

BIOLOGICAL SCIENCES

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Why study biology at the University of Denver?

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

Research areas

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

- Cell and molecular biology is supported by major research facilities that include real-time PCR instruments, a DNA WAVE HPLC, a Hitachi transmission electron microscope and an Olympus Fluoview 1000 confocal microscope and other advanced imaging systems.
- Biology, ecology and evolution takes advantage of unique field study sites that include an alpine research station on Mt. Evans in the Arapaho National Forest and collaborative research opportunities with the Denver Botanic Gardens.

Career opportunities

A student who completes the MS degree is in a strong position to pursue a range of postgraduate opportunities, including a career in biotech, academic or government lab or agency, or continued studies in a professional or PhD program. The doctoral degree carries the credential for a professional career in research or academics.

Doctor of Philosophy in Biological Sciences with a Concentration in Biology, Ecology and Evolution

Degree and GPA Requirements

- Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.
- Grade point average: The minimum undergraduate GPA for admission consideration for graduate study at the University of Denver is a cumulative 2.5 on a 4.0 scale or a 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree. An earned master's degree or higher from a regionally accredited institution supersedes the minimum standards for the baccalaureate. For applicants with graduate coursework but who have not earned a master's degree or higher, the GPA from the graduate work may be used to meet the requirement. The minimum GPA is a cumulative 3.0 on a 4.0 scale for all graduate coursework undertaken.
- Program GPA requirement: The minimum undergraduate GPA for admission consideration for this program is a cumulative 2.5 on a 4.0 scale.

Prerequisites

- Students with an undergraduate major in chemistry, physics or mathematics and minimal preparation in biological sciences also will be considered but may be required to take undergraduate courses when the prerequisites are lacking. Course prerequisites include: one year of general chemistry, one year of calculus (recommended), one year of physics, two years of biology and one year of organic chemistry.

Standardized Test Scores

- GRE scores are optional for admission to this program. Applications submitted without scores will receive full consideration. Every application undergoes a comprehensive evaluation, including a careful review of all application materials.

If you choose to submit test scores, you may upload your Test Taker Score Report PDF, which is considered unofficial. Official scores must be received directly from the appropriate testing agency upon admission to the University of Denver. The ETS institution code to submit GRE scores to the University of Denver is 4842.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5

- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

English Conditional Admission: No, this program does not offer English Conditional Admission.

Doctor of Philosophy in Biological Sciences with a Concentration in Cell and Molecular Biology

Degree and GPA Requirements

- Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.
- Grade point average: The minimum undergraduate GPA for admission consideration for graduate study at the University of Denver is a cumulative 2.5 on a 4.0 scale or a 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree. An earned master's degree or higher from a regionally accredited institution supersedes the minimum standards for the baccalaureate. For applicants with graduate coursework but who have not earned a master's degree or higher, the GPA from the graduate work may be used to meet the requirement. The minimum GPA is a cumulative 3.0 on a 4.0 scale for all graduate coursework undertaken.
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- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

English Conditional Admission: No, this program does not offer English Conditional Admission.

Professional Science Master in Biomedical Sciences

Degree and GPA Requirements

- Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.
- Grade point average: The minimum undergraduate GPA for admission consideration for graduate study at the University of Denver is a cumulative 2.5 on a 4.0 scale or a 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree. An earned master's degree or higher from a regionally accredited institution supersedes the minimum standards for the baccalaureate. For applicants with graduate coursework but who have not earned a master's degree or higher, the GPA from the graduate work may be used to meet the requirement. The minimum GPA is a cumulative 3.0 on a 4.0 scale for all graduate coursework undertaken.
- Program GPA requirement: The minimum undergraduate GPA for admission consideration for this program is a cumulative 2.5 on a 4.0 scale.

Prerequisites

- Applicants must earn and submit proof of earning the equivalent of a baccalaureate degree in biology, biochemistry, biomedical sciences or a related field from a regionally accredited institution prior to beginning graduate coursework at DU. Students with an undergraduate major in chemistry, physics or mathematics and minimal preparation in biological sciences will also be considered but may be required to take undergraduate courses when the prerequisites are lacking. Course prerequisites include: two years of biology and one year of chemistry, one year of calculus (recommended), and one year of physics (recommended).

Standardized Test Scores

- GRE, MCAT or DAT scores are optional for admission to this program. Applications submitted without scores will receive full consideration. Every application undergoes a comprehensive evaluation, including a careful review of all application materials.
- If you choose to submit test scores, you may upload your Test Taker Score Report PDF, which is considered unofficial. Official scores must be received directly from the appropriate testing agency upon admission to the University of Denver. The ETS institution code to submit GRE scores to the University of Denver is 4842.

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- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

English Conditional Acceptance Offered: No, this program does not offer English Conditional Admission.

Professional Science Master in Biomedical Sciences with a Concentration in Clinical Exercise Physiology

Degree and GPA Requirements

- Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.
- Grade point average: The minimum undergraduate GPA for admission consideration for graduate study at the University of Denver is a cumulative 2.5 on a 4.0 scale or a 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree. An earned master's degree or higher from a regionally accredited institution supersedes the minimum standards for the baccalaureate. For applicants with graduate coursework but who have not earned a master's degree or higher, the GPA from the graduate work may be used to meet the requirement. The minimum GPA is a cumulative 3.0 on a 4.0 scale for all graduate coursework undertaken.
- Program GPA requirement: The minimum undergraduate GPA for admission consideration for this program is a cumulative 2.5 on a 4.0 scale.

Prerequisites

- Applicants must earn and submit proof of earning the equivalent of a baccalaureate degree in biology, biochemistry, biomedical sciences or a related field from a regionally accredited institution prior to beginning graduate coursework at DU. Students with an undergraduate major in chemistry, physics or mathematics and minimal preparation in biological sciences will also be considered but may be required to take undergraduate courses when the prerequisites are lacking. Course prerequisites include: two years of biology and one year of chemistry, one year of calculus (recommended), and one year of physics (recommended).

Standardized Test Scores

- GRE, MCAT or DAT scores are optional for admission to this program. Applications submitted without scores will receive full consideration. Every application undergoes a comprehensive evaluation, including a careful review of all application materials.
- If you choose to submit test scores, you may upload your Test Taker Score Report PDF, which is considered unofficial. Official scores must be received directly from the appropriate testing agency upon admission to the University of Denver. The ETS institution code to submit GRE scores to the University of Denver is 4842.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

English Conditional Acceptance Offered: No, this program does not offer English Conditional Admission.

Master of Science in Biological Sciences with a Concentration in Biology, Ecology and Evolution

Degree and GPA Requirements

- Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.
- Grade point average: The minimum undergraduate GPA for admission consideration for graduate study at the University of Denver is a cumulative 2.5 on a 4.0 scale or a 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the

baccalaureate degree. An earned master's degree or higher from a regionally accredited institution supersedes the minimum standards for the baccalaureate. For applicants with graduate coursework but who have not earned a master's degree or higher, the GPA from the graduate work may be used to meet the requirement. The minimum GPA is a cumulative 3.0 on a 4.0 scale for all graduate coursework undertaken.

- Program GPA requirement: The minimum undergraduate GPA for admission consideration for this program is a cumulative 2.5 on a 4.0 scale.

Standardized Test Scores

- GRE scores are optional for admission to this program. Applications submitted without scores will receive full consideration. Every application undergoes a comprehensive evaluation, including a careful review of all application materials.

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- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

English Conditional Acceptance Offered: No, this program does not offer English Conditional Admission.

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

Degree and GPA Requirements

- Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.
- Grade point average: The minimum undergraduate GPA for admission consideration for graduate study at the University of Denver is a cumulative 2.5 on a 4.0 scale or a 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree. An earned master's degree or higher from a regionally accredited institution supersedes the minimum standards for the baccalaureate. For applicants with graduate coursework but who have not earned a master's degree or higher, the GPA from the graduate work may be used to meet the requirement. The minimum GPA is a cumulative 3.0 on a 4.0 scale for all graduate coursework undertaken.
- Program GPA requirement: The minimum undergraduate GPA for admission consideration for this program is a cumulative 2.5 on a 4.0 scale.

Standardized Test Scores

- GRE scores are optional for admission to this program. Applications submitted without scores will receive full consideration. Every application undergoes a comprehensive evaluation, including a careful review of all application materials.

If you choose to submit test scores, you may upload your Test Taker Score Report PDF, which is considered unofficial. Official scores must be received directly from the appropriate testing agency upon admission to the University of Denver. The ETS institution code to submit GRE scores to the University of Denver is 4842.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

English Conditional Acceptance Offered: No, this program does not offer English Conditional Admission.

Master of Science in Clinical Exercise Physiology

Degree and GPA Requirements

- Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.

- Grade point average: The minimum undergraduate GPA for admission consideration for graduate study at the University of Denver is a cumulative 2.5 on a 4.0 scale or a 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree. An earned master's degree or higher from a regionally accredited institution supersedes the minimum standards for the baccalaureate. For applicants with graduate coursework but who have not earned a master's degree or higher, the GPA from the graduate work may be used to meet the requirement. The minimum GPA is a cumulative 3.0 on a 4.0 scale for all graduate coursework undertaken.
- Program GPA requirement: The minimum undergraduate GPA for admission consideration for this program is a cumulative 2.5 on a 4.0 scale.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

English Conditional Acceptance Offered: No, this program does not offer English Conditional Admission.

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

Doctoral Programs

Doctor of Philosophy in Biological Sciences with a Concentration in Biology, Ecology and Evolution

Degree Requirements

The major requirements for completion of the PhD degree are 90 quarter hours of graduate course work and research credit, completion of all candidacy exams, and successful defense of the PhD dissertation. Graduate Students must maintain a minimum GPA of 3.0 and make adequate progress on research as assessed by their adviser and dissertation committee.

Coursework Requirements

The course work includes the following graduate core curriculum:

Code	Title	Credits
BIOL 4220	Grad Sem: Ecology & Evolution	
BIOL 4090 or BIOL 4085	Biostatistics Accelerated Biostatistics	
BIOL 4095	Research Methods and Analysis	
BIOL 4330	Foundations in Literature: Ecology (3 terms required)	
BIOL 4231	Responsible Conduct in Rsrch	
BIOL 4991 or BIOL 4995	Independent Study (*) Independent Research	

- Courses that the dissertation committee judges to complement the student's major field also may be used.

Total Credits **90**

Non-coursework requirements

Additional requirements are attendance at departmental seminars, passing performance in the qualifying examination and the research proposal examination, presentation of one departmental seminar per year, completion of a research dissertation of publishable quality, and successful oral defense of the dissertation. PhD students are required to pass both a qualifying exam and research proposal exam to advance to candidacy.

Up to 10 quarter hours of graduate credit (or a blanket transfer of 45 quarter hours from a previous master's program) may be accepted as transfer credit with approval of the departmental graduate committee and the Office of Graduate Studies.

Doctor of Philosophy in Biological Sciences with a Concentration in Cell and Molecular Biology

Degree Requirements

The major requirements for completion of the PhD degree are 90 quarter hours of graduate course work and research credit, completion of all candidacy exams, and successful defense of the PhD dissertation. Graduate Students must maintain a minimum GPA of 3.0 and make adequate progress on research as assessed by their adviser and dissertation committee.

Coursework Requirements

The course work includes the 20-credit graduate core curriculum:

Code	Title	Credits
BIOL 4211	Advanced Cell Biology	
BIOL 4212	Advanced Molecular Biology	
BIOL 4213	Advanced Cell Signaling	
BIOL 4310	Foundations in Literature: Cell and Molecular Biology (3 terms required)	
BIOL 4090 or BIOL 4085	Biostatistics Accelerated Biostatistics	
BIOL 4231	Responsible Conduct in Rsrch	
BIOL 4991 or BIOL 4995	Independent Study (*) Independent Research	
• Courses the dissertation committee judges to complement the student's major field also may be used.		
Total Credits		90

Non-coursework requirements

Additional requirements are attendance at departmental seminars, passing performance in the qualifying examination and the research proposal examination, presentation of one departmental seminar per year, completion of a research dissertation of publishable quality, and successful oral defense of the dissertation. PhD students are required to pass both a qualifying exam and research proposal exam to advance to candidacy.

Up to 10 quarter hours of graduate credit (or a blanket transfer of 45 quarter hours from a previous master's program) may be accepted as transfer credit with approval of the departmental graduate committee and the Office of Graduate Studies.

Professional Science Master Programs

Professional Science Master in Biomedical Sciences

The Professional Science Master's (PSM) program in Biomedical Sciences offers rigorous academic training and professional practical skills to prepare students for challenging careers in the biomedical and health sciences. Through advanced coursework in the natural sciences and complementary coursework, students gain in-depth scientific knowledge and a strong foundation in ethics, leadership, communication and professional skills. Furthermore, the students will gain awareness of the many issues, concerns, and future directions of health and biomedical sciences fields.

This multi- and inter-disciplinary program is designed to be very individualized with one-on-one advising to customize the curriculum and capstone internship in order to complement and expand on the student's past academics and experiences and to prepare them for their future career goals. The student is matched with a capstone mentor whose professional experiences aligns with the student's future career goals. The overall goal of the capstone experience is for the student to gain advanced disciplinary knowledge and professional skills by applying the appropriate modes of inquiry, research and professional skills to address a specific problem or concern in the biomedical sciences.

The PSM program emphasizes active communication with an external Advisory Board to ensure that the curriculum and capstone experiences are relevant and beneficial to both students and the bioscience and healthcare industries. The advisory board, comprised of leaders in biomedical research, biotechnology, clinical healthcare, health institutions and hospital administration, provides input regarding the knowledge and skill set and professional competencies most sought by employers and academic graduate programs in biomedical fields. This Master's program is recognized and approved as an affiliated PSM program with the National Professional Science Association.

Professional Science Master in Biomedical Sciences

Degree Requirements

Coursework Requirements

Code	Title	Credits
Required Courses		
BIOL 4085	Accelerated Biostatistics	2
BIOL 4155	Leadership in Science	1

BIOL 4211 or BIOL 4213	Advanced Cell Biology Advanced Cell Signaling	3
BIOL 4212	Advanced Molecular Biology	3
BIOL 4231	Responsible Conduct in Rsrch	1
BIOL 4310 or BIOL 4331	Foundations in Literature: Cell and Molecular Biology Foundations in Literature: Evolution	2
Must be taken 2 times.		
BIOL 4870	Medical Ethics	4
BIOL 4880	Capstone in Biomedical Sciences	4
BIOL 4980	Internship in Biomedical Sciences	2
BIOL 4991	Independent Study	1

Elective Courses **20**

Electives can be chosen from the approved list of existing elective courses in consultation with the Program Director. Additional upper level (3000- or 4000-level) elective courses will be considered with approval of the Program Director.

Natural Sciences

BIOL 3005	Science Communication	4
BIOL 3025	Science and the Law	2,4
BIOL 3110	Special Topics: Biology	1-4
BIOL 3120	General Microbiology	4
BIOL 3145	Cellular and Molecular Biology of Cancer	4
BIOL 3150	Intracellular Dynamics	4
BIOL 3160	Biophysics: Ion Channels & Disease	4
BIOL 3241	Anatomy and Physiology of the Skeletal, Nervous and Muscular systems	5
BIOL 3242	Human Anatomy and Physiology - Systems of homeostasis	5
BIOL 3251	Exercise Physiology	4
BIOL 3252	High Altitude Physiology	4
BIOL 3253	Environmental Physiology of Animals	4
BIOL 3256	Advanced Human Anatomy & Physiology	5
BIOL 3260	Nutritional Physiology	3
BIOL 3280	Intro to Pathophysiology	4
BIOL 3410	Animal Behavior	4
BIOL 3560	Molecular Biology Laboratory	4
BIOL 3570	Proteins in Biological Systems	4
BIOL 3610	Developmental Biology	4
BIOL 3615	Blood Vessel Development and Disease	4
BIOL 3630	Cell Biology of Development	4
BIOL 3640	Introductory Neurobiology	4
BIOL 3641	Systems Neuroscience	4
BIOL 3642	Neuropharmacology	4
BIOL 3644	Neuromuscular Pathophysiology	4
BIOL 3647	Neuroscience of Movement	4
BIOL 3648	Molecular Mechanisms of Neurological Disease	4
BIOL 3649	Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics	4
BIOL 3650	Endocrinology	4
BIOL 3656	Cellular Aspects of Diabetes and Obesity	4
BIOL 3670	Molecular Immunology	4
BIOL 3675	Virology	4
BIOL 3702	Advanced Topics in Regulatory Biology	1-4
BIOL 3704	Advanced Topics in Cell Biology	1-4
BIOL 3705	Advanced Topics in Molecular Biology	1-4
BIOL 3708	Topics in Integrative Physiology	2-4
BIOL 3800	Human Molecular Biology	4

BIOL 3850	Genetic Engineering	4
BIOL 3855	Genetic Model Organisms in Health & Disease	4
BIOL 3910	Viruses & Infectious Human Diseases	4
BIOL 3920	Forensic Pathology	2-4
BIOL 4095	Research Methods and Analysis	4
BIOL 4500	Clinical Exercise Physiology	5
BIOL 4510	Exercise Testing & Prescription	4
BIOL 4515	Research Techniques in Exercise Physiology	4
BIOL 4530	Advanced Cardiovascular and Pulmonary Physiology	4
BIOL 4540	Electrocardiogram Interpretation	2
HLTH 3600	Cultural Responsiveness in Health Care	2
HLTH 3700	Topics in Health	1-4
CHEM 3811	Biochemistry-Proteins	3
CHEM 3812	Biochemistry-Membranes/Metabolism	3
CHEM 3813	Biochemistry-Nucleic Acids	3
CHEM 3820	Biochemistry Lab	3
CHEM 3831	Advanced Protein Biochemistry	3
Global Health		
GEOG 3755	Geography of Health	4
INTS 4362	Gender and Health	4
INTS 4367	Global Health Affairs	4
INTS 4368	HIV & AIDS in International Affairs	4
INTS 4423	Introduction to Epidemiology	4
INTS 4435	Health and Development	4
INTS 4516	Major Diseases in Global Health (From Pathophysiology to Action)	4
INTS 4557	Cross-Cultural Communications	4
Social Sciences		
ANTH 4320	Medical Anthropology	4
CNP 4707	Introduction to Integrated Health	3
CNP 4772	Diversity Seminar: Psycho-Social Issues	1-5
CNP 4778	Health Psychology	3
CNP 4784	Psychopathology	5
CNP 4788	Physiological Psychology	3
CNP 4789	Pharmacology of Addictive Behavior I and II	4
PSYC 3020	Adolescence	4
PSYC 4011	Proseminar in Emotion	4
PSYC 4045	Proseminar in Human Brain Development	4
PSYC 4085	Stress & Health	4
PSYC 4262	Affective Neuroscience	4
PSYC 4526	Prosem in Cog Neuroscience	4
PSYC 4571	Multicult Issues & Ment Health	4
PSYC 4688	Clinical Psychopharmacology	4
Engineering		
ENBI 4510	Biomechanics	4
ENBI 4520	Introduction to Cardiovascular Engineering	4
Business		
ACTG 4610	Financial Accounting and Reporting	4
FIN 4630	Managerial Finance	4
INFO 4000	Foundations of Business	4
INFO 4100	Survey of Business Analytics	4
MGMT 4620	Organizational Dynamics	4
MGMT 4630	Strategic Human Resources Management	4

MKTG 4100	Marketing Concepts	4
Public Policy		
PPOL 4400	Introduction to Policy Analysis	4
PPOL 4501	Great Issues Forum	2
PPOL 4502	Issues Forum II	2
PPOL 4600	Regulation and Institutional Analysis	4
PPOL 4700	Public Management & Budgeting	4
Total Credits		45

Minimum credits required for degree: 45

Non-coursework Requirements

- Capstone project- The program requires a capstone project which involves interactions with health or biomedical professions from outside of the DU community. The capstone experience will be culminated in a formal scholarly work (both written and orally presented) that reflects a student's individual professional interest and the integration of science with strong professional skills. Thus, the capstone project includes a written and public oral presentation of the project.

Additional requirements:

- maintain a minimum GPA of 3.0
- successful completion of capstone project
- completion of capstone paper
- successful oral defense of capstone project

Professional Science Master in Biomedical Sciences with a Concentration in Clinical Exercise Physiology

The Professional Science Master's (PSM) in Biomedical Sciences program offers rigorous advanced academic training and professional practical skills in order to prepare students for challenging careers in the biomedical sciences and health sciences. The PSM in Biomedical Sciences is a rigorous one-year academic program requiring 45-credit hours of course work and successful completion of the written and oral defense of a capstone project. The concentration in Clinical Exercise Physiology provides expanding academic offerings in the area of integrative human physiology, as well as advanced knowledge of cardiovascular, pulmonary and metabolic diseases, orthopedic or musculoskeletal, neuromuscular, and neoplastic immunological or hematological diseases.

Students who enroll in the concentration in Clinical Exercise Physiology are required to complete the PSM required coursework and choose from the physiology-selected elective coursework. The physiology coursework is relatively flexible to consider the academic background of the individual student. All coursework plans will be determined in collaboration with the program director and approved by the director. For the concentration in CEP, student will complete a capstone project related to exercise physiology with a capstone mentor who specializes in a specific physiological system and/or exercise physiology.

Professional Science Master in Biomedical Sciences with a Concentration in Clinical Exercise Physiology

Degree Requirements

Minimum credits required for degree: 45

Code	Title	Credits
Required Courses:		25
BIOL 4085	Accelerated Biostatistics	2
BIOL 4155	Leadership in Science	1
BIOL 4211	Advanced Cell Biology	3
or BIOL 4213	Advanced Cell Signaling	
BIOL 4212	Advanced Molecular Biology	3
BIOL 4231	Responsible Conduct in Rsrch	1
BIOL 4310	Foundations in Literature: Cell and Molecular Biology (Must be taken two times)	2
or BIOL 4331	Foundations in Literature: Evolution	
BIOL 4870	Medical Ethics	4
BIOL 4880	Capstone in Biomedical Sciences	4
BIOL 4980	Internship in Biomedical Sciences	2
BIOL 4991	Independent Study	1
Elective Courses		20

Electives can be chosen from the approved list of existing elective courses in consultation with the Program Director. Additional upper level (3000- or 4000-level) elective courses will be considered with approval of the Program Director.

Natural Sciences

BIOL 3005	Science Communication
BIOL 3110	Special Topics: Biology
BIOL 3120	General Microbiology
BIOL 3252	High Altitude Physiology
BIOL 3241 & BIOL 3242	Anatomy and Physiology of the Skeletal, Nervous and Muscular systems and Human Anatomy and Physiology - Systems of homeostasis
BIOL 3260	Nutritional Physiology
BIOL 3610	Developmental Biology
BIOL 3647	Neuroscience of Movement
BIOL 3648	Molecular Mechanisms of Neurological Disease
BIOL 3649	Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics
BIOL 3650	Endocrinology
BIOL 3656	Cellular Aspects of Diabetes and Obesity
BIOL 3670	Molecular Immunology
BIOL 3675	Virology
BIOL 3702	Advanced Topics in Regulatory Biology
BIOL 3704	Advanced Topics in Cell Biology
BIOL 3850	Genetic Engineering
BIOL 4095	Research Methods and Analysis
BIOL 4500	Clinical Exercise Physiology
BIOL 4510	Exercise Testing & Prescription
BIOL 4515	Research Techniques in Exercise Physiology
BIOL 4530	Advanced Cardiovascular and Pulmonary Physiology
BIOL 4540	Electrocardiogram Interpretation
HLTH 3600	Cultural Responsiveness in Health Care
HLTH 3700	Topics in Health
CHEM 3811	Biochemistry-Proteins
CHEM 3812	Biochemistry-Membranes/Metabolism
CHEM 3813	Biochemistry-Nucleic Acids

Global Health

INTS 4423	Introduction to Epidemiology
INTS 4516	Major Diseases in Global Health (From Pathophysiology to Action)
INTS 4557	Cross-Cultural Communications

Social Sciences

CNP 4707	Introduction to Integrated Health
CNP 4784	Psychopathology
CNP 4789	Pharmacology of Addictive Behavior I and II
PSYC 3020	Adolescence
PSYC 4011	Proseminar in Emotion
PSYC 4045	Proseminar in Human Brain Development
PSYC 4085	Stress & Health
PSYC 4262	Affective Neuroscience
PSYC 4526	Prosem in Cog Neuroscience
PSYC 4688	Clinical Psychopharmacology

Non-coursework Requirements

- Capstone project- The program requires a capstone project which involves interactions with health or biomedical professions from outside of the DU community. The capstone experience will be culminated in a formal scholarly work (both written and orally presented) that reflects a student's professional interest and the integration of science with strong professional skills. Thus, the capstone project includes a written and public oral presentation of the project.

Additional requirements:

- maintain a minimum GPA of 3.0
- successful completion of capstone project
- completion of capstone paper
- successful oral defense of capstone project

Master of Science Programs

Master of Science in Biological Sciences with a Concentration in Biology, Ecology and Evolution

Degree Requirements

The major requirements for completion of the MS degree are 45 quarter hours of course work and research credit, and successful defense of the MS thesis. Graduate Students must maintain a minimum GPA of 3.0 and make adequate progress on research as assessed by the major adviser and thesis committee.

Coursework Requirements

The course work includes the following graduate core curriculum:

Code	Title	Credits
BIOL 4220	Grad Sem: Ecology & Evolution	
BIOL 4090 or BIOL 4085	Biostatistics Accelerated Biostatistics	
BIOL 4095	Research Methods and Analysis	
BIOL 4330	Foundations in Literature: Ecology (2 terms needed)	
BIOL 4231	Responsible Conduct in Rsrch	
BIOL 4991 or BIOL 4995	Independent Study (*) Independent Research	

• Courses the thesis committee judges to complement the student's major field also may be used.

Total Credits **45**

Non-coursework Requirements

Additional requirements are attendance at all departmental seminars, a thesis based on a research project approved by the thesis committee, and a successful oral defense of the thesis.

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

Degree Requirements

The major requirements for completion of the MS degree are 45 quarter hours of course work and research credit, and successful defense of the MS thesis. Graduate Students must maintain a minimum GPA of 3.0 and make adequate progress on research as assessed by the major adviser and thesis committee.

Coursework Requirements

The course work includes the 16-credit graduate core curriculum:

Code	Title	Credits
BIOL 4211	Advanced Cell Biology	
BIOL 4310	Foundations in Literature: Cell and Molecular Biology (3 terms required)	
BIOL 4231	Responsible Conduct in Rsrch	
BIOL 4090 or BIOL 4085	Biostatistics Accelerated Biostatistics	
BIOL 4212	Advanced Molecular Biology	
BIOL 4213	Advanced Cell Signaling	
BIOL 4991 or BIOL 4995	Independent Study (*) Independent Research	

- Courses the thesis committee judges to complement the student's major field also may be used.

Total Credits**45****Non-coursework requirements**

Additional requirements are attendance at all departmental seminars, a thesis based on a research project approved by the thesis committee and a successful oral defense of the thesis.

Master of Science in Clinical Exercise Physiology

In clinical exercise physiology (CEP), exercise is used to help patients manage or reduce their risk of chronic disease. Clinicians develop exercise recommendations, administer diagnostics tests and provide guidance that promotes healthy lifestyles. This Master's degree program provides in-depth knowledge and hands-on experiences in preventive and rehabilitative practices for patients at-risk of or challenged by cardiovascular, pulmonary and metabolic diseases, orthopedic or musculoskeletal, neuromuscular, and neoplastic immunological or hematological diseases, as well as healthy and low risk populations. The curriculum provides the knowledge, clinical experience and skills needed by individuals preparing for successful completion of the exam for the ACSM clinical exercise physiologist certification. The program prepares students for clinical and research careers in clinics, research centers, or health and wellness centers, especially careers in cardiac rehabilitation, pulmonary rehabilitation, diabetes prevention, cancer prevention and rehabilitation, obesity prevention and treatment, and other related careers. CEPs also could pursue positions working with both amateur and professional athletes who aspire to improve their performance. If further advanced education is of interest, this program provides an excellent foundation for doctoral work in physical therapy, occupational therapy, and other related disciplines or in preparation for medical school.

Master of Science in Clinical Exercise Physiology

Degree Requirements

45 credit hours of coursework and written comprehensive exam and internship presentation

Code	Title	Credits
Required Courses		
BIOL 3260	Nutritional Physiology	4
BIOL 4085	Accelerated Biostatistics	2
BIOL 4231	Responsible Conduct in Rsrch	1
BIOL 4500	Clinical Exercise Physiology	5
BIOL 4510	Exercise Testing & Prescription	4
BIOL 4515	Research Techniques in Exercise Physiology (Research Techniques in Exercise Physiology)	4
BIOL 4530	Advanced Cardiovascular and Pulmonary Physiology	4
BIOL 4540	Electrocardiogram Interpretation	2
BIOL 4980	Internship in Biomedical Sciences	6
Clinical Exercise Physiology Elective Courses		13
BIOL 3145	Cellular and Molecular Biology of Cancer	
BIOL 3160	Biophysics: Ion Channels & Disease	
BIOL 3252	High Altitude Physiology	
BIOL 3280	Intro to Pathophysiology	
BIOL 3615	Blood Vessel Development and Disease	
BIOL 3641	Systems Neuroscience	
BIOL 3644	Neuromuscular Pathophysiology	
BIOL 3647	Neuroscience of Movement	
BIOL 3649	Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics	
BIOL 3650	Endocrinology	
BIOL 3656	Cellular Aspects of Diabetes and Obesity	
BIOL 3670	Molecular Immunology	
BIOL 3675	Virology	
BIOL 3708	Topics in Integrative Physiology	
BIOL 3910	Viruses & Infectious Human Diseases	
BIOL 4870	Medical Ethics	

Total Credits**45**

Biology (BIOL)

BIOL 3005 Science Communication (4 Credits)

Science communication has shaped, and continues to shape, the world in which we live (e.g., why you wash your hands, why we don't feed bears in U.S. national parks anymore, and why some students imagine themselves becoming scientists or not). Sharing how science is conducted and how new knowledge is generated through the scientific method also plays a critical role in our future: creating engaged citizens, shaping the next generation of scientists, increasing diversity and diverse perspectives in the sciences, informing policy-makers and lawyers, combatting misconceptions, increasing trust of scientists, and guiding our own individual behaviors. But, like any other complex skillset, science communication takes practice. This course provides students with a range of resources and skills for effective, ethical, and evidence-based communication of complex socio-scientific issues. It provides a supportive environment in which students will practice and refine their science communication through peer feedback and engagement with real audiences. The focus is on cultivating practical communication skills, with emphasis on effective speaking, writing and exhibition of scientific topics with the variety of audiences students will encounter in their future careers. Course readings, activities, and final projects also examine how identity shapes both the science we do and the lenses we and other stakeholders bring to communication tasks. The course is hybrid, highly interactive, and writing-intensive. This course is restricted to Junior or Senior Standing UG majoring in the College of Natural Sciences and Mathematics.

BIOL 3025 Science and the Law (2,4 Credits)

This course will focus on the intersection of science and US law. Four major areas of focus that will be covered are the admissibility of expert witnesses / scientific evidence in court; how advances in forensic genetics and national DNA databases raise legal issues pertaining to expectations of privacy and the standards for reaching a verdict; the impact of US Supreme Court opinions on the patenting of genes used as diagnostic markers for human disease and the legal landscape surrounding issues of evolution and creationism/intelligent design. Students will then explore how the law impacts their own areas of scientific interest. The goal of this course is to increase our understanding as scientists of how advances in science impact and are impacted by the US judicial system. PREREQUISITES: BIOL 1010 AND BIOL 1011.

BIOL 3035 Invasive Species Ecology (4 Credits)

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

BIOL 3044 Coral Reef Ecology (3 Credits)

Ecology of coral reefs; organization and distribution of reefs; review of reef organisms and their interactions with each other and their physical environment; threats to coral reef conservation. This course counts as a category elective for Ecology and Biodiversity majors. Prerequisite: (BIOL 2010 or BIOL 2050) OR (GEOG 1201, GEOG 1202, and GEOG 1203).

BIOL 3045 Coral Reef Ecology Lab (1 Credit)

Ecology of coral reefs laboratory to supplement lecture material; travel to the Caribbean over spring break to observe coral reefs firsthand; introduction to research methods. SCUBA certification and permission of instructor required. A travel and dive fee is associated with this course.

BIOL 3055 Ecology of the Rockies (4 Credits)

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

BIOL 3070 Ecological Field Methods (4 Credits)

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

BIOL 3074 Forest Ecology (4 Credits)

This course provides an overview of the distribution, structure, function, and dynamics of forest ecosystems. Topics include: paleoecology, ecophysiology, disturbance, succession, community analysis, forest hydrology, primary productivity, and nutrient cycling. Throughout, we maintain an emphasis on the scientific process and how it is used to study the controls on the distribution and abundance of organisms.

BIOL 3085 Insect Ecology (4 Credits)

A general introduction to insect biology and the science of entomology. Arthropods are the most diverse group of animals on Earth and insects account for more than half of all known living organisms. This course explores the biodiversity of insects on Earth, insect morphology and physiology. The evolutionary history and taxonomy of key orders of insects is emphasized as well as the importance of insects to our everyday lives. This course counts as a category elective for Ecology and Biodiversity majors. Prerequisites: BIOL 1010, BIOL 1011, and BIOL 2010.

BIOL 3090 Microbial Ecology (4 Credits)

Interactions among microorganisms and their environment. Impact of ecological principles on microbial diseases, pollutant degradation, nutrient cycles and global change. Prerequisites: BIOL 1010, BIOL 1020, AND BIOL 2510.

BIOL 3095 Global Change Ecology (4 Credits)

Over the past century, the mean surface temperature of our planet has increased slightly less than 1°C. While this may seem like a small increment, this change is already profoundly affecting Earth's organisms and ecological communities, and predictions for the impacts of continued change range from severe to catastrophic. Humans are also changing the environment through alteration of nutrient and water regimes. Topics include cause of climate change, comparison to past climatic change, human contribution to change and effect on organisms, communities and ecosystems. Prerequisites: BIOL 1010, BIOL 1011, AND BIOL 2010. RECOMMENDED PREREQUISITES/COREQUISITES: BIOL 2090.

BIOL 3110 Special Topics: Biology (1-5 Credits)

Topics of special interest to teaching/research faculty of department presented as needed to complement and expand existing curriculum. May be repeated for credit. PREREQUISITES: BIOL 1010.

BIOL 3120 General Microbiology (4 Credits)

Fundamental principles of microorganisms in the world and in disease; role of bacteria in biological phenomena. Includes laboratory. Lab fee associated with this course. Counts as a category elective for Ecology and Biodiversity majors. Prerequisite: BIOL 2120.

BIOL 3145 Cellular and Molecular Biology of Cancer (4 Credits)

This course examines the mechanisms that underlie the development and progression of cancer. The cellular and molecular events that drive uncontrolled cell proliferation and eventual metastasis of tumors are discussed. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3150 Intracellular Dynamics (4 Credits)

Focuses on spatial and temporal control of intracellular processes with an emphasis on neuronal and endocrine cells. Topics include vesicular traffic, protein targeting, dynamics and spatial organization of signaling complexes. Emphasis on modern techniques of cell and molecular biology with examples from primary literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3160 Biophysics: Ion Channels & Disease (4 Credits)

Examines ion channel structure and function and the ways in which this information provides insight into human disease. The focus is on the use of biophysical techniques in combination with molecular and genetic analysis of channel genes. General Physics recommended. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

BIOL 3230 Nutrition (3 Credits)

Investigation of metabolism, all nutrients and various applications of nutrition to sports and healthy living. Prerequisite: BIOL 3250.

BIOL 3241 Anatomy and Physiology of the Skeletal, Nervous and Muscular systems (0-5 Credits)

This course is designed to introduce students to the fundamental concepts, content and scientific bases of Skeletal, Muscular, and Nervous system anatomy and physiology at both macroscopic and microscopic levels. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. The course will utilize diverse resources, exercises, and activities to engage you in the learning process, including, text, video, animations, models, dissections, inquiry-based learning, and a variety of assessments. Please note that the lab portion of this course does require dissection. Prerequisites: BIOL 2120.

BIOL 3242 Human Anatomy and Physiology - Systems of homeostasis (0-5 Credits)

This course is designed to introduce students to the fundamental concepts, content and scientific bases of Cardiovascular, Respiratory, Urinary, Digestive, Immune and Reproductive system anatomy and physiology at both macroscopic and microscopic levels. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. The course will utilize diverse resources, exercises, and activities to engage you in the learning process, including, text, video, animations, models, dissections, inquiry-based learning, and a variety of assessments. Please note that the lab portion of this course does require dissection. Prerequisites: BIOL 2120.

BIOL 3251 Exercise Physiology (4 Credits)

This course will cover exercise physiology topics included but not limited to: energy systems, physiological response to exercise/training, and exercise programming. A strong background in human physiology is recommended. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 1010.

BIOL 3252 High Altitude Physiology (4 Credits)

This course is an advanced course in physiology for those interested in both the impacts of altitude exposure on health and athletic performance. We live at altitude in Denver, and in fact there are many factors affecting our bodies (which we may or may not realize) that impact our daily lives. This course aims to provide insight on the acute and chronic physiological responses of altitude as well as to provide a deeper understanding into the use of hypoxic environments for improving health and benefiting athletic performance. We will explore the physiological mechanisms related to these reduced oxygen environments as well as develop projects that contribute to the understanding of using this environment as a stimulus. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 3242.

BIOL 3253 Environmental Physiology of Animals (4 Credits)

By studying species across the animal kingdom, we will learn about the vast array of physiological strategies that have evolved to help animals maintain homeostasis in the face of varied environmental challenges. We will cover foundational principals of animal physiological ecology and evolution, as well as new and exciting discoveries through weekly discussions of primary literature. We will focus primary literature discussions on "extreme environments," as Earth's harshest landscapes provide exciting and powerful examples of adaptations of physiological systems. This course will be delivered through a combination of lectures, active learning assignments, readings from the scientific literature, and group discussions. By the end of this course, you will develop a new perspective on the ecological and evolutionary factors that shape physiological similarities and differences among the animals of our planet (including humans). This course counts as a category elective for the Ecology and Biodiversity major and Physiology in Health and Disease major. Prerequisites: BIOL 1010 and BIOL 1011.

BIOL 3256 Advanced Human Anatomy & Physiology (0-5 Credits)

This one quarter course is intended for advanced biology and physiology majors with an interest in the anatomical structure and physiological functioning of body systems. This course builds upon the Human Anatomy and Human Physiology courses that are prerequisites. This advanced course will explore in greater depth understanding mechanisms of action of major body systems and elaborate on the relationship between structure and function. In addition to didactic content, students will complete evaluation of primary literature and design laboratory experiments to test hypotheses of interest. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, models, dissections, inquiry-based learning, experimentation and a variety of assessments. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. Please note that the lab portion of this course requires dissection. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisites: BIOL 3241 and BIOL 3242.

BIOL 3260 Nutritional Physiology (4 Credits)

This course is designed to introduce the fundamental concepts, content and scientific bases of nutritional physiology at the levels. This course will examine the scientific structure and properties of carbohydrates, proteins and lipids as the major macronutrients required for human health. In addition, it includes exploration of the digestion, absorption and metabolism of both macronutrients and micronutrients. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, inquiry-based learning, experimentation and a variety of assessments. Prerequisite: BIOL 2120.

BIOL 3280 Intro to Pathophysiology (4 Credits)

This course is designed as an introduction of the mechanisms and consequences of disease based on physiological dysfunction in the major organ systems. The course will focus on the fundamental concepts and processes of human pathophysiology through exploration of the unique physiological roles of several body systems, how these systems have important integrative relationships that underlie the overall physiological functioning of healthy humans, and how system function is altered in disease and the clinical manifestations of these changes. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 2120. A course in human physiology is recommended.

BIOL 3410 Animal Behavior (4 Credits)

This class examines animal behavior from an evolutionary and ecological perspective. The course provides the background needed to understand behavioral evolution, including a focus on the inheritance of behavior, natural selection, sexual selection, and kin selection. This class studies the evolution of a variety of behaviors, including communication and displays, mate choice, parental care, cooperation, mating systems, social behavior, habitat selection, foraging, and anti-predator behavior. The emphasis is on theoretical principles, design of experiments, and interpretation of data. This course counts as a category elective for the Ecology and Biodiversity major. Prerequisites: BIOL 1010 and BIOL 1011, and BIOL 2010. Recommended Prerequisite: BIOL 2090.

BIOL 3560 Molecular Biology Laboratory (4 Credits)

Laboratory based course that covers techniques in gene excision, cloning and reinsertion and gene sequencing. Lab fee associated with this course. Prerequisite: BIOL 2510, or permission of instructor.

BIOL 3570 Proteins in Biological Systems (4 Credits)

Proteins considered in their biological setting; protein synthesis and degradation; survey of protein functions in vivo; introduction to protein biotechnology. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120.

BIOL 3610 Developmental Biology (4 Credits)

Processes and mechanisms of development, exemplified by higher animal embryogenesis, with consideration of microbial model systems. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120 and 2510.

BIOL 3615 Blood Vessel Development and Disease (4 Credits)

This course details the underlying biological programs during blood vessel development and mechanisms that lead to vascular pathologies. The class will incorporate aspects embryology, signaling transduction, and genetics as well as current techniques in developmental biology to comprehensively cover how blood vessels are formed embryonically. Additionally, we will discuss in detail how defects in blood vessel-related signaling programs later manifest into disease. Prerequisite for this course is Cell Structure and Function (BIOL2120/2121).

BIOL 3630 Cell Biology of Development (4 Credits)

Every organism has a stereotypical shape, but how does this shape arise? This course examines the cellular and molecular mechanisms that direct the forming of body and tissue shape. This course counts a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3640 Introductory Neurobiology (4 Credits)

Organization and function of vertebrate central nervous system; nature of action potential, biochemistry of neurotransmitters, neuropeptides, functional anatomy of nervous system, phylogeny of nervous system. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

BIOL 3641 Systems Neuroscience (4 Credits)

Structure and function of the brain and spinal cord, emphasis on functional systems including sensory perception, motor control and consciousness. This course counts as a category elective for the Cognitive Neuroscience concentration. Prerequisite: BIOL 3640 or 3241.

BIOL 3642 Neuropharmacology (4 Credits)

How psychoactive drugs exert their effects on the nervous system; drugs of abuse and drugs used in the treatment of psychotic and neurodegenerative disorders. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120. Recommended prerequisites: BIOL 3640.

BIOL 3644 Neuromuscular Pathophysiology (4 Credits)

Cellular and molecular basis for normal nerve and muscle functions and the alteration of these functions by toxins, trauma and diseases of the brain, nerves and muscles; how specific insults produce clinical symptoms and pathology. Prerequisite: BIOL 2120.

BIOL 3646 Seminar: Cognitive Neuroscience (2 Credits)

This seminar is the capstone course for the neuroscience portion of the cognitive neuroscience program. Seminar topics include but are not limited to neurological disorders, model systems in neuroscience and sensory systems.

BIOL 3647 Neuroscience of Movement (4 Credits)

Producing the vast array of movements that humans (and many animals) use everyday represents one of the body's greatest challenges and greatest successes. These various movements require that the nervous, muscular, and skeletal systems work in concert to achieve a common goal. This course will explore the scientific basis of movement production, with particular emphasis on the neuroscience of motor control. We will explore how the nervous system drives the development of movement strategies at an early age, modifies movement strategies to adapt to changing demands throughout life, and how injury, dysfunction, and/or aging can lead to movement challenges. This course counts as a category elective for the Physiology in Health and Disease major and Cognitive Neuroscience concentration. Required prerequisite: Cell Structure & Function (BIOL 2120); Recommended prerequisite (1 or more of the following): Introduction to Neuroscience (BIOL 3640) or permission of instructor.

BIOL 3648 Molecular Mechanisms of Neurological Disease (4 Credits)

This course will be an in-depth study into some of the key molecular mechanisms involved in the pathogenesis of human neurological disease. A particular emphasis will be placed on the role of RNA regulation and metabolism. The primary focus will be on five devastating diseases: 1. Spinal Muscular Atrophy (SMA) 2. Fragile X Syndrome (FXS) and Fragile X Tremor Ataxia Syndrome (FXTAS) 3. Myotonic Dystrophy type 1 and 2 (DM1 and DM2) 4. Spinocerebellar Ataxia type 2 (SCA2) 5. Amyotrophic Lateral Sclerosis (ALS) and Frontotemporal Dementia (FTD) This course will cover a variety of topics including disease pathophysiology and pathogenesis. However, readings will be assigned from the recent primary literature discussing cellular and molecular mechanisms. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2510 Genetics.

BIOL 3649 Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics (4 Credits)

Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics covers the following disorders: Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, Huntington's disease, spinocerebellar ataxia, Creutzfeldt-Jakob disease, multiple sclerosis, traumatic brain injury and spinal cord injury. Course literature includes primary journal articles and review papers describing the etiology and pathophysiological mechanisms of these disorders. Potential therapeutic approaches to treatment are also investigated. The course format typically includes a lecture reviewing the basic biology, symptoms, and current treatments for each disorder, followed by a thorough analysis of primary research papers focused on novel molecular mechanisms and new targets for therapeutic development. Grading is based on 3 exams throughout the academic quarter and participation in discussing journal articles in class. This course counts as a category elective for the Cognitive Neuroscience concentration. Prerequisite: BIOL 2120 Cell Structure and Function. Recommended: BIOL 3640 Introductory Neurobiology. For Graduate Students: an additional term paper is required with the exact topic to be agreed upon by the student and instructor.

BIOL 3650 Endocrinology (4 Credits)

Mechanisms of hormone action, evolution of vertebrate endocrine systems, analysis of function integration of hormonal responses in maintenance of homeostasis. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

BIOL 3656 Cellular Aspects of Diabetes and Obesity (4 Credits)

This course focuses on specific cellular and molecular events key to the understanding of the pathological conditions of diabetes and obesity. Topics include the endocrine pancreas, adipose tissue and neuroendocrine control energy expenditure and feeding behavior. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3670 Molecular Immunology (4 Credits)

The ability to distinguish self from non-self is crucial to all organisms. In humans Organs, cells and other higher animals, this task fall to the immune system. Suppression of this system is key to numerous pathogenic viruses including Ebola and human immunodeficiency virus. The failure to adequately regulate immune response underlies allergic reactions, arthritis and diabetes. This course will introduce students to the organs, cells and molecules that underlie mammalian immune response; immunogenetics and the fundamental mechanisms of cell mediated and humoral immune response; and the relationship of immune system to human disease. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510.

BIOL 3675 Virology (4 Credits)

Viruses are the ultimate cell biologists. They usurp essential cellular components to create new virus progeny leading to pathological cellular physiology. This course will delve into the genetic and cellular principles that govern virus entry, replication, and assembly and cover a broad range of DNA and RNA-based virus families. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120 and BIOL 2510.

BIOL 3700 Topics in Ecology (1-4 Credits)

Topics vary; may include plant, animal, biochemical, alpine or aquatic; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: one quarter of undergraduate ecology and/or instructor's permission.

BIOL 3701 Topics in Genetics (1-4 Credits)

Topics vary; may include genetic methods, molecular genetics, human genetics, chromosomes or population genetics; one topic per quarter. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510 and/or instructor's permission.

BIOL 3702 Advanced Topics in Regulatory Biology (1-4 Credits)

Topics vary; may include endocrinology, physiology or immunology; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: varies with topic and instructor; instructor's permission usually required.

BIOL 3703 Advanced Topics in Developmental Biology (1-4 Credits)

Topics vary; may include gene expression in development, developmental immunogenetics, developmental biochemistry or aging; one topic per quarter. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: instructor's permission.

BIOL 3704 Advanced Topics in Cell Biology (1-4 Credits)

Topics vary; may include supramolecular structure, microscopy, membranes and techniques. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120.

BIOL 3705 Advanced Topics in Molecular Biology (1-4 Credits)

Topics vary, but may include biochemistry, supramolecular structure and function, molecular genetics, membrane biology. May be taken more than once for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: varies with course and instructor; instructor's permission usually required.

BIOL 3706 Topics in Evolution (1-4 Credits)

Topics vary, but may include molecular evolution, plant evolution and animal evolution. Prerequisite: BIOL 2120 and BIOL 2510.

BIOL 3707 Advanced Topics in Conservation Biology (1-4 Credits)**BIOL 3708 Topics in Integrative Physiology (2-4 Credits)**

Topics for this course include, but are not limited to, human physiology and disease, integrative physiology, environmental or social impacts on human physiology and health, and comparative physiology. Students will gain knowledge of a specific topic in physiology and/or pathophysiology through discussion of current literature and research. May be repeated for credit. Prerequisite: BIOL 2120.

BIOL 3800 Human Molecular Biology (4 Credits)

Medical Genetics is the 24th member of the American Board of Medical Specialties. This course will introduce students to the fundamentals of molecular biology with an emphasis on understanding of how the field is applied in the context of medical diagnostics, personalized/precision medicine and other commercial applications. Students will be introduced to published research reports and provided with opportunities to critically examine the application of molecular biology to central questions in such areas as oncology, inherited diseases and genetically engineered organisms. Prerequisite: BIOL 2510.

BIOL 3850 Genetic Engineering (4 Credits)

This course will cover principles in gene manipulation and its application in research, medicine and industry. More specifically, this course will explain emerging technologies in genetic engineering and its practical and ethical implications. Topics will incorporate historical and emerging aspects of developmental biology, chemistry, and genetics as well as current techniques in genetic manipulation that are related to genomic editing. Additionally, students will be trained to interface with genomic databases and employ DNA sequence editing software to manipulate DNA sequences to achieve novel cloned products. This course counts as a category elective for the Molecular Biology major. Prerequisite for this course is Genetics BIOL 2510.

BIOL 3855 Genetic Model Organisms in Health & Disease (4 Credits)

This course is focused on how basic science studies using genetic model organisms have had a major impact on human health and disease in addition to helping us understand fundamental aspects of biology. We will cover clinically relevant recent advances from bacterial studies (i.e. CRISPR/Cas9-mediated genome editing) to how studies in fruit flies revealed insights into immune disease. Students will gain a better appreciation for why researchers using model organisms were awarded Nobel prizes as well as why major medical funding organizations like the National Institutes of Health, American Cancer Society, and American Heart Association support research using non-human systems. This course will prepare students to understand health-relevant research from varied model systems. Students will learn practical aspects for determining which model systems are best suited to answer which types of questions. They will also practice designing experiments and defending their importance in grant abstract-style essays. Prerequisites: BIOL 2120 and BIOL 2510.

BIOL 3910 Viruses & Infectious Human Diseases (4 Credits)

From sexually transmitted viruses to bacterial pneumonia, infectious pathogens are the number one threat to human health. This course will introduce students to prions, viruses and bacterial pathogens with an emphasis on those commonly encountered in clinical medical practice. Through the use of technical/scientific research journals students will be encouraged to investigate the etiology, pathogenesis and treatment of human infectious disease with an emphasis on the clinical, molecular diagnostic and therapeutic aspects of the disease. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510. Recommended prerequisite: BIOL 3800.

BIOL 3950 Undergraduate Research (1-10 Credits)

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

BIOL 3991 Independent Study (1-10 Credits)

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

BIOL 3995 Independent Research (1-10 Credits)**BIOL 4050 Topics in Plant Biology (2 Credits)**

Varying topics; areas of plant-animal interactions, co-evolution, plant ecology, plant biochemistry/physiology.

BIOL 4085 Accelerated Biostatistics (2 Credits)

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

BIOL 4090 Biostatistics (4 Credits)

Statistic on biological research; emphasis on procedures, applications of regression, correlation, analysis of variance, and nonparametric tests. Include instruction on computer aided (Mac and PC) statistical analysis and presentation of results. Cross listed with BIOL 2090.

BIOL 4095 Research Methods and Analysis (4 Credits)

The purpose of this course is to introduce you to topics of applying statistical knowledge to real data, including specific tests/models as well as issues related to project design such as adequate sample size, avoiding confounding variables, unexplained error, and other common challenges. It is geared toward both field and lab-based projects, but the topics covered are relevant to research generally. Each week we will discuss the reading for that week with the objective of clarifying points and where possible, applying the concepts to real data from our own work. Prerequisites: BIOL 4090 or permission of instructor. Prerequisites: BIOL 4090.

BIOL 4150 Special Topics in Adv Biology (1-4 Credits)

Topics of special interests to teaching and research faculty presented as needed to complement and expand existing curriculum. May be taken more than once for credit.

BIOL 4155 Leadership in Science (1 Credit)

This course addresses the basic leadership skills necessary to succeed in the dynamic professional environment of the biomedical sciences. Topics covered include leadership strategies and professional negotiation, conflict resolution, and team-building. Students will determine leadership strengths and weaknesses and use case studies to strengthen their leadership practices.

BIOL 4211 Advanced Cell Biology (4 Credits)

Students study the subcellular structure and organization of the cell. Organelle structure and function are examined in detail as well as biogenesis and degradation (turnover) of these subcellular structures. Cytoskeletal dynamics are also a major focus. Specific topics covered include cell division, macromolecular synthesis, membrane transport, cell-matrix and cell-cell communication, cell migration, cell differentiation, and mechanisms of cell death. The course follows a lecture format in conjunction with selected journal article presentations and discussions by the students. Cross listed with BIOP 4150.

BIOL 4212 Advanced Molecular Biology (3 Credits)

This course focuses on a detailed analysis of regulated gene expression. The topics include lectures and readings of relevant literature in areas covering gene regulation at multiple steps, including transcription, RNA processing, and translation. In particular, the logic of experimental design and data analysis are emphasized.

BIOL 4213 Advanced Cell Signaling (3 Credits)

Students in this course investigate a large array of cellular signal transduction cascades. Specific signaling pathways to be covered include growth factor receptors, cytokine receptors, steroid receptors, integrin-extracellular matrix, heterotrimeric G-protein coupled receptors, monomeric G-proteins, transcription factors, lipids, cytoskeleton, cell cycle, and apoptosis. Each of these topics is examined in the context of normal cell physiology as well as their roles in specific disease processes. The course follows a lecture format in conjunction with selected journal article presentations and discussions by the students.

BIOL 4220 Grad Sem: Ecology & Evolution (2 Credits)

A series of student presentations focusing on varied topics involving ecology and evolution. May be taken more than once for credit.

BIOL 4231 Responsible Conduct in Rsrch (1 Credit)

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

BIOL 4310 Foundations in Literature: Cell and Molecular Biology (2 Credits)

Students participate in a weekly discussion group that focuses on recent papers from the primary literature in Cell and Molecular Biology.

BIOL 4330 Foundations in Literature: Ecology (2 Credits)

Students participate in a weekly discuss group that focuses on recent papers from the primary literature in Ecology.

BIOL 4331 Foundations in Literature: Evolution (2 Credits)

Students participate in a weekly discussion group that focuses on recent papers from the primary literature in Evolution.

BIOL 4500 Clinical Exercise Physiology (5 Credits)

This graduate course in clinical physiology will provide an understanding of fundamental practices and assessments within clinical settings. We will combine knowledge from various backgrounds in physiology and tie theoretical and practical concepts together for assessing body function and developing methods for improving health and performance. We will connect the physiological concepts related to the cardiovascular, respiratory, and muscle systems as well as develop projects that require combining knowledge of the assessment skills and evaluation for clear communication and exercise prescription to special populations.

BIOL 4510 Exercise Testing & Prescription (4 Credits)

The purpose of this graduate course is to develop knowledge combined with hands-on skills for integration of exercise testing and prescription concepts. Material in this course will be applicable for performance as well as clinical considerations. This is an active course which will require your participation as both the subject and technician, giving perspective and understanding of methods and protocols along with their justification for various purposes. Prerequisite: BIOL 4500.

BIOL 4515 Research Techniques in Exercise Physiology (4 Credits)

This graduate level course is designed to provide exposure to several methods of research within the area of exercise physiology. This is a hands-on course that combines theory and literature with practical research experiences in physiology. In this course, students will perform data collection and analysis of differing topics. These may include the following topics: pulse and tissue oxygenation, signaling (heart rate variability, oxygen kinetics), respiratory loops, Doppler ultrasound (blood flow and tissue structure), etc. Our aims will focus on understanding how and why the method works, how to collect data, as well as the analysis and reporting of variables for proper interpretation.

BIOL 4520 Advanced Nutrition and Exercise (4 Credits)

This is a one quarter course intended for graduate students and advanced biology and physiology majors. This course builds upon the prerequisite introductory nutrition course. The course will focus on understanding, evaluating and implementing the fundamental principles and evidence based best practices of nutrition related to exercise, physical activity and health. Starting with a review of nutritional biochemistry and exercise, major macromolecule and micronutrient metabolism will be addressed in depth. Applications of nutritional science to various types of exercise (endurance, power, speed) will be explored, as well as nutrition and exercise specific to age and sex across the lifespan. In addition to didactic content, students will complete evaluation of primary literature and propose a nutritional program for a specific population of interest. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, inquiry-based learning, experimentation and a variety of assessments. Prerequisite: BIOL 3260 Nutrition or the equivalent.

BIOL 4530 Advanced Cardiovascular and Pulmonary Physiology (4 Credits)

This course is developed to provide a deeper level of physiological knowledge of the cardiac, vascular, circulatory, and pulmonary systems and their functions. With both lecture materials as well as in-class discussion of concepts and research articles, we will go deep into the basic levels of composition and function and facilitate the understanding of mechanisms that limit disease populations, elderly, etc. How can we adapt our lifestyles to improve our cardiovascular health? Prerequisite: BIOL 3250.

BIOL 4540 Electrocardiogram Interpretation (2 Credits)

This course is an advanced course in cardiac physiology for those interested in understanding principles associated with cardiac function, electrical physiology of the heart, and interpretation of the electrocardiogram. As the functions related to our heart drive our cardiovascular system, we will find ways to relate our experiences of daily life to the concepts and principles learned throughout this course to deepen our knowledge and retain this information. We will explore the physiological mechanisms related to the cardiac system as well as develop projects that require combining knowledge of the electrical pathways and of use of electrocardiography for proper interpretation.

BIOL 4550 Cardiopulmonary Rehabilitation (2 Credits)

This course focuses specifically on cardiopulmonary rehabilitation. Students will gain an understanding of (1) the impact of lung and heart disease on daily physical activity levels, (2) common mechanisms limiting exercise tolerance, and (3) risks and benefits of exercise for patients with lung and heart disease. Students will learn guidelines for exercise prescription and rehabilitation programs for patients with cardiovascular and pulmonary diseases. Practical application of knowledge and skills gained in BIOL 4530 will be emphasized. Prerequisite: BIOL 4530 Advanced Cardiovascular & Pulmonary Physiology.

BIOL 4570 Advanced Human Pharmacology (2 Credits)

This class will focus on how drugs and other therapeutics can be used to treat and prevent diseases. Students will develop a deep understanding of pharmacokinetics/ pharmacodynamics, the major classes of drugs, how and why they are used, drug side effects, and drug interactions. Specific emphasis will relate to effects of drugs utilized for disease prevention or treatment on physical activity and exercise.

BIOL 4580 Physical Activity for Management of Chronic Diseases (3 Credits)

This one quarter course is intended for graduate students in the clinical exercise physiology program or other related programs. This course builds upon previous coursework in clinical exercise physiology. It will focus on understanding, evaluating and implementing the fundamental principles and evidence based best practices of exercise management for persons with chronic diseases and disabilities. Starting with an overview of the concept of "exercise as medicine," the principles of safe exercise as a method for improving health outcomes will be applied to individuals with chronic diseases. Various chronic disease states and their associated medical challenges will be explored, and the recommendations for modified exercise activities, durations and outcomes to support healthy and safe outcomes will be addressed. In addition to didactic content, students will complete evaluation of primary literature in the field. Prerequisite BIOL 4500/4510 Clinical Exercise Physiology I and II.

BIOL 4870 Medical Ethics (4 Credits)

This course presents knowledge and discussion of ethical issues that arise from advances in the biomedical sciences and medicine. Several specific ethical issues and policies related to methodologies and procedures, emerging medical technologies, treatment decisions, doctor-patient relationship, informed consent, medical experimentation/clinical research, and health care reform.

BIOL 4880 Capstone in Biomedical Sciences (4 Credits)

This is the capstone course for students enrolled in the Professional Science Master's program. In this course, students integrate advanced knowledge in science and math along with courses taken outside traditional science and math courses as their electives. This course incorporates lectures, guest speakers, and class discussions focusing on current issues or concerns in the chosen concentration. PSM students only. Requires instructor approval.

BIOL 4980 Internship in Biomedical Sciences (1-4 Credits)

The internship course provides individualized opportunities to gain experience and professional skills. This course includes a structured practical and productive internship experience that allows for the integration and application of disciplinary knowledge in a professional setting. The internship can be administrative, clinical, programmatic, or research focused. Students will work with a professional from healthcare, pharmaceutical and biotech companies, or private and public health services to identify the student's specific project focus.

BIOL 4991 Independent Study (1-17 Credits)**BIOL 4995 Independent Research (1-8 Credits)****BIOL 5991 Independent Study (1-17 Credits)****BIOL 5995 Independent Research (1-8 Credits)**

Health Sciences (HLTH)

HLTH 3000 Seminar in Health Science (1-2 Credits)

This seminar is the capstone course for the Human Health Science & Systems program. This class will focus on the current understanding of several topics in human health. Emphasis will be on critical reading and discussion of current scientific literature related to human health and health care. Students will learn to recognize and appreciate different approaches and methods of health-related research. Students will utilize and integrate knowledge from previous courses to understand to present effective discussions on current topics in health. For students' continued development of strong oral communication skills, student presentations of primary literature will generate the basis of discussion. Prerequisites: HLTH 2000 and 2010.

HLTH 3600 Cultural Responsiveness in Health Care (2 Credits)

To contribute to reducing health inequities and improving health outcomes, this course will promote an improved understanding and responsiveness to the realities of social and structural impacts that influence the health of an individual or community. Topics will include health care delivery and access, political economy of health care, implicit biases, professionalism, relational leadership, dealing with patients in difficult situations, and health equity. The course will help students learn to provide more informed and effective care and promote a more culturally sensitive and responsive future workforce in healthcare, while also serving community needs. Prerequisite: HLTH 2000 or equivalent.

HLTH 3700 Topics in Health (1-4 Credits)

Topics in the area of, but are not limited to, human health and disease, environmental or social impacts on health, healthcare delivery, evidence-based medicine. Students will gain knowledge of a specific topic in human health and/or health care through discussion of current literature and research. May be repeated for credit. Prerequisites: HLTH 2000 or 2010.

HLTH 4210 Advanced Health Education and Promotion (2 Credits)

This course will provide students foundational knowledge about how to deliver health education and promote healthy behaviors to patients and community. This course will provide students with the practical skills and best practices for communicating and educating others about health, clinical tests and results, and clinical plans of action. Students will gain practical skills for encouraging goal setting and behavioral change and will develop an understanding of motivational considerations especially for patients with mental health challenges or psychosocial concerns related to acute and chronic physical disorders. Students will focus on integrating evidence-based research and strategies for the purpose of leading culturally sensitive discussions and/or difficult conversations and encouraging healthy behaviors.

HLTH 4300 Basic Legal Consideration in Healthcare (2 Credits)

This course will provide a basic understanding of legal issues that may affect care providers and business owners. Basic legal terminology and concepts will be presented, in addition to basic court processes and procedures. A goal of establishing this basic understanding is to prevent or reduce the consequences of lawsuits. Professionalism and the code of ethics will also be discussed.

Biology Courses

BIOL 3005 Science Communication (4 Credits)

Science communication has shaped, and continues to shape, the world in which we live (e.g., why you wash your hands, why we don't feed bears in U.S. national parks anymore, and why some students imagine themselves becoming scientists or not). Sharing how science is conducted and how new knowledge is generated through the scientific method also plays a critical role in our future: creating engaged citizens, shaping the next generation of scientists, increasing diversity and diverse perspectives in the sciences, informing policy-makers and lawyers, combatting misconceptions, increasing trust of scientists, and guiding our own individual behaviors. But, like any other complex skillset, science communication takes practice. This course provides students with a range of resources and skills for effective, ethical, and evidence-based communication of complex socio-scientific issues. It provides a supportive environment in which students will practice and refine their science communication through peer feedback and engagement with real audiences. The focus is on cultivating practical communication skills, with emphasis on effective speaking, writing and exhibition of scientific topics with the variety of audiences students will encounter in their future careers. Course readings, activities, and final projects also examine how identity shapes both the science we do and the lenses we and other stakeholders bring to communication tasks. The course is hybrid, highly interactive, and writing-intensive. This course is restricted to Junior or Senior Standing UG majoring in the College of Natural Sciences and Mathematics.

BIOL 3025 Science and the Law (2,4 Credits)

This course will focus on the intersection of science and US law. Four major areas of focus that will be covered are the admissibility of expert witnesses / scientific evidence in court; how advances in forensic genetics and national DNA databases raise legal issues pertaining to expectations of privacy and the standards for reaching a verdict; the impact of US Supreme Court opinions on the patenting of genes used as diagnostic markers for human disease and the legal landscape surrounding issues of evolution and creationism/intelligent design. Students will then explore how the law impacts their own areas of scientific interest. The goal of this course is to increase our understanding as scientists of how advances in science impact and are impacted by the US judicial system. PREREQUISITES: BIOL 1010 AND BIOL 1011.

BIOL 3035 Invasive Species Ecology (4 Credits)

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

BIOL 3044 Coral Reef Ecology (3 Credits)

Ecology of coral reefs; organization and distribution of reefs; review of reef organisms and their interactions with each other and their physical environment; threats to coral reef conservation. This course counts as a category elective for Ecology and Biodiversity majors. Prerequisite: (BIOL 2010 or BIOL 2050) OR (GEOG 1201, GEOG 1202, and GEOG 1203).

BIOL 3045 Coral Reef Ecology Lab (1 Credit)

Ecology of coral reefs laboratory to supplement lecture material; travel to the Caribbean over spring break to observe coral reefs firsthand; introduction to research methods. SCUBA certification and permission of instructor required. A travel and dive fee is associated with this course.

BIOL 3055 Ecology of the Rockies (4 Credits)

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

BIOL 3070 Ecological Field Methods (4 Credits)

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

BIOL 3074 Forest Ecology (4 Credits)

This course provides an overview of the distribution, structure, function, and dynamics of forest ecosystems. Topics include: paleoecology, ecophysiology, disturbance, succession, community analysis, forest hydrology, primary productivity, and nutrient cycling. Throughout, we maintain an emphasis on the scientific process and how it is used to study the controls on the distribution and abundance of organisms.

BIOL 3085 Insect Ecology (4 Credits)

A general introduction to insect biology and the science of entomology. Arthropods are the most diverse group of animals on Earth and insects account for more than half of all known living organisms. This course explores the biodiversity of insects on Earth, insect morphology and physiology. The evolutionary history and taxonomy of key orders of insects is emphasized as well as the importance of insects to our everyday lives. This course counts as a category elective for Ecology and Biodiversity majors. Prerequisites: BIOL 1010, BIOL 1011, and BIOL 2010.

BIOL 3090 Microbial Ecology (4 Credits)

Interactions among microorganisms and their environment. Impact of ecological principles on microbial diseases, pollutant degradation, nutrient cycles and global change. Prerequisites: BIOL 1010, BIOL 1020, AND BIOL 2510.

BIOL 3095 Global Change Ecology (4 Credits)

Over the past century, the mean surface temperature of our planet has increased slightly less than 1°C. While this may seem like a small increment, this change is already profoundly affecting Earth's organisms and ecological communities, and predictions for the impacts of continued change range from severe to catastrophic. Humans are also changing the environment through alteration of nutrient and water regimes. Topics include cause of climate change, comparison to past climatic change, human contribution to change and effect on organisms, communities and ecosystems. Prerequisites: BIOL 1010, BIOL 1011, AND BIOL 2010. RECOMMENDED PREREQUISITES/COREQUISITES: BIOL 2090.

BIOL 3110 Special Topics: Biology (1-5 Credits)

Topics of special interest to teaching/research faculty of department presented as needed to complement and expand existing curriculum. May be repeated for credit. PREREQUISITES: BIOL 1010.

BIOL 3120 General Microbiology (4 Credits)

Fundamental principles of microorganisms in the world and in disease; role of bacteria in biological phenomena. Includes laboratory. Lab fee associated with this course. Counts as a category elective for Ecology and Biodiversity majors. Prerequisite: BIOL 2120.

BIOL 3145 Cellular and Molecular Biology of Cancer (4 Credits)

This course examines the mechanisms that underlie the development and progression of cancer. The cellular and molecular events that drive uncontrolled cell proliferation and eventual metastasis of tumors are discussed. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3150 Intracellular Dynamics (4 Credits)

Focuses on spatial and temporal control of intracellular processes with an emphasis on neuronal and endocrine cells. Topics include vesicular traffic, protein targeting, dynamics and spatial organization of signaling complexes. Emphasis on modern techniques of cell and molecular biology with examples from primary literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3160 Biophysics: Ion Channels & Disease (4 Credits)

Examines ion channel structure and function and the ways in which this information provides insight into human disease. The focus is on the use of biophysical techniques in combination with molecular and genetic analysis of channel genes. General Physics recommended. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

BIOL 3230 Nutrition (3 Credits)

Investigation of metabolism, all nutrients and various applications of nutrition to sports and healthy living. Prerequisite: BIOL 3250.

BIOL 3241 Anatomy and Physiology of the Skeletal, Nervous and Muscular systems (0-5 Credits)

This course is designed to introduce students to the fundamental concepts, content and scientific bases of Skeletal, Muscular, and Nervous system anatomy and physiology at both macroscopic and microscopic levels. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. The course will utilize diverse resources, exercises, and activities to engage you in the learning process, including, text, video, animations, models, dissections, inquiry-based learning, and a variety of assessments. Please note that the lab portion of this course does require dissection. Prerequisites: BIOL 2120.

BIOL 3242 Human Anatomy and Physiology - Systems of homeostasis (0-5 Credits)

This course is designed to introduce students to the fundamental concepts, content and scientific bases of Cardiovascular, Respiratory, Urinary, Digestive, Immune and Reproductive system anatomy and physiology at both macroscopic and microscopic levels. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. The course will utilize diverse resources, exercises, and activities to engage you in the learning process, including, text, video, animations, models, dissections, inquiry-based learning, and a variety of assessments. Please note that the lab portion of this course does require dissection. Prerequisites: BIOL 2120.

BIOL 3251 Exercise Physiology (4 Credits)

This course will cover exercise physiology topics included but not limited to: energy systems, physiological response to exercise/training, and exercise programming. A strong background in human physiology is recommended. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 1010.

BIOL 3252 High Altitude Physiology (4 Credits)

This course is an advanced course in physiology for those interested in both the impacts of altitude exposure on health and athletic performance. We live at altitude in Denver, and in fact there are many factors affecting our bodies (which we may or may not realize) that impact our daily lives. This course aims to provide insight on the acute and chronic physiological responses of altitude as well as to provide a deeper understanding into the use of hypoxic environments for improving health and benefiting athletic performance. We will explore the physiological mechanisms related to these reduced oxygen environments as well as develop projects that contribute to the understanding of using this environment as a stimulus. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 3242.

BIOL 3253 Environmental Physiology of Animals (4 Credits)

By studying species across the animal kingdom, we will learn about the vast array of physiological strategies that have evolved to help animals maintain homeostasis in the face of varied environmental challenges. We will cover foundational principals of animal physiological ecology and evolution, as well as new and exciting discoveries through weekly discussions of primary literature. We will focus primary literature discussions on "extreme environments," as Earth's harshest landscapes provide exciting and powerful examples of adaptations of physiological systems. This course will be delivered through a combination of lectures, active learning assignments, readings from the scientific literature, and group discussions. By the end of this course, you will develop a new perspective on the ecological and evolutionary factors that shape physiological similarities and differences among the animals of our planet (including humans). This course counts as a category elective for the Ecology and Biodiversity major and Physiology in Health and Disease major. Prerequisites: BIOL 1010 and BIOL 1011.

BIOL 3256 Advanced Human Anatomy & Physiology (0-5 Credits)

This one quarter course is intended for advanced biology and physiology majors with an interest in the anatomical structure and physiological functioning of body systems. This course builds upon the Human Anatomy and Human Physiology courses that are prerequisites. This advanced course will explore in greater depth understanding mechanisms of action of major body systems and elaborate on the relationship between structure and function. In addition to didactic content, students will complete evaluation of primary literature and design laboratory experiments to test hypotheses of interest. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, models, dissections, inquiry-based learning, experimentation and a variety of assessments. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. Please note that the lab portion of this course requires dissection. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisites: BIOL 3241 and BIOL 3242.

BIOL 3260 Nutritional Physiology (4 Credits)

This course is designed to introduce the fundamental concepts, content and scientific bases of nutritional physiology at the levels. This course will examine the scientific structure and properties of carbohydrates, proteins and lipids as the major macronutrients required for human health. In addition, it includes exploration of the digestion, absorption and metabolism of both macronutrients and micronutrients. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, inquiry-based learning, experimentation and a variety of assessments. Prerequisite: BIOL 2120.

BIOL 3280 Intro to Pathophysiology (4 Credits)

This course is designed as an introduction of the mechanisms and consequences of disease based on physiological dysfunction in the major organ systems. The course will focus on the fundamental concepts and processes of human pathophysiology through exploration of the unique physiological roles of several body systems, how these systems have important integrative relationships that underlie the overall physiological functioning of healthy humans, and how system function is altered in disease and the clinical manifestations of these changes. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 2120. A course in human physiology is recommended.

BIOL 3410 Animal Behavior (4 Credits)

This class examines animal behavior from an evolutionary and ecological perspective. The course provides the background needed to understand behavioral evolution, including a focus on the inheritance of behavior, natural selection, sexual selection, and kin selection. This class studies the evolution of a variety of behaviors, including communication and displays, mate choice, parental care, cooperation, mating systems, social behavior, habitat selection, foraging, and anti-predator behavior. The emphasis is on theoretical principles, design of experiments, and interpretation of data. This course counts as a category elective for the Ecology and Biodiversity major. Prerequisites: BIOL 1010 and BIOL 1011, and BIOL 2010. Recommended Prerequisite: BIOL 2090.

BIOL 3560 Molecular Biology Laboratory (4 Credits)

Laboratory based course that covers techniques in gene excision, cloning and reinsertion and gene sequencing. Lab fee associated with this course. Prerequisite: BIOL 2510, or permission of instructor.

BIOL 3570 Proteins in Biological Systems (4 Credits)

Proteins considered in their biological setting; protein synthesis and degradation; survey of protein functions in vivo; introduction to protein biotechnology. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120.

BIOL 3610 Developmental Biology (4 Credits)

Processes and mechanisms of development, exemplified by higher animal embryogenesis, with consideration of microbial model systems. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120 and 2510.

BIOL 3615 Blood Vessel Development and Disease (4 Credits)

This course details the underlying biological programs during blood vessel development and mechanisms that lead to vascular pathologies. The class will incorporate aspects embryology, signaling transduction, and genetics as well as current techniques in developmental biology to comprehensively cover how blood vessels are formed embryonically. Additionally, we will discuss in detail how defects in blood vessel-related signaling programs later manifest into disease. Prerequisite for this course is Cell Structure and Function (BIOL2120/2121).

BIOL 3630 Cell Biology of Development (4 Credits)

Every organism has a stereotypical shape, but how does this shape arise? This course examines the cellular and molecular mechanisms that direct the forming of body and tissue shape. This course counts a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3640 Introductory Neurobiology (4 Credits)

Organization and function of vertebrate central nervous system; nature of action potential, biochemistry of neurotransmitters, neuropeptides, functional anatomy of nervous system, phylogeny of nervous system. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

BIOL 3641 Systems Neuroscience (4 Credits)

Structure and function of the brain and spinal cord, emphasis on functional systems including sensory perception, motor control and consciousness. This course counts as a category elective for the Cognitive Neuroscience concentration. Prerequisite: BIOL 3640 or 3241.

BIOL 3642 Neuropharmacology (4 Credits)

How psychoactive drugs exert their effects on the nervous system; drugs of abuse and drugs used in the treatment of psychotic and neurodegenerative disorders. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120. Recommended prerequisites: BIOL 3640.

BIOL 3644 Neuromuscular Pathophysiology (4 Credits)

Cellular and molecular basis for normal nerve and muscle functions and the alteration of these functions by toxins, trauma and diseases of the brain, nerves and muscles; how specific insults produce clinical symptoms and pathology. Prerequisite: BIOL 2120.

BIOL 3646 Seminar: Cognitive Neuroscience (2 Credits)

This seminar is the capstone course for the neuroscience portion of the cognitive neuroscience program. Seminar topics include but are not limited to neurological disorders, model systems in neuroscience and sensory systems.

BIOL 3647 Neuroscience of Movement (4 Credits)

Producing the vast array of movements that humans (and many animals) use everyday represents one of the body's greatest challenges and greatest successes. These various movements require that the nervous, muscular, and skeletal systems work in concert to achieve a common goal. This course will explore the scientific basis of movement production, with particular emphasis on the neuroscience of motor control. We will explore how the nervous system drives the development of movement strategies at an early age, modifies movement strategies to adapt to changing demands throughout life, and how injury, dysfunction, and/or aging can lead to movement challenges. This course counts as a category elective for the Physiology in Health and Disease major and Cognitive Neuroscience concentration. Required prerequisite: Cell Structure & Function (BIOL 2120); Recommended prerequisite (1 or more of the following): Introduction to Neuroscience (BIOL 3640) or permission of instructor.

BIOL 3648 Molecular Mechanisms of Neurological Disease (4 Credits)

This course will be an in-depth study into some of the key molecular mechanisms involved in the pathogenesis of human neurological disease. A particular emphasis will be placed on the role of RNA regulation and metabolism. The primary focus will be on five devastating diseases: 1. Spinal Muscular Atrophy (SMA) 2. Fragile X Syndrome (FXS) and Fragile X Tremor Ataxia Syndrome (FXTAS) 3. Myotonic Dystrophy type 1 and 2 (DM1 and DM2) 4. Spinocerebellar Ataxia type 2 (SCA2) 5. Amyotrophic Lateral Sclerosis (ALS) and Frontotemporal Dementia (FTD) This course will cover a variety of topics including disease pathophysiology and pathogenesis. However, readings will be assigned from the recent primary literature discussing cellular and molecular mechanisms. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2510 Genetics.

BIOL 3649 Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics (4 Credits)

Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics covers the following disorders: Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, Huntington's disease, spinocerebellar ataxia, Creutzfeldt-Jakob disease, multiple sclerosis, traumatic brain injury and spinal cord injury. Course literature includes primary journal articles and review papers describing the etiology and pathophysiological mechanisms of these disorders. Potential therapeutic approaches to treatment are also investigated. The course format typically includes a lecture reviewing the basic biology, symptoms, and current treatments for each disorder, followed by a thorough analysis of primary research papers focused on novel molecular mechanisms and new targets for therapeutic development. Grading is based on 3 exams throughout the academic quarter and participation in discussing journal articles in class. This course counts as a category elective for the Cognitive Neuroscience concentration. Prerequisite: BIOL 2120 Cell Structure and Function. Recommended: BIOL 3640 Introductory Neurobiology. For Graduate Students: an additional term paper is required with the exact topic to be agreed upon by the student and instructor.

BIOL 3650 Endocrinology (4 Credits)

Mechanisms of hormone action, evolution of vertebrate endocrine systems, analysis of function integration of hormonal responses in maintenance of homeostasis. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

BIOL 3656 Cellular Aspects of Diabetes and Obesity (4 Credits)

This course focuses on specific cellular and molecular events key to the understanding of the pathological conditions of diabetes and obesity. Topics include the endocrine pancreas, adipose tissue and neuroendocrine control energy expenditure and feeding behavior. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

BIOL 3670 Molecular Immunology (4 Credits)

The ability to distinguish self from non-self is crucial to all organisms. In humans Organs, cells and other higher animals, this task fall to the immune system. Suppression of this system is key to numerous pathogenic viruses including Ebola and human immunodeficiency virus. The failure to adequately regulate immune response underlies allergic reactions, arthritis and diabetes. This course will introduce students to the organs, cells and molecules that underlie mammalian immune response; immunogenetics and the fundamental mechanisms of cell mediated and humoral immune response; and the relationship of immune system to human disease. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510.

BIOL 3675 Virology (4 Credits)

Viruses are the ultimate cell biologists. They usurp essential cellular components to create new virus progeny leading to pathological cellular physiology. This course will delve into the genetic and cellular principles that govern virus entry, replication, and assembly and cover a broad range of DNA and RNA-based virus families. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120 and BIOL 2510.

BIOL 3700 Topics in Ecology (1-4 Credits)

Topics vary; may include plant, animal, biochemical, alpine or aquatic; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: one quarter of undergraduate ecology and/or instructor's permission.

BIOL 3701 Topics in Genetics (1-4 Credits)

Topics vary; may include genetic methods, molecular genetics, human genetics, chromosomes or population genetics; one topic per quarter. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510 and/or instructor's permission.

BIOL 3702 Advanced Topics in Regulatory Biology (1-4 Credits)

Topics vary; may include endocrinology, physiology or immunology; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: varies with topic and instructor; instructor's permission usually required.

BIOL 3703 Advanced Topics in Developmental Biology (1-4 Credits)

Topics vary; may include gene expression in development, developmental immunogenetics, developmental biochemistry or aging; one topic per quarter. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: instructor's permission.

BIOL 3704 Advanced Topics in Cell Biology (1-4 Credits)

Topics vary; may include supramolecular structure, microscopy, membranes and techniques. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120.

BIOL 3705 Advanced Topics in Molecular Biology (1-4 Credits)

Topics vary, but may include biochemistry, supramolecular structure and function, molecular genetics, membrane biology. May be taken more than once for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: varies with course and instructor; instructor's permission usually required.

BIOL 3706 Topics in Evolution (1-4 Credits)

Topics vary, but may include molecular evolution, plant evolution and animal evolution. Prerequisite: BIOL 2120 and BIOL 2510.

BIOL 3707 Advanced Topics in Conservation Biology (1-4 Credits)**BIOL 3708 Topics in Integrative Physiology (2-4 Credits)**

Topics for this course include, but are not limited to, human physiology and disease, integrative physiology, environmental or social impacts on human physiology and health, and comparative physiology. Students will gain knowledge of a specific topic in physiology and/or pathophysiology through discussion of current literature and research. May be repeated for credit. Prerequisite: BIOL 2120.

BIOL 3800 Human Molecular Biology (4 Credits)

Medical Genetics is the 24th member of the American Board of Medical Specialties. This course will introduce students to the fundamentals of molecular biology with an emphasis on understanding of how the field is applied in the context of medical diagnostics, personalized/precision medicine and other commercial applications. Students will be introduced to published research reports and provided with opportunities to critically examine the application of molecular biology to central questions in such areas as oncology, inherited diseases and genetically engineered organisms. Prerequisite: BIOL 2510.

BIOL 3850 Genetic Engineering (4 Credits)

This course will cover principles in gene manipulation and its application in research, medicine and industry. More specifically, this course will explain emerging technologies in genetic engineering and its practical and ethical implications. Topics will incorporate historical and emerging aspects of developmental biology, chemistry, and genetics as well as current techniques in genetic manipulation that are related to genomic editing. Additionally, students will be trained to interface with genomic databases and employ DNA sequence editing software to manipulate DNA sequences to achieve novel cloned products. This course counts as a category elective for the Molecular Biology major. Prerequisite for this course is Genetics BIOL 2510.

BIOL 3855 Genetic Model Organisms in Health & Disease (4 Credits)

This course is focused on how basic science studies using genetic model organisms have had a major impact on human health and disease in addition to helping us understand fundamental aspects of biology. We will cover clinically relevant recent advances from bacterial studies (i.e. CRISPR/Cas9-mediated genome editing) to how studies in fruit flies revealed insights into immune disease. Students will gain a better appreciation for why researchers using model organisms were awarded Nobel prizes as well as why major medical funding organizations like the National Institutes of Health, American Cancer Society, and American Heart Association support research using non-human systems. This course will prepare students to understand health-relevant research from varied model systems. Students will learn practical aspects for determining which model systems are best suited to answer which types of questions. They will also practice designing experiments and defending their importance in grant abstract-style essays. Prerequisites: BIOL 2120 and BIOL 2510.

BIOL 3910 Viruses & Infectious Human Diseases (4 Credits)

From sexually transmitted viruses to bacterial pneumonia, infectious pathogens are the number one threat to human health. This course will introduce students to prions, viruses and bacterial pathogens with an emphasis on those commonly encountered in clinical medical practice. Through the use of technical/scientific research journals students will be encouraged to investigate the etiology, pathogenesis and treatment of human infectious disease with an emphasis on the clinical, molecular diagnostic and therapeutic aspects of the disease. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510. Recommended prerequisite: BIOL 3800.

BIOL 3950 Undergraduate Research (1-10 Credits)

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

BIOL 3991 Independent Study (1-10 Credits)

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

BIOL 3995 Independent Research (1-10 Credits)**BIOL 4050 Topics in Plant Biology (2 Credits)**

Varying topics; areas of plant-animal interactions, co-evolution, plant ecology, plant biochemistry/physiology.

BIOL 4085 Accelerated Biostatistics (2 Credits)

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

BIOL 4090 Biostatistics (4 Credits)

Statistic on biological research; emphasis on procedures, applications of regression, correlation, analysis of variance, and nonparametric tests. Include instruction on computer aided (Mac and PC) statistical analysis and presentation of results. Cross listed with BIOL 2090.

BIOL 4095 Research Methods and Analysis (4 Credits)

The purpose of this course is to introduce you to topics of applying statistical knowledge to real data, including specific tests/models as well as issues related to project design such as adequate sample size, avoiding confounding variables, unexplained error, and other common challenges. It is geared toward both field and lab-based projects, but the topics covered are relevant to research generally. Each week we will discuss the reading for that week with the objective of clarifying points and where possible, applying the concepts to real data from our own work. Prerequisites: BIOL 4090 or permission of instructor. Prerequisites: BIOL 4090.

BIOL 4150 Special Topics in Adv Biology (1-4 Credits)

Topics of special interests to teaching and research faculty presented as needed to complement and expand existing curriculum. May be taken more than once for credit.

BIOL 4155 Leadership in Science (1 Credit)

This course addresses the basic leadership skills necessary to succeed in the dynamic professional environment of the biomedical sciences. Topics covered include leadership strategies and professional negotiation, conflict resolution, and team-building. Students will determine leadership strengths and weaknesses and use case studies to strengthen their leadership practices.

BIOL 4211 Advanced Cell Biology (4 Credits)

Students study the subcellular structure and organization of the cell. Organelle structure and function are examined in detail as well as biogenesis and degradation (turnover) of these subcellular structures. Cytoskeletal dynamics are also a major focus. Specific topics covered include cell division, macromolecular synthesis, membrane transport, cell-matrix and cell-cell communication, cell migration, cell differentiation, and mechanisms of cell death. The course follows a lecture format in conjunction with selected journal article presentations and discussions by the students. Cross listed with BIOP 4150.

BIOL 4212 Advanced Molecular Biology (3 Credits)

This course focuses on a detailed analysis of regulated gene expression. The topics include lectures and readings of relevant literature in areas covering gene regulation at multiple steps, including transcription, RNA processing, and translation. In particular, the logic of experimental design and data analysis are emphasized.

BIOL 4213 Advanced Cell Signaling (3 Credits)

Students in this course investigate a large array of cellular signal transduction cascades. Specific signaling pathways to be covered include growth factor receptors, cytokine receptors, steroid receptors, integrin-extracellular matrix, heterotrimeric G-protein coupled receptors, monomeric G-proteins, transcription factors, lipids, cytoskeleton, cell cycle, and apoptosis. Each of these topics is examined in the context of normal cell physiology as well as their roles in specific disease processes. The course follows a lecture format in conjunction with selected journal article presentations and discussions by the students.

BIOL 4220 Grad Sem: Ecology & Evolution (2 Credits)

A series of student presentations focusing on varied topics involving ecology and evolution. May be taken more than once for credit.

BIOL 4231 Responsible Conduct in Rsrch (1 Credit)

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

BIOL 4310 Foundations in Literature: Cell and Molecular Biology (2 Credits)

Students participate in a weekly discussion group that focuses on recent papers from the primary literature in Cell and Molecular Biology.

BIOL 4330 Foundations in Literature: Ecology (2 Credits)

Students participate in a weekly discuss group that focuses on recent papers from the primary literature in Ecology.

BIOL 4331 Foundations in Literature: Evolution (2 Credits)

Students participate in a weekly discussion group that focuses on recent papers from the primary literature in Evolution.

BIOL 4500 Clinical Exercise Physiology (5 Credits)

This graduate course in clinical physiology will provide an understanding of fundamental practices and assessments within clinical settings. We will combine knowledge from various backgrounds in physiology and tie theoretical and practical concepts together for assessing body function and developing methods for improving health and performance. We will connect the physiological concepts related to the cardiovascular, respiratory, and muscle systems as well as develop projects that require combining knowledge of the assessment skills and evaluation for clear communication and exercise prescription to special populations.

BIOL 4510 Exercise Testing & Prescription (4 Credits)

The purpose of this graduate course is to develop knowledge combined with hands-on skills for integration of exercise testing and prescription concepts. Material in this course will be applicable for performance as well as clinical considerations. This is an active course which will require your participation as both the subject and technician, giving perspective and understanding of methods and protocols along with their justification for various purposes. Prerequisite: BIOL 4500.

BIOL 4515 Research Techniques in Exercise Physiology (4 Credits)

This graduate level course is designed to provide exposure to several methods of research within the area of exercise physiology. This is a hands-on course that combines theory and literature with practical research experiences in physiology. In this course, students will perform data collection and analysis of differing topics. These may include the following topics: pulse and tissue oxygenation, signaling (heart rate variability, oxygen kinetics), respiratory loops, Doppler ultrasound (blood flow and tissue structure), etc. Our aims will focus on understanding how and why the method works, how to collect data, as well as the analysis and reporting of variables for proper interpretation.

BIOL 4520 Advanced Nutrition and Exercise (4 Credits)

This is a one quarter course intended for graduate students and advanced biology and physiology majors. This course builds upon the prerequisite introductory nutrition course. The course will focus on understanding, evaluating and implementing the fundamental principles and evidence based best practices of nutrition related to exercise, physical activity and health. Starting with a review of nutritional biochemistry and exercise, major macromolecule and micronutrient metabolism will be addressed in depth. Applications of nutritional science to various types of exercise (endurance, power, speed) will be explored, as well as nutrition and exercise specific to age and sex across the lifespan. In addition to didactic content, students will complete evaluation of primary literature and propose a nutritional program for a specific population of interest. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, inquiry-based learning, experimentation and a variety of assessments. Prerequisite: BIOL 3260 Nutrition or the equivalent.

BIOL 4530 Advanced Cardiovascular and Pulmonary Physiology (4 Credits)

This course is developed to provide a deeper level of physiological knowledge of the cardiac, vascular, circulatory, and pulmonary systems and their functions. With both lecture materials as well as in-class discussion of concepts and research articles, we will go deep into the basic levels of composition and function and facilitate the understanding of mechanisms that limit disease populations, elderly, etc. How can we adapt our lifestyles to improve our cardiovascular health? Prerequisite: BIOL 3250.

BIOL 4540 Electrocardiogram Interpretation (2 Credits)

This course is an advanced course in cardiac physiology for those interested in understanding principles associated with cardiac function, electrical physiology of the heart, and interpretation of the electrocardiogram. As the functions related to our heart drive our cardiovascular system, we will find ways to relate our experiences of daily life to the concepts and principles learned throughout this course to deepen our knowledge and retain this information. We will explore the physiological mechanisms related to the cardiac system as well as develop projects that require combining knowledge of the electrical pathways and of use of electrocardiography for proper interpretation.

BIOL 4550 Cardiopulmonary Rehabilitation (2 Credits)

This course focuses specifically on cardiopulmonary rehabilitation. Students will gain an understanding of (1) the impact of lung and heart disease on daily physical activity levels, (2) common mechanisms limiting exercise tolerance, and (3) risks and benefits of exercise for patients with lung and heart disease. Students will learn guidelines for exercise prescription and rehabilitation programs for patients with cardiovascular and pulmonary diseases. Practical application of knowledge and skills gained in BIOL 4530 will be emphasized. Prerequisite: BIOL 4530 Advanced Cardiovascular & Pulmonary Physiology.

BIOL 4570 Advanced Human Pharmacology (2 Credits)

This class will focus on how drugs and other therapeutics can be used to treat and prevent diseases. Students will develop a deep understanding of pharmacokinetics/ pharmacodynamics, the major classes of drugs, how and why they are used, drug side effects, and drug interactions. Specific emphasis will relate to effects of drugs utilized for disease prevention or treatment on physical activity and exercise.

BIOL 4580 Physical Activity for Management of Chronic Diseases (3 Credits)

This one quarter course is intended for graduate students in the clinical exercise physiology program or other related programs. This course builds upon previous coursework in clinical exercise physiology. It will focus on understanding, evaluating and implementing the fundamental principles and evidence based best practices of exercise management for persons with chronic diseases and disabilities. Starting with an overview of the concept of "exercise as medicine," the principles of safe exercise as a method for improving health outcomes will be applied to individuals with chronic diseases. Various chronic disease states and their associated medical challenges will be explored, and the recommendations for modified exercise activities, durations and outcomes to support healthy and safe outcomes will be addressed. In addition to didactic content, students will complete evaluation of primary literature in the field. Prerequisite: BIOL 4500/4510 Clinical Exercise Physiology I and II.

BIOL 4870 Medical Ethics (4 Credits)

This course presents knowledge and discussion of ethical issues that arise from advances in the biomedical sciences and medicine. Several specific ethical issues and policies related to methodologies and procedures, emerging medical technologies, treatment decisions, doctor-patient relationship, informed consent, medical experimentation/clinical research, and health care reform.

BIOL 4880 Capstone in Biomedical Sciences (4 Credits)

This is the capstone course for students enrolled in the Professional Science Master's program. In this course, students integrate advanced knowledge in science and math along with courses taken outside traditional science and math courses as their electives. This course incorporates lectures, guest speakers, and class discussions focusing on current issues or concerns in the chosen concentration. PSM students only. Requires instructor approval.

BIOL 4980 Internship in Biomedical Sciences (1-4 Credits)

The internship course provides individualized opportunities to gain experience and professional skills. This course includes a structured practical and productive internship experience that allows for the integration and application of disciplinary knowledge in a professional setting. The internship can be administrative, clinical, programmatic, or research focused. Students will work with a professional from healthcare, pharmaceutical and biotech companies, or private and public health services to identify the student's specific project focus.

BIOL 4991 Independent Study (1-17 Credits)**BIOL 4995 Independent Research (1-8 Credits)****BIOL 5991 Independent Study (1-17 Credits)****BIOL 5995 Independent Research (1-8 Credits)****Health Sciences Courses****HLTH 3000 Seminar in Health Science (1-2 Credits)**

This seminar is the capstone course for the Human Health Science & Systems program. This class will focus on the current understanding of several topics in human health. Emphasis will be on critical reading and discussion of current scientific literature related to human health and health care. Students will learn to recognize and appreciate different approaches and methods of health-related research. Students will utilize and integrate knowledge from previous courses to understand to present effective discussions on current topics in health. For students' continued development of strong oral communication skills, student presentations of primary literature will generate the basis of discussion. Prerequisites: HLTH 2000 and 2010.

HLTH 3600 Cultural Responsiveness in Health Care (2 Credits)

To contribute to reducing health inequities and improving health outcomes, this course will promote an improved understanding and responsiveness to the realities of social and structural impacts that influence the health of an individual or community. Topics will include health care delivery and access, political economy of health care, implicit biases, professionalism, relational leadership, dealing with patients in difficult situations, and health equity. The course will help students learn to provide more informed and effective care and promote a more culturally sensitive and responsive future workforce in healthcare, while also serving community needs. Prerequisite: HLTH 2000 or equivalent.

HLTH 3700 Topics in Health (1-4 Credits)

Topics in the area of, but are not limited to, human health and disease, environmental or social impacts on health, healthcare delivery, evidence-based medicine. Students will gain knowledge of a specific topic in human health and/or health care through discussion of current literature and research. May be repeated for credit. Prerequisites: HLTH 2000 or 2010.

HLTH 4210 Advanced Health Education and Promotion (2 Credits)

This course will provide students foundational knowledge about how to deliver health education and promote healthy behaviors to patients and community. This course will provide students with the practical skills and best practices for communicating and educating others about health, clinical tests and results, and clinical plans of action. Students will gain practical skills for encouraging goal setting and behavioral change and will develop an understanding of motivational considerations especially for patients with mental health challenges or psychosocial concerns related to acute and chronic physical disorders. Students will focus on integrating evidence-based research and strategies for the purpose of leading culturally sensitive discussions and/or difficult conversations and encouraging healthy behaviors.

HLTH 4300 Basic Legal Consideration in Healthcare (2 Credits)

This course will provide a basic understanding of legal issues that may affect care providers and business owners. Basic legal terminology and concepts will be presented, in addition to basic court processes and procedures. A goal of establishing this basic understanding is to prevent or reduce the consequences of lawsuits. Professionalism and the code of ethics will also be discussed.