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 - Biotechnology Track, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biology---biotechnology-track-bs/)
- Biology - Human Biology Track, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biology---human-biology-track-bs/)
- Biology - Integrative Biology Track, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biology---integrative-biology-track-bs/)
- Biology - Microbiology Track, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biology---microbiology-track-bs/)
- Biology - Organisms and Ecosystems Track, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/integrative-biology/biology---organisms-ecosystems-track-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

Michael 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, Univeristy 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 1135 - Human Biology (3 Credits)
Topics include: basic human body chemistry, healthy internal body balance, new disease treatments, human inheritance and human beings as part of Earth's living systems. Note: For students who are not majoring in biology. Max hours: 3 Credits.
Grading Basis: Letter Grade
Additional Information: Denver Core Requirement, Biol Phys Sci - Lec.

BIOL 1137 - Human Biology Laboratory (1 Credit)
Lab activities will investigate the function of the human body while emphasizing the use of the scientific method. Intended for non-science majors. Students may not receive credit for this course if they have already received credit for BIOL2011(2081) or 2021(2071). No co-credit with BIOL 1560. Prereq or Coreq: BIOL 1135. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq or Coreq: BIOL 1135.
Additional Information: Denver Core Requirement, Biol Phys Sci - Lab.
Typically Offered: Spring.

BIOL 1400 - Biology for All (3 Credits)
The course will focus on how biology impacts our lives. Foundational concepts (DNA, evolution, and ecology) will be applied to current events. Note: For students who are not majoring in science. Students may not receive credit for this course if they have already received credit for BIOL 2010(2051) or BIOL 2020(2061). No co-credit with BIOL 1550. Max hours: 3 Credits.
Grading Basis: Letter Grade
Additional Information: Denver Core Requirement, Biol Phys Sci - Lec.
Typically Offered: Fall.

BIOL 1401 - Biology for All Laboratory (1 Credit)
Lab activities will investigate DNA, ecology and evolution while emphasizing the use of the scientific method. Intended for non-science majors. 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 BIOL2011(2081) or 2021(2071). No co-credit with BIOL 1550. Prereq or coreq: BIOL 1400. Max hours: 1 Credit.
Grading Basis: Letter Grade
Prereq/Coreq: BIOL 1400.
Additional Information: Denver Core Requirement, Biol Phys Sci - Lab.
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: 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 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: 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 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 2032/2081), and CHEM 2038(or 2039/2088) 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 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 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 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. 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.

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 3226 - Human Physiology (3 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. No co-credit with BIOL 3225. 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) AND CHEM 2031(or 2032/2081), and CHEM 2061(or 2062/2091) 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), BIOL 2021 (or 2071/2096/2041) AND CHEM 2031(or 2032/2081), and CHEM 2061(or 2062/2091) with a C- or higher.
Typically Offered: Fall, Spring.

BIOL 3227 - Human Physiology Lab (1 Credit)
The focus of this laboratory course is on acquainting students with the practical aspects of physiological experimentation. Emphasis on data interpretation and experimental design. Students often collect non-invasive data on themselves as part of the class. Complements the Human Physiology Lecture course. No co-credit with BIOL 3225. Prereq or coreq: BIOL 3226 (or BIOL 3225) with a C- or higher. Term offered: fall, spring. Max hours: 1 Credit.
Grading Basis: Letter Grade
Prereq or coreq: BIOL 3226 (or BIOL 3225) with C- or higher.
Typically Offered: Fall, Spring.

BIOL 3240 - Human Anatomy Lecture (3 Credits)
Introduces the structural aspects of the human body, from proteins and organelles to tissues to organs and organ systems. No co-credit with BIOL 3244. 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: 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.

BIOL 3241 - Human Anatomy Cadaver Lab (2 Credits)
Introduces the structural aspects of the human body, from proteins and organelles to tissues to organs and organ systems utilizing models, images, videos, and human cadavers. No co-credit for BIOL 3242 or BIOL 3244. Prereq or coreq: BIOL 3240. Term offered: fall, spring. Max hours: 2 Credits.
Grading Basis: Letter Grade
Coreq or prereq: BIOL 3240.
Typically Offered: Fall, Spring.

BIOL 3242 - Virtual Human Anatomy Lab (2 Credits)
Introduces the structural aspects of the human body. Images of models, cadavers, videos, microscopic slides, and Visible Body software will be used as materials to become familiar with the structures of the human body. Note: This virtual lab may not be accepted by professional health programs. No co-credit for BIOL 3241 or BIOL 3244. Prereq or coreq: BIOL 3240. Term offered: fall, spring. Max hours: 2 Credits.
Grading Basis: Letter Grade
Coreq or prereq: BIOL 3240.
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 3350 - Diversity of Life (3 Credits)
This course surveys the history and diversity of life. The origins of life are discussed, and fundamental processes that govern all life will be used to organize the diversity of life. While prokaryotes and eukaryotes are represented, there is an emphasis on the evolution, classification and taxonomy, structure and function, and ecology of the major eukaryotic groups: protists, fungi, plants, and animals. 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 2039/2088), CHEM 2061(or 2091) and 2068(or 2069/2098) 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 2032/2081), and CHEM 2038(or 2039/2088) 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 3124 OR BIOL 3832 and 3611 with a grade of C- or higher. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3124 OR BIOL 3832 and 3611 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 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: 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) with a 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). 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 2032/2081), and CHEM 2038(or 2039/2088) 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 2032/2081), and CHEM 2038(or 2039/2088) 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: 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 2032/2081), and CHEM 2038(or 2039/2088) with a C- or higher. Term offered: fall, spring. Max hours: 2 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 2032/2081), and CHEM 2038(or 2039/2088) with a C- or higher.
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 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 AND have a cumulative 2.0 GPA or higher AND be a declared Biology Major or Minor. 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 AND have a cumulative 2.0 GPA or higher AND be a declared Biology Major or Minor.
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 3124 or BIOL 3832 with a C- or higher. Cross-listed with BIOL 5024. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3124 or 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 - Infectious 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. Pre-req: 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 5053. 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 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 Biochemestry 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. Completion of Introduction to Molecular Biology with a C- or higher is required in order for students to enroll in this course. Prereq: BIOL 3124 or BIOL 3832 with a C- or higher. Cross-listed with BIOL 5126. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3124 or BIOL 3832 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 or BIOL 3832 with a C- or higher. Cross-listed with BIOL 5128. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3124 or BIOL 3832 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: BIOL 3124 or BIOL 3832 with a C- or higher. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3124 or BIOL 3832 with a 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: BIOL 3650 (or BIOL 3654) with a grade of C- or higher. Cross-listed with BIOL 5144. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3650 (or 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 3226 (or 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 3226 (or 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 3124 or BIOL 3832 with a C- or higher. Cross-listed with BIOL 5225. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3124 or 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 4274 - Environmental Physiology. (3 Credits)
Lecture. A look at the physiological mechanisms used by animals and plants in adapting to changes in such natural environmental parameters as temperature, light, and water availability. The intent is to lay the groundwork for approaching the study of the effects of changing environments on organisms. Prereq: one year of chemistry and one course in either plant or animal physiology. Max hours: 3 Credits.
Grading Basis: Letter Grade

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: 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 AND junior or higher status. Cross-listed with BIOL 5335. 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) with a C- or higher AND junior or higher status.
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 4410 - Microbial Genomics (3 Credits)
Microbial genomics is being used to address many current medical and environmental challenges (e.g., COVID-19 pandemic, bioremediation of contaminated water). In this class, you will learn how to investigate microbial genomes and predict microbial function (e.g., metabolism, motility) through gene/protein analyses. We will predict microbial responses to environmental conditions such as viral infection (e.g., CRISPR signatures) and antibiotic exposure (e.g., resistance genes). We will apply our knowledge to analyze real microbial genome sequence data and synthesize our findings in a written manuscript format. We will communicate our science to non-scientists in order to deepen our own learning and to make an impact on our communities. Prereq: BIOL3654 or BIOL3650/3651 with a C- or higher. Cross-listed with BIOL 5410. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3650 and BIOL 3651 (or BIOL 3654) with a grade of 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: BIOL 3650 and BIOL 3651 (or BIOL 3654) with a grade of C- or higher. Cross-listed with BIOL 5415. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3650 and BIOL 3651 (or 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 4440 - Ethnobotany: Medicine, Human Health and the Ecosystem Services of Plants (3 Credits)
This course explores various aspects of ethnobotany. One emphasis will be on the utilization of plants in various aspects of life including human health, fiber, nutrition, and shelter, beginning with a consideration of indigenous wisdom and traditions in native cultures, in primarily north, central, and south America. A second major emphasis will be on plant secondary metabolites and their utilization in traditional and modern medications and medical breakthroughs. A third major course emphasis will survey and explore several case-studies on the roles of plants in applied ecological contexts, global economies, and ecosystem services, highlighting case studies in conservation and sustainability. Note: Recommended completion of at least one upper division BIOL 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 AND junior standing. Cross-listed with BIOL 5440. 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 AND junior or higher status.
Typically Offered: Fall.

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 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 5460. 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 4463 - Exercise Physiology (4 Credits)
Examines how the systems of the body function to support increased and sometimes extreme energy expenditure associated with exercise. Laboratory component provides the opportunity to learn about the techniques and measurements associated with the assessment of fitness. Prereq: BIOL 3226 and BIOL 3227 (or BIOL 3225) with a grade of C- or higher. Cross-listed with BIOL 5463. Term offered: fall. Max hours: 4 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3226 and BIOL 3227 (or BIOL 3225) with a grade of C- or higher.
Typically Offered: Fall.

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 3226 and BIOL 3227 (or BIOL 3225) or BIOL 3240 and BIOL 3242 (or BIOL 3244) with a grade of C- or higher. Cross-listed with BIOL 5475. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3226 and BIOL 3227 (or BIOL 3225) or BIOL 3240 and BIOL 3242 (or BIOL 3244) with a grade of 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: BIOL 3124 or BIOL 3832 and BIOL 3445 with a C- or higher. Cross-listed with BIOL 5494. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL 3124 or 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: BIOL3124 OR BIOL 3832, AND BIOL 3611 with a C- or higher. Cross-listed with BIOL 5634. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: BIOL3124 OR BIOL 3832, AND BIOL 3611 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 or coreq: BIOL3240 and 3241 or BIOL3240 and 3242 (or BIOL 3244) with a C- or higher. Cross-listed with BIOL 5644. Term offered: fall, spring. Max hours: 2 Credits.
Grading Basis: Letter Grade
Prereq or coreq: BIOL3240 and 3241 or BIOL3240 and 3242 (or 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. 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.

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. 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.

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: 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 5910. 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.

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.