiversity, such as the genetics of small populations, captive propagation, restoration ecology and the design of nature reserves. Prereq: Students must have completed BIOL 3411 (Principles of Ecology) with a C- or higher, in order to enroll in this course. Cross-listed with BIOL 5154. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3411 with C- or higher.

BIOL 4165 - Neurobiology (3 Credits)

Overview of neuroscience, covering the cellular basis of neuronal activity, sensory structures and the structure and function of the human brain. Prereq: BIOL 3611 and PSYC 2220 with a C- or higher OR BIOL 3225 with a C- or higher. Cross-listed with BIOL 5165. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 and PSYC 2220 with a C- or higher OR BIOL 3225 with a C- or higher.

BIOL 4225 - Genomics and Bioinformatics (3 Credits)

Explores how genome-wide data are collected and analyzed. Example applications include human disease, microbial evolution, ecological genomics, and parasite drug resistance. Students implement projects based on real DNA sequencing data. Prereq: BIOL 3832 with a C- or higher. Cross-listed with BIOL 5225. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prerequisite: BIOL 3832 with a C- or higher.

BIOL 4250 - Mechanisms of Animal Behavior (3 Credits)

The proximate and ultimate mechanisms of animal behavior are analyzed using comparative animal examples from the scientific literature.

Proximate mechanisms include genetic and physiological processes.

Ultimate mechanisms include the role of natural and sexual selection in the evolution of behavior. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher. Genetics and human physiology are recommended. Cross-listed with BIOL 5250. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

BIOL 4335 - Plant Structure and Development (4 Credits)

Inclusive and in-depth study of functional anatomy and biology of vascular plants. Topics include: plant biochemistry, biology of the plant cell, simple and complex tissues, secretory structures, functional anatomy, primary and secondary growth, angiosperm reproduction and life cycles, development and additional topics. Responsibilities include lectures, lab, and potential field trips. Course must be taken with both lecture and lab together. Prereq: One year of General Cell Biology (BIOL 3611) with a grade of "C-" or higher. Cross-listed with BIOL 5335. Max hours: 4 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

Typically Offered: Spring.

BIOL 4345 - Flora of Colorado (4 Credits)

Inclusive and in-depth study of functional anatomy and biology of vascular plants. Topics include: plant biochemistry, biology of the plant cell, simple and complex tissues, secretory structures, functional anatomy, primary and secondary growth, angiosperm reproduction and life cycles, development and additional topics. Responsibilities include lectures, lab, and potential field trips. Course must be taken with both lecture and lab together. Prereq: Students must have completed BIOL 3411 (Principles of Ecology) with a C- or higher, in order to enroll in this course. Cross-listed with BIOL 5345. Max hours: 4 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3411 with C- or higher.

BIOL 4415 - Applied Microbial Ecology (3 Credits)

An in-depth study of ecology as it relates to microorganisms; abiotic and biotic interactions within microbial populations in macro- and microhabitats; and the role of microorganisms in influencing and responding to environmental conditions in natural and anthropogenic ecosystems. Emphasis is placed on how the ecology of microorganisms impacts how we engage with our environment. Prereq: General microbiology with a grade of "C-" or higher. Cross-listed with BIOL 5415. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3654 with a grade of C- or higher

Typically Offered: Fall, Spring.

BIOL 4425 - Biogeography (3 Credits)

An in-depth study of biological populations through analysis of geographic distribution patterns in space and time. Emphasis on how biogeography informs studies of evolution and ecology and on applied studies in conservation, sustainability, epidemiology, and disease dynamics. Prereq: Students must have completed BIOL 3411 (Principles of Ecology) with a C- or higher, in order to enroll in this course. Cross-listed with BIOL 5425. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3411 with C- or higher.

BIOL 4430 - Introduction to Spatial Ecology (3 Credits)

Focuses on patterns of life and ecological interactions in space. Emphasis on drivers of patterns, practical application of spatial ecology software, programming, and introductory spatial statistics on the quantification of patterns. Main topics: Scale and scaling, pattern development, detecting and characterizing patterns, temporal dynamics, and implications of spatial structure to conservation biology, resilience, and ecosystem functioning. Cross-listed with BIOL 5430. Prereq: BIOL 3411 with C- or higher. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3411 with C- or higher.

BIOL 4460 - Environmental Toxicology (3 Credits)

Text and literature-based course provides students with background knowledge concerning environmental toxins, the nature and extent of environmental contamination, and toxicant effects on individual organisms and populations. Prereq: BIOL 3611 with a grade of C- or higher. Cross-listed with BIOL 5460. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

BIOL 4464 - Exercise Physiology (3 Credits)

This course addresses the dynamic physiological changes associated with exercise. Where human physiology addresses physiological processes at rest, this course explores how the cardiovascular, respiratory, nervous and endocrine systems support increased energy transfer as skeletal muscle becomes more active. Prereq: Human Physiology (BIOL 3225 or equivalent) with a grade of C- or higher. Cross-listed with BIOL 5464. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3225 with a grade of C- or higher

BIOL 4475 - Mechanisms of Human Pathology (3 Credits)

Studies physiological, cellular and biochemical processes in human diseases. Mechanisms of inflammatory diseases, infectious diseases, neoplastic diseases, and others will be examined. Prereq: BIOL 3225 or BIOL 3244 with a grade of C- or higher. Cross-listed with BIOL 5475. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prerequisite: BIOL 3225 or BIOL 3244 with a C- or higher

BIOL 4494 - Population and Evolutionary Genetics (3 Credits)

Introduces the genetic processes underlying evolutionary change in microbial, plant and animal populations. Topics include: sources of variation, Hardy-Weinberg equilibrium, population genetic structure, natural selection and other evolutionary forces, quantitative genetics and molecular phylogenetics. Emphasis on experimental data. Prereq: Completion of General Genetics and Introduction to Evolution with a C- or higher is required in order for students to enroll in this course. Cross-listed with BIOL 5494. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3832 and BIOL 3445 with a C- or higher

BIOL 4550 - Cell Signaling (3 Credits)

Lecture by faculty and student presentations cover mechanism of hormones and regulation of various cellular processes through second messenger systems. Prereq: General cell biology with a grade of "C-" or higher; one semester of biochemistry recommended. Cross-listed with BIOL 5550. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

BIOL 4622 - Topics in Immunology (3 Credits)

An in-depth study of immunological concepts. Topics will vary from semester to semester and may range from specifics of immune cell responses to tolerance and autoimmunity. Delivery will include lecture, student presentations, and discussion. Prereq: BIOL 3621 with a C- or higher. Cross-listed with BIOL 5622. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3621 with a C- or higher

BIOL 4634 - Biology of Cancer (3 Credits)

Cancer is the second leading cause of death in the United States. This course offers an overview of recent research into the causes, treatments and possible prevention of cancer. Includes a detailed look at the mechanisms of action of various oncogenes. Prereq: BIOL 3611 and BIOL 3832 with a C- or higher. Cross-listed with BIOL 5634. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 and BIOL 3832 with a C- or higher.

BIOL 4644 - Advanced Human Anatomy Laboratory (2 Credits)

Advanced laboratory course in human anatomy. In-depth look at the structural aspects of the human body, emphasizing function. Models, microscope slides, and visual media will supplement cadaver-based dissections. Prereq: One year of general biology and human anatomy with a grade of "C-" (2.0) or higher. Cross-listed with BIOL 5644. Term offered: fall, spring. Max hours: 2 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3244 with a C- or higher.

Typically Offered: Fall, Spring.

BIOL 4674 - Endocrinology (3 Credits)

This systematic survey of the endocrine system looks at the cellular basis and biochemical characteristics of individual endocrine tissues. Their function in the regulation of other endocrinological, physiological, and behavioral events is analyzed. The course emphasizes the human system and complements studies in physiology, behavior and neurobiology. Prereq: BIOL 3611 with a grade of C- or higher. Students will not earn credit for this course if they have already earned credit for BIOL 4674. Cross-listed with BIOL 5674. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3611 with a C- or higher

BIOL 4780 - Aquatic Ecology (3 Credits)

This course explores the physical, chemical, and biological (including human) properties of aquatic ecosystems, and how the interrelationships between these properties define and influence advanced ecological processes. Special focus is given to lakes, reservoirs, wetlands, streams, rivers, and groundwater. Learning is facilitated through lectures, discussions, student presentations, laboratory and data exercises, and periodic (often virtual) field excursions. Prereq: BIOL 2010 (or 2061/2097/2030) and BIOL 2011 (or 2081/2098/2031) with a C- or higher. Cross-listed with BIOL 5780, ENVS 4780, and ENVS 5780. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030) and BIOL 2011 (or 2081/2098/2031) with a C- or higher.

BIOL 4815 - Structural Biology of Neurodegenerative Diseases (3 Credits)

Advanced course in Biochemistry/Biophysics. Principles of Protein Folding, Structure-Function Relationship, and spectroscopic techniques related to characterization of these processes as applied to neurodegenerative diseases such as Parkinson's and Alzheimer's. Prereq: 1) BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041), and 2) CHEM 3810 or CHEM 4810 or CHEM 5810 with a C- or higher. Coreq: PHYS 2020 or PHYS 2331. Cross-listed with CHEM 4815, CHEM 5815, and BIOL 5815. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: 1) BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041), and 2) CHEM 3810 or CHEM 4810 or CHEM 5810 with a C- or higher. Coreq: PHYS 2020 or PHYS 2331

BIOL 4825 - Biochemistry of Metabolic Disease (3 Credits)

Advanced course in biochemistry. An expanded study of selected topics in metabolism and how they relate to diseases, including inflammation, diabetes, obesity, and rare genetic disorders. Prereq: 1) BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041), and 2) CHEM 3810 or CHEM 4810 or CHEM 5810 with a C- or higher. Coreq: PHYS 2020 or PHYS 2331. Cross-listed with CHEM 4825, CHEM 5825, and BIOL 5825. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: 1) BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041), and 2) CHEM 3810 or CHEM 4810 or CHEM 5810 with a C- or higher. Coreq: PHYS 2020 or PHYS 2331

BIOL 4835 - Biochemistry of Gene Regulation and Cancer (3 Credits)

Explores the biochemical and molecular aspects of cancer biology. Topics include DNA mutations and repair, gene regulation, oncogenes and tumor suppressors, stem cells and differentiation, and cancer drug development. Prereq: 1) BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041), and 2) CHEM 3810 or CHEM 4810 or CHEM 5810 with a C- or higher. Coreq: PHYS 2020 or PHYS 2331. Cross-listed with CHEM 4835, CHEM 5835, and BIOL 5835. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: 1) BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041), and 2) CHEM 3810 or CHEM 4810 or CHEM 5810 with a C- or higher. Coreq: PHYS 2020 or PHYS 2331

BIOL 4840 - Independent Study (1-6 Credits)

Student will contribute to ongoing faculty or graduate student's lab or field-based investigation that makes an original intellectual or creative contribution to the discipline. Associated coursework includes scientific reading/writing/presentation(s). Note: Registration by special processing form only. Prereq: Students must have completed one year of general biology with a grade of "C-" or higher and must submit a special processing form completely filled out and signed by the student and faculty member, describing the course expectations, assignments and outcomes, to the CLAS undergraduate advising office for approval. Term offered: fall, spring, summer. Repeatable. Max Hours: 12 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 12.

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041) with a C- or higher.

Typically Offered: Fall, Spring, Summer.

BIOL 4880 - Directed Research (1-6 Credits)

A student designed lab or field-based investigation that involves data collection, and that makes an original intellectual or creative contribution to the discipline. Note: Students must submit a special processing form completely filled out and signed by the student and faculty member, describing the course expectations, assignments and outcomes, to the CLAS undergraduate advising office for approval. Term offered: fall, spring, summer. Repeatable. Max Hours: 6 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 6.

Typically Offered: Fall, Spring, Summer.

BIOL 4910 - Field Studies (3 Credits)

Field studies of individuals, populations and communities comprising a specified ecosystem. Emphasis on field identification of vascular plants and vertebrate animals. Topics include the physical environment, biotic and abiotic interactions, life history, ecological adaptations and biogeography. Note: Lectures and a week-long field trip. Prereq: Students must have completed BIOL 3411 (Principles of Ecology) with a C- or higher, in order to enroll in this course. Cross-listed with BIOL 5910.

Repeatable. Max hours: 6 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 6.

Prereq: BIOL 3411 with C- or higher.

BIOL 4974 - Advanced Evolution (3 Credits)

A capstone course that draws upon concepts from all fields of biology. Topics include the fossil record, mass extinctions, the historical development of the modern synthesis, principles and mechanisms of evolution, current viewpoints and controversies. Prereq: BIOL 3445 and 3832 with a C- or higher. Cross-listed with BIOL 5974. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: BIOL 3445 and 3832 with a grade of C- or higher

BIOL 4990 - Undergraduate Research Seminar (1 Credit)

Introduces research in the biological sciences. Students read current scientific literature, attend related seminars and participate in discussions. This course offers students a chance to interact with visiting scientists, who will present state-of-the-field biological research in a seminar setting. Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), and BIOL 2021 (or 2071/2096/2041), BIOL 3411, BIOL 3445, BIOL 3611 and BIOL 3832 with a C- or higher. Restriction: Restricted to Senior standing or higher with an overall GPA of 3.0 or higher. Cross-listed with BIOL 6655. Max hours: 1 Credit.

Grading Basis: Letter Grade

Prereq: BIOL 2010 (or 2061/2097/2030), BIOL 2011 (or 2081/2098/2031), BIOL 2020 (or 2051/2095/2040), BIOL 2021 (or 2071/2096/2041), BIOL 3411, 3445, 3611 and BIOL 3832 with a C- or higher. Restriction: Senior standing or higher with GPA of 3.0 or higher.