**BIOLOGY**

**Undergraduate Program Information**

A student may earn the Bachelor of Arts in biology or the Bachelor of Science in biology, genetics, microbiology or conservation ecology through major studies in the Department of Biology. The Bachelor of Science in biology or microbiology is recommended for premedical and predental students, for those preparing to teach biology and other sciences at the secondary and college levels, for those interested in the numerous fields of biological research and applied biology, and for those planning on obtaining an advanced degree in biology.

Freshmen should begin taking required biology and chemistry courses in their first year. Students are required to speak with an advisor as soon as they declare a major within the department. The department welcomes students considering a biology major who wish preliminary advising. More information on the Department of Biology is available on our website, http://bio.nmsu.edu.

A student must earn a grade of C- or better to receive credit for any nondepartmental or departmental requirement for any major or minor offered by the Department of Biology.

It is strongly recommended that students include a minor or supplementary course work in a specific discipline to enhance their academic experience. See the "Programs A-Z" (http://catalogs.nmsu.edu/nmsu/programsaz) section of this catalog for specific minors and see the departmental sections for the requirements for each. Selection of a minor or a supplementary coursework area should be done in consultation with an advisor.

The department offers a minor in biology, microbiology, human biology, and conservation ecology. A student may not earn a major and a minor in the same discipline.

A student must fulfill a second language requirement to receive a Bachelor of Arts or Bachelor of Science degree in the Biology and Conservation Ecology majors. This requirement does not apply to the Conservation Ecology major, offered jointly with the Department of Fisheries, Wildlife and Conservation Ecology, or the Genetics major, offered jointly with the Department of Plant and Environmental Science. To meet the second language requirement, the student must do one of the following:

- Complete two semesters of second language courses numbered 111 and 112 with a grade of C- or better. Spanish speakers should enter and complete SPAN 113 Spanish for Heritage Learners I, SPAN 213 Spanish for Heritage Learners II or SPAN 214 Spanish for Heritage Learners III with a C- or better to fulfill the requirement.
- Challenge the 112 level of French, Chinese, German, Japanese, or Spanish; or the 113 level for the Spanish-for Heritage Learners student or the 213 level for Portuguese.
- Obtain college certification of completion of two years of a second language at the high school level with a grade of C- or higher in the second-year level. (i.e. equivalent to FREN 112 Elementary French II, GER 112 Elementary German II, SPAN 112 Elementary Spanish II, etc.)
- Complete two semesters of American Sign Language, courses C D 374 American Sign Language I and C D 375 American Sign Language II, with a grade of C- or better.

**Graduate Program Information**

The Department of Biology offers graduate study leading to the Doctor of Philosophy and Master of Science degrees. Our goal is to prepare students for careers in the various fields in biology through formal coursework and research experiences as well as through seminars and discussion groups.

All prospective applicants must submit the materials specified in the current Department Graduate Application Packet that is available on the Graduate Student section of the Biology website http://bio.nmsu.edu/grads/. The Departmental Graduate Application Packet also describes how to apply for Graduate Assistantships. These assistantships are awarded based on departmental needs and student merit; in general they are reserved for Ph.D. and thesis Master of Science students, and are not available to non-thesis Master of Science students.

There are three formal course requirements for all Biology Graduate students, with the exception of students in the accelerated non-thesis MS Biotechnology option. These core courses are:

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>BIOL 510</td>
<td>Current Topics in Biology</td>
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<td>BIOL 610</td>
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Students are required to successfully complete the Seminar course once each year that they are in the program.

For research toward the Master of Science or the Ph.D., students can choose among the Department’s three areas of emphasis:

1. Behavioral, Ecological and Evolutionary Biology
2. Cell and Organismal Biology
3. Microbiology

All graduate students should develop their curriculum plan in consultation with their faculty advisor and graduate committee. Details of sample course sequences within the different emphases are described in the Biology Graduate Handbook available for download from the Graduate Student section of the Biology website http://bio.nmsu.edu/grads/. Graduate students may also take a minor in other graduate departments and programs.

**Degrees for the Department**

- Biology - Bachelor of Science (http://catalogs.nmsu.edu/nmsu/arts-sciences/biology/biology-bachelor-science)
- Biology - Bachelor of Arts (http://catalogs.nmsu.edu/nmsu/arts-sciences/biology/biology-bachelor-arts)
- Microbiology - Bachelor of Science (http://catalogs.nmsu.edu/nmsu/arts-sciences/biology/microbiology-bachelor-science)
- Genetics and Biotechnology - Bachelor of Science in Genetics (http://catalogs.nmsu.edu/nmsu/arts-sciences/biology/genetics-biotechnology-bachelor-science-genetics)
- Biology - Master of Science (http://catalogs.nmsu.edu/nmsu/arts-sciences/biology/biology-master-science)
Minors for the Department

Biology - Undergraduate Minor

Microbiology - Undergraduate Minor

Conservation Ecology - Undergraduate Minor

Genetics and Biotechnology - Undergraduate Minor

Human Biology - Undergraduate Minor

Michelle Nishiguchi, Professor, Department Head
Jennifer Curtiss, Associate Professor, Associate Department Head

Professors
Boecklen, Hanley, Houde, Milligan, Nishiguchi, C. Shuster, Serrano, Smith, Unquez, Wright; Associate Professors Bailey, Curtiss, Hansen, Mabry, M. Shuster, Xu; Assistant Professors Castillo, Indriolo, Ferrenberg, James, Lodato, Lopez

BIOL 101G. Human Biology

1 Credit

Biology - Doctor of Philosophy

Minors for the Department

Biology - Undergraduate Minor

Microbiology - Undergraduate Minor

Conservation Ecology - Undergraduate Minor

Genetics and Biotechnology - Undergraduate Minor

Human Biology - Undergraduate Minor

Michelle Nishiguchi, Professor, Department Head
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Biology Courses

BIOL 101G. Human Biology

3 Credits

Introduction to modern biological concepts. Emphasis on relevance to humans and their relationships with their environment. Cannot be taken for credit after successful completion of BIOL 111G or BIOL 211G. Appropriate for non-science majors. Requires successful completion of BIOL 101GL in order to meet the NM Common Core Area III Laboratory Science requirements.

BIOL 101GL. Human Biology Laboratory

1 Credit

Laboratory for BIOL 101G. Laboratory experiences and activities exploring biological concepts and their relevance to humans and their relationship with their environment.

Prerequisite(s)/Corequisite(s): BIOL 101G.
BIOL 221. Introductory Microbiology
3 Credits
Principles of isolation, taxonomy, and physiology of microorganisms. Restricted to Community Colleges campuses only.
Prerequisite(s): CHEM 110G or CHEM 111G or CHEM 112G.
Corequisite(s): BIOL 221 L.

BIOL 221 L. Introductory Microbiology Laboratory
1 Credit
A laboratory course to accompany BIOL 221 or BIOL 219.
Prerequisite: BIOL 221 or BIOL 219 or concurrent enrollment.

BIOL 225. Human Anatomy and Physiology I
4 Credits (3+3P)
The first in a two-course sequence that covers the structure and function of the human body, including terminology of the human gross anatomy, chemistry overview, cell structure, cell physiology (including DNA, protein synthesis and cell division). The organization of cells and tissues and their metabolic and homeostatic processes and regulation are also covered. Physical and chemical operation of organs and systems of the human body include the intergumentary, skeletal, muscular, and nervous systems. Pre/ Restricted to: Community Colleges only.
Corequisite(s): CHEM 110G or CHEM 111G.

BIOL 226. Human Anatomy and Physiology II
4 Credits (3+3P)
The second in a two-course sequence that covers the structure and function of the human body. Includes the physical and chemical operation of the organs and systems of the human body, including endocrine, cardiovascular, lymphatic, immune, respiratory, digestive, urinary and reproduction system. Concepts of nutrition, metabolism, energy, fluid and electrolyte balance, heredity pregnancy and human embryonic and fetal development are also covered. Restricted to: Community Colleges only.
Prerequisite(s): BIOL 225, CHEM 110G or CHEM 111G.

BIOL 227. Pathophysiology
3 Credits
A study of the structure and function of the human body with specialized emphasis on disease processes.
Prerequisite(s): AHS 153 or BIOL 225 Corequisite/Prerequisites(s): AHS 154 or BIOL 226 Restricted to: Community Colleges only.

BIOL 250. Special Topics
1-3 Credits
Specific subjects to be announced in the Schedule of Classes. May be repeated for a maximum of 6 credits. Community Colleges only.

BIOL 253. Human Anatomy
4 Credits (3+3P)
Detailed presentations of human anatomy, with laboratory. For nursing, prenursing, and human nutrition and food science majors only. Restricted to: HNFS, PNUR majors.
Prerequisite(s): Grade of C- in BIOL 211G and either CHEM 111G or CHEM 110G.

BIOL 254. Human Physiology
3 Credits
Physical and chemical operation of the organs and systems of the human body. Not open to students who have passed BIOL 354 or BIOL 381.
Prerequisite(s): Grade of at least C- in BIOL 211G; BIOL 211GL; CHEM 111G or CHEM 110G.

BIOL 262. Human Pathophysiology I
3 Credits
The first in a two-course sequence that covers changes in body physiology that result from disease or injury. Includes a general introduction to pathophysiology as well as an overview of altered cellular and tissue biology, injury, inflammation, and neoplasia. Students will also explore deviation from fluid, hemodynamic, and endocrinologic balance. Topics related to the science of pathophysiology, including pathology, pathogenesis, etiology, epidemiology, and clinical manifestations, are also discussed throughout the course where relevant. Grade of C- or higher in microbiology is recommended. Restricted to Community Colleges campuses only.
Prerequisite(s): Grade of C- or higher in BIOL 225 and BIOL 226.

BIOL 263. Pathophysiology II
3 Credits
The second in a two-course sequence that covers changes in body physiology that result from disease or injury. This course focuses on the pathophysiology of the nervous, cardiovascular, lymphatic, respiratory, digestive, urinary, and reproductive systems. Topics related to the science of pathophysiology, including pathology, pathogenesis, etiology, epidemiology, and clinical manifestations, are also discussed throughout the course where relevant. Grade of C- or higher in microbiology is recommended. Restricted to Community Colleges campuses only.
Prerequisite(s): Grade of C- or higher in BIOL 225, BIOL 226, and BIOL 262.

BIOL 301. Principles of Ecology
3 Credits
A survey of ecology including general theory, the adaptations of organisms, population dynamics, species interactions, and the structure and function of natural communities and ecosystems. MATH 191G and A ST 311 recommended. Same as E S 301. Crosslisted with: E S 301.
Prerequisite(s): BIOL 111G, MATH 121G.

BIOL 302. Molecular Biology Techniques Laboratory
3 Credits
This combined lecture and laboratory course emphasizes molecular biology laboratory practices through the hands-on application of commonly applied techniques, protocols, and equipment. The topics covered include both the fundamental development of empirical data as well as data analysis using stand-alone and web-based resources. Consent of instructor required.
Prerequisite(s): BIOL 211G or equivalent, and MATH 121G.

BIOL 305. Principles of Genetics
3 Credits
Covers fundamental principles of reproduction, variation, and heredity in plants and animals. Crosslisted with: HORT 305 and AGRO 305
Prerequisite(s): BIOL 111G and BIOL 211G, or BIOL 211G and BCHE 140, either CHEM 111G or CHEM 115, and MATH 121G.

BIOL 309. Guided Biological Research Lab
3 Credits
This laboratory course provides a guided experience to hands-on research in biology. It is intended for early-career undergraduates who have finished the introductory sequence of Biology courses. Topics will vary with instructor.
Prerequisite(s): BIOL 111G, BIOL 211G, and MATH 121G.

BIOL 311. General Microbiology
3 Credits
Principles of physiology, molecular biology, ecology, and taxonomy of microorganisms.
Prerequisite(s): BIOL 211G and MATH 121G.
Biology

BIOL 311 L. General Microbiology Laboratory
2 Credits
Microbiology techniques and procedures, including isolation and identification of microorganisms and biotechnology procedures that employ microorganisms.
Prerequisite(s)/Corequisite(s): BIOL 219 or BIOL 311. Prerequisite(s): BIOL 211G and MATH 121G.

BIOL 312. Plant Taxonomy
3 Credits (2+3P)
Classification and identification of representative plant families and local plants. Emphasis on ability to use technical sources. Saturday field trips may be recommended.
Prerequisite(s): BIOL 111G and MATH 121G.

BIOL 313. Structure and Function of Plants
3 Credits (2+3P)
Structure, function, and survey of plants. BIOL 211G recommended.
Prerequisite(s): BIOL 111G, MATH 121G, and sophomore-level standing.

BIOL 314. Plant Physiology
3 Credits
Photosynthesis, respiration, water relation of plants, minerals and organic nutrition, growth and development.
Prerequisite(s): BIOL 211G and CHEM 112G.

BIOL 322. Zoology
3 Credits (2+3P)
Structure, function, and survey of animals. BIOL 211G recommended.
Prerequisite(s): BIOL 111G, MATH 121G, and at least sophomore-level standing.

BIOL 350. Special Topics
1-4 Credits
Specific subjects announced in Schedule of Classes and offered as scheduled courses. May be repeated for unlimited credit.

BIOL 351. Biology Internship
1-6 Credits
Substantial off-campus experience in biology selected by student in consultation with regular biology faculty member. Internship must be approved by faculty member. Student will supply mutually agreed upon documentation of internship activities after the internship is completed. May be repeated up to 6 credits. Restricted to: BIOL, MBIO, CEC, GEBT majors. S/U Grading (S/U, Audit).
Prerequisite(s): 45 college credits, 2.5 or better GPA, consent of instructor.

BIOL 353. Pre-Professional Human Anatomy
4 Credits
Pre-professional clinically-oriented survey of human anatomy. Designed primarily for pre-nursing majors. Provides comprehensive anatomical training for students planning careers in health and allied health sciences, such as medicine, dentistry, nursing, physical therapy, physicians aid, human nutrition, and food science. Suitable as a biology elective. Concurrent enrollment in BIOL 354L is recommended but not required.
Prerequisite(s): BIOL 211G and either CHEM 110G, CHEM 111G, or CHEM 115.

BIOL 353 L. Pre-Professional Human Anatomy Laboratory
1 Credit
Laboratory experience in human anatomy using anatomical models and cat dissections. Designed as a learning aid to support and augment BIOL 353 pre-professional Human Anatomy. For students planning careers in health and allied health sciences such as medicine, dentistry, nursing, physical therapy, physicians aid, human nutrition, and food science.
Prerequisite(s)/Corequisite(s): BIOL 253 or BIOL 353. Prerequisite(s): BIOL 211G and either CHEM 110G, CHEM 111G, or CHEM 115.

BIOL 354. Physiology of Humans
3 Credits
Principles of integrative functions in humans. A systems approach emphasizing tissues, organs, and their regulation.
Prerequisite(s): BIOL 211G and MATH 121G.

BIOL 354 L. Laboratory of Human Physiology
1 Credit
Laboratory to accompany BIOL 354.
Prerequisite(s): MATH 121G and either BIOL 254, BIOL 381, BIOL 354, or concurrent enrollment in BIOL 354.

BIOL 373. Fungal Biology
3 Credits (3+2P)
Same as EPWS 372.
Prerequisite: EPWS 310 or BIOL 311 or consent of instructor.

BIOL 377. Cell Biology
3 Credits
Fundamentals of eukaryotic cell structure, organization, and function. Emphasis on membranes, subcellular organelle systems, cytoskeleton, and cell cycle. Includes basic aspects of molecular biology. May be repeated up to 3 credits. BIOL 111G recommended.
Prerequisite(s): (BIOL 211G, BIOL 305 or GENE 315) and MATH 121G.

BIOL 381. Animal Physiology
3 Credits
Principles of integrative function in animals, emphasizing tissues, organs, organ systems, and regulation. Includes adaptations of animals to their environments. BIOL 111G and BIOL 377 recommended.
Prerequisite(s): BIOL 211G and junior-level standing, MATH 121G.

BIOL 382. Plant Signalling and Development
3 Credits
This is a course that introduces plant signalling pathways and their role in development to students. The lectures are structured to facilitate in-class discussions on the current state and future directions in this field. Topics will cover a wide range of biological questions and the methods used to study them. May be repeated up to 3 credits.
Prerequisite(s): BIOL 305 or GENE 315, and MATH 121G.

BIOL 385. An Introduction to Cancer
3 Credits
This course will cover 3 areas of cancer research and their interdisciplinary connections: clinical cancer research, epidemiology and public health, and basic cancer research. May be repeated up to 3 credits.
Prerequisite(s): BIOL 305 or GENE 315 or equivalent and MATH 121G.

BIOL 398. Biology Research Programs
1-3 Credits
Directed studies and research experiences, by arrangement with instructor. May be repeated for a maximum of 6 credits.
BIOL 402. Biology Honors Thesis
1-3 Credits (1-3)
Provides guidance in how to write a scientific paper in the sciences. Students will produce an honors thesis based on previous independent research. Consent of instructor required.
Prerequisite(s): MATH 121G and consent of instructor.

BIOL 408. Ecology of Plants
3 Credits
Controlling factors, succession, community dynamics, and the classification of vegetation.
Prerequisite(s): BIOL 301 and MATH 121G.

BIOL 412. Seminar in Microbiology
1 Credit
Seminar to aid students in assessment and presentation of current topics in microbiology. Graded: S/U.
Prerequisite(s): BIOL 311, BIOL 311L, and MATH 121G.

BIOL 423. Primate Adaption and Evolution
3 Credits
Prerequisite(s): ANTH 355 or consent of instructor.

BIOL 423 L. Primate Evolution Laboratory
1 Credit
Laboratory with exercises on non-human primate adaptation and evolution. Crosslisted with: ANTH 473 L.
Prerequisite(s): ANTH 355 or consent of instructor.
Corequisite(s): BIOL 423L when offered.

BIOL 424. Human Osteology
3 Credits
Corequisite(s): BIOL 424L when offered.
Prerequisite(s)/Corequisite(s): Recommend ANTH 355 or equivalent.

BIOL 424 L. Human Osteology Lab
1 Credit
Laboratory for ANTH 474. Experiences and activities related to identifying teeth and bones of the human skeleton. Crosslisted with: ANTH 474 L.
Prerequisite(s): Recommend ANTH 355 or equivalent.
Corequisite(s): BIOL 424.

BIOL 427. Symbiosis
3 Credits
In-depth treatment of the ecology, evolution, and mechanisms that are found in symbiotic systems. May be repeated up to 3 credits.
Prerequisite(s): BIOL 111G, BIOL 211G, and MATH 121G.

BIOL 434. Human Evolution
3 Credits
Overview of human biological evolution from the emergence of Miocene apes to the modern human diaspora. Crosslisted with: ANTH 434.
Prerequisite(s): ANTH 355 or consent of instructor.
Corequisite(s): BIOL 434L when offered.

BIOL 434 L. Human Evolution Laboratory
1 Credit
Laboratory in human evolution, includes exercises and activities to learn the human fossil record. Crosslisted with: ANTH 434 L.
Prerequisite(s): ANTH 355 or consent of instructor.
Corequisite(s): BIOL 434.

BIOL 436. Disease Vector Biology
3 Credits
Fundamentals of disease vector biology with emphasis on molecular biology. Explores an overview of vector borne diseases, insect endocrinology, insect immunity, olfaction, vector genome projects and transgenic insect techniques. Includes student presentations and literature discussions. Crosslisted with: BIOL 536
Prerequisite(s): BIOL 211G, BIOL 305, and MATH 121G.

BIOL 442. Genomics Technology
3 Credits
The course introduces current genomic techniques in genome sequencing, transcriptome analysis, detection of genetic variation, and metagenomics.
Prerequisite(s): BIOL 211G, BIOL 305 or BIOL 478 or GENE 315, and MATH 121G.

BIOL 446. Bioinformatics and NCBI Database
3 Credits
The course discusses how to use NCBI database and bioinformatic tools for research with genomics approaches. The topics include nucleotide and protein sequence analysis, similarity search with blast algorithms, gene/genome annotation, protein structure analysis, gene expression analysis, and metagenomic study.
Prerequisite(s): BIOL 211G, BIOL 305 or BIOL 478 or GENE 315, and MATH 121G.

BIOL 450. Special Topics
1-3 Credits
Specific subjects announced in the Schedule of Classes and offered as scheduled courses. May be repeated for unlimited credit.

BIOL 451. Physiology of Microorganisms
3 Credits
Aspects of cellular physiology unique to prokaryotes. BCHE 395 recommended.
Prerequisite(s): C- or better in BIOL 311, MATH 121G.

BIOL 455. Biometry
3 Credits
Biometry is the analysis of biological data using mathematical and statistical models. The course will cover basic theories of probability and statistics and will introduce principles of sampling, estimation, experimental design, and hypothesis testing. Students will analyze biological data using computer programs and will perform tests for goodness-of-fit, independence, analysis of variance, correlation, and regression.
Prerequisite(s): BIOL 111G or BIOL 211G, and MATH 121G.
BIOL 459. Darwinism Versus Creationism
3 Credits
This course examines the debate regarding Creationism versus Darwinism as explanations for the origin and diversification of life on Earth. Topics covered include the nature and philosophy of science, new-world creationism, old-world creationism, intelligent design, history of evolutionary thought, modern evolutionary theory, and the Creationism-Darwinism debate at the societal, political, and educational interfaces. The course structure will include formal lectures and in-class discussion of assigned readings.
Prerequisite(s): BIOL 111G or BIOL 211G, and MATH 121G.

BIOL 462. Conservation Biology
3 Credits
Examination of the value of biological diversity, the natural processes that control biological diversity, and the ways in which human activities have resulted in the loss of biological diversity, both regionally and globally.
Prerequisite(s): BIOL 301 and either MATH 142G or MATH 191G.

BIOL 465. Invertebrate Zoology
4 Credits (3+3P)
Survey, ecology, behavior and physiology. BIOL 322 recommended.
Prerequisite(s): MATH 121G, BIOL 111G, and junior-level standing.

BIOL 466. Invertebrate Zoology Field Trip
1 Credit
A one-week field trip for the study of marine invertebrates. Registrants must provide own camping gear. Graded: S/U.
Prerequisite(s): MATH 121G, BIOL 465 or equivalent (or concurrent enrollment) or consent of instructor.

BIOL 467. Evolution
3 Credits
Covers theory, historical background, population variation, natural selection, adaptation, speciation.
Prerequisite(s): BIOL 111G, BIOL 305 or GENE 320, and MATH 121G.

BIOL 469. Biology of Emerging Infectious Diseases
3 Credits
This class will investigate the evolutionary and ecological drivers of disease emergence. The effect of emerging diseases on human health will be addressed throughout the class, but the class will also consider the consequences of disease emergence for the health of wildlife and plant populations. Additionally, the class will consider the mechanisms used to control disease emergence and why they succeed or fail.
Prerequisite(s): MATH 121G, Introductory Genetics (BIOL 305 or equivalent) or consent of the instructor.

BIOL 470. Developmental Biology
3 Credits
The purpose of this course is to introduce students to the principles that govern the development of a single fertilized egg cell into a complex multicellular organism. These principles, and often the molecular mechanisms by which they are accomplished, appear to be universal for all multicellular organisms including both plants and animals. We will explore issues such as: how cells become committed to particular cell fates and how this commitment is maintained; how organs acquire particular shapes, sizes, and positions; the developmental causes of some human diseases; how the environment affects development; and, how changes in development provide the material basis for evolutionary change.
Prerequisite(s): BIOL 211G, BIOL 305, and MATH 121G.

BIOL 472. Primate Behavior and Ecology
3 Credits
Survey of the social behavior and ecology of nonhuman primates. Crosslisted with: ANTH 472.

BIOL 473. Ecology of Microorganisms
3 Credits (2+3P)
The metabolic interactions of microorganisms in the environment, with emphasis on their roles in ecological processes.
Prerequisite(s): MATH 121G, BIOL 311 or consent of instructor.

BIOL 474. Immunology
3 Credits
Basic concepts of the immune response.
Prerequisite(s): MATH 121G, BIOL 305, and CHEM 211 or CHEM 313.

BIOL 475. Virology
3 Credits
Mechanisms of viral infections of animals and man. BCHE 395 or BIOL 305 are recommended.
Prerequisite(s): BIOL 311 and MATH 121G.

BIOL 476. Soil Microbiology
3 Credits
Nature and physiology of soil microorganisms, how they affect plant growth and recycle nutrients. Land framing, bioremediation, and other environmental problems as influenced by soil microorganisms. SOIL 252 and BIOL 311 recommended. Same as SOIL 476.

BIOL 476 L. Soil Microbiology Laboratory
1 Credit
Enumeration of soil microorganisms, their activities, and transformations they mediate. Same as SOIL 476L.
Prerequisite(s)/Corequisite(s): BIOL 476.

BIOL 477. Applied and Environmental Microbiology
4 Credits
A lecture-laboratory course on the microorganisms and the reactions they mediate which either impact the environment or have industrial applications. Reading of current literature will be emphasized. Topics include bioremediation, water quality, and aspects of industrial and food microbiology.
Prerequisite(s): MATH 121G, BIOL 311, and 311 L, or consent of instructor.

BIOL 478. Molecular Biology of Microorganisms
3 Credits
The biochemical basis for gene mutation, recombination, and expression with emphasis on prokaryotes. Includes fundamentals of recombinant DNA technology. BIOL 305 and BCHE 395 recommended.
Prerequisite(s): BIOL 311 and MATH 121G.

BIOL 479. Medical Microbiology
3 Credits
An in-depth overview of microbial pathogens associated with human infectious disease. Etiological agents, pathogenesis, and processes leading to the disease state and the therapies of infectious disease.
Prerequisite(s): MATH 121G and BIOL 311 required, BIOL 474 recommended.

BIOL 479 L. Medical Microbiology Laboratory
1 Credit
Overview of common procedures used by medical microbiologists to identify agents of disease or microbial pathogen traits. May be repeated up to 1 credits.
Prerequisite(s)/Corequisite(s): BIOL 479. Prerequisite(s): MATH 121G, BIOL 311, BIOL 311L.
BIOL 480. Animal Behavior
3 Credits
A survey of the field of animal behavior. BIOL 322 recommended.
Prerequisite(s): MATH 121G, BIOL 111G, and junior-level standing.

BIOL 484. Animal Communication
3 Credits
An examination of how animals produce and perceive signals, what factors influence the form of signals in different sensory modalities, and how conflicts between senders and receivers affect signaling strategies. Weekly discussion from the primary literature and group research products.
Prerequisite(s): BIOL 111G or consent of instructor, and MATH 121G.

BIOL 485. Comparative Stress Physiology
3 Credits
This course explores the biochemical, hormonal, and molecular aspects of stress physiology in all organisms from bacteria to humans. Focus area include hormesis, temperature, radiation, oxygen, infection, and dehydration.
Prerequisite(s): MATH 121 and BIOL 211G.

BIOL 488. Principles of Conservation Genetics
3 Credits
Fundamentals of the genetics of small populations. Genetic technologies used in studying small populations. Application of genetics and evolution to the conservation of biological populations.
Prerequisite(s): MATH 121G and BIOL 305.

BIOL 489. Genetic Aspects of Population Biology
3 Credits
Basic theory of population genetics and how that theory has guided, and been influenced by, studies of natural populations.
Prerequisite(s): MATH 121G and BIOL 305 or equivalent.

BIOL 490. Neurobiology
3 Credits
Fundamentals of neurobiology with an emphasis on properties of neurons and glia, principles of synaptic transmission, development of nervous system and organization of motor and sensory systems.
Prerequisite(s): BIOL 211, MATH 142G or equivalent.

BIOL 498. Biology Research Programs
1-3 Credits
Directed studies and research experiences, by arrangement with instructor. May be repeated for a maximum of 6 credits.

BIOL 503 L. Advanced Primate Adaptation and Evolution Laboratory
1 Credit
Laboratory with exercises on non-human primate adaptation and evolution. Crosslisted with: ANTH 573 L.
Corequisite(s): BIOL 503.

BIOL 510. Current Topics in Biology
3 Credits
Introduction to diverse topics in modern biology, including dynamic areas of current research.

BIOL 514. Plant Physiology
2 Credits
Same as EPWS 514.
Prerequisites: BIOL 211G and CHEM 112G.

BIOL 520. Molecular Cell Biology
3 Credits
An in-depth look at cellular processes and structures at the molecular level. Emphasis is placed on formal student presentations and discussions of current literature.
Prerequisite: BIOL 377 or equivalent.

BIOL 527. Symbiosis
3 Credits
In-depth treatment of the ecology, evolution, and mechanisms that are found in symbiotic systems.
Prerequisite: graduate status.

BIOL 533. Environmental Physiology of Plants
3 Credits
Integral responses of plants and crop productivity to naturally occurring and modified environmental factors such as radiation, temperatures, water vapor, carbon dioxide, and air flow. Same as AGRO 533 and HORT 533.
Prerequisite: BIOL 314 or consent of instructor.

BIOL 534. Advanced Human Evolution
3 Credits
Advanced overview of human biological evolution from the emergence of Miocene apes to the modern human diaspora. Crosslisted with: ANTH 534.
Prerequisite(s): ANTH 355 or consent of instructor.
Corequisite(s): ANTH 534L when offered.

BIOL 536. Advanced Disease Vector Biology
3 Credits
Prerequisite(s): BIOL 211G and BIOL 305.

BIOL 540. Science and Ethics
1-3 Credits (1-3)
Ethical concerns facing researchers in the basic and applied biological sciences. Coverage of responsible conduct in research including scientific integrity and research misconduct, mentor/trainee responsibilities, data management, authorship, publication practices, human subjects, animal welfare, intellectual property, conflicts of interest and effort and collaborative science. Emphasis on ethical reasoning skills. Discussion of ethical and societal implications of issues selected from a broad range of contemporary research areas (genetics, reproductive biology, environmental sciences, nanoscience, drug discovery, bioengineering, neuroscience). Subtitled. May be repeated up to 4 credits. Crosslisted with: PHIL 540.

BIOL 541. Professional Development Seminar
1-3 Credits
Practical aspects of career enhancement including job seeking, professional presentations, grant proposals, etc.
Prerequisite: consent of instructor.

BIOL 545. Molecular and Biochemical Genetics
3 Credits
Same as BCHE 545.
BIOL 550. Special Topics
1-3 Credits
Readings, discussions, and/or field and laboratory investigation of selected problems. Possible topics: human genetics, systematic entomology, or parasitism in animals. May be repeated for unlimited credit.
Prerequisite: consent of instructor, and designation of a specific topic before registration.

BIOL 562. Advanced Genomics Technology
3 Credits
This course covers current genomics techniques in genome sequencing, transcriptome analysis, detection of genetic variation, and metagenomics. Consent of Instructor required.

BIOL 566. Advanced Bioinformatics and NCBI Database
3 Credits
The course discusses how to use NCBI database and bioinformatic tools for research with genomics approaches. The topics include nucleotide and protein sequence analysis, similarity search with blast algorithms, gene/genome annotation, protein structure analysis, gene expression analysis, and metagenomic study. Consent of Instructor required.

BIOL 568. Communities and Ecosystems
3 Credits
Community ecology is an interdisciplinary field that integrates numerous theories, concepts, and methods to study the patterns and dynamics of biotic assemblages. Because biotic groups affect the biogeophysical and biogeochemical processes that govern Earth system functioning, community ecology also plays an increasingly large role in the study of ecosystem ecology, a discipline which seeks to understand the processes governing nutrient and energy flow across the Earth system. This course will explore the theories and methods for study of biodiversity, biogeography, and community assembly, as well as the pathways through which communities exert influence on ecosystem functioning. Topics will also include evolutionary influences on communities, the integration of community ecology into conservation and land management, and community ecology in an era of rapid environmental change.

BIOL 571. Advanced Molecular and Cellular Mycology
3 Credits
Exploration of the world of fungi with emphasis on fungal molecular biology and development, including discussion of fungal taxonomy and genomics, using current literature. Consent of instructor required.

BIOL 572. Advanced Primate Behavior and Ecology
3 Credits

BIOL 573. Fungal Biology
3 Credits (3+2P)
Same as EPWS 572.
Prerequisites: EPWS 310 or BIOL 311, or consent of instructor.

BIOL 574. Advanced Human Osteology
3 Credits
Advanced human osteology surveying the functional, developmental and evolutionary biology of the human skeleton. Identifying bones and teeth from hands-on experience with skeletal and dental material. Provides a foundation for human evolutionary studies, bioarchaeology and forensic anthropology. Crosslisted with: ANTH 574.
Corequisite(s): BIOL 574L when offered.

BIOL 574 L. Human Osteology Laboratory
1 Credit
Laboratory for BIOL 574. Experiences and activities related to identifying teeth and bones of the human skeleton. Crosslisted with: ANTH 574 L.
Corequisite(s): BIOL 574.

BIOL 577. Advanced Topics in Environmental Microbiology
3 Credits
This course is based on current literature in Environmental Microbiology, and is a seminar-style, discussion-based class. Topics typically include marine microbiology, ancient DNA and the human microbiome.
Prerequisite(s): Consent of instructor.

BIOL 581. Physiology of Animals
3 Credits
Comprehensive treatment of integrative physiology of animals, emphasizing tissues, organ systems, and regulatory control, including neuroendocrine function, circulation, respiration, and excretion. Term paper required. BIOL 111G, BIOL 377 recommended.
Prerequisite: BIOL 211G.

BIOL 582. Advanced Plant Signalling and Development
3 Credits
This is a course that introduces plant signalling pathways and their role in development to students. The lectures are structured to facilitate in-class discussions on the current state and future directions in this field. Topics will cover a wide range of biological questions and the methods used to study them. May be repeated up to 3 credits.
Prerequisite(s): BIOL 305 or GENE 315, and MATH 121G.

BIOL 587. Behavioral and Evolutionary Ecology
3 Credits
This course will investigate the causes and consequences of phenotypic variation and the adaptive value of phenotypic traits.

BIOL 589. Speciation and Adaptation
3 Credits
Examination of the two great themes of evolutionary biology. Begins with an historical overview of perspectives on these evolutionary processes, and then moves through the foundations of modern research to focus on recent advances driven by improvements in theory and technology. Emphasis on synthesis of the primary literature through lectures, discussion, and written assignments.

BIOL 590. Neuroscience
1-3 Credits
Detailed examination of the principles underlying nervous system organization and function. Emphasis on recent advances in multidisciplinary, integrated approaches to study the nervous system. May be repeated up to 9 credits.

BIOL 598. Special Research Programs
1-9 Credits
Individual investigations either analytical or experimental.

BIOL 599. Master's Thesis
15 Credits
Thesis.

BIOL 600. Doctoral Research
1-15 Credits
Research.

BIOL 610. Seminar
1-3 Credits (1-3)
Oral presentation and discussion of journal articles and ongoing research projects. May be repeated up to 6 credits. S/U Grading (S/U, Audit).
Biol 612. Microbiology Seminar
1 Credit
Seminar to aid graduate students in assessment and presentation of classical and current topics in microbiology.

Biol 697. University Teaching Experience
1-3 Credits
Certain graduate students will be permitted to teach up to one-third of one of the biology courses. The student will prepare and deliver lectures and will prepare, administer, and grade at least one examination. The professor in charge of the course will attend and evaluate the student's lectures.

Biol 698. Selected Topics
1-3 Credits
Selected topics for doctoral students.

Biol 700. Doctoral Dissertation
15 Credits
Dissertation.

Genetics Courses

Gene 110. Experimental Systems in Genetics
1 Credit
Survey of molecular, biochemical, organismal, and computer science based approaches to investigate how genes determine important traits. Historical development and topics of current interest will be discussed.

Gene 303v. Genetics and Society
3 Credits
Relates the science of genetics with social ramifications. Ways in which genetics and evolution interact with social, political, and economic issues. Includes genetic engineering, gene therapy, DNA fingerprinting, ancient DNA, plant and animal improvement, and future prospects. Students required to formulate value judgments on contemporary biological issues that will impact society. Crosslisted with: Agro 303v.

Gene 305. Principles of Genetics
3 Credits
Covers fundamental principles of reproduction, variation, and heredity in plants and animals. Crosslisted with: Agro 305, Ansc 305, Biol 305 and Hort 305
Prerequisite(s): Biol 111g, Biol 211g and either Chem 111g or Chem 115.

Gene 305 L. Genetic Techniques
1 Credit
Experimental procedures used in genetic research including: sexual transmission genetics, eukaryotic DNA isolation, DNA marker development and genotyping, polymerase chain reaction, and cytogenetics. Pre/
Corequisite(s): Gene 315, or Agro/Ansc/Biol/Hort 305.

Gene 315 L. Genetic Techniques
1 Credit
Experimental procedures used in genetic research including: sexual transmission genetics, eukaryotic DNA isolation, DNA marker development and genotyping, polymerase chain reaction, and cytogenetics. Pre/
Corequisite(s): Gene 315, or Agro/Ansc/Biol/Hort 305.

Gene 315. Molecular Genetics
3 Credits
Covers fundamental principles of DNA structure and replication, transcription, translation, gene regulation, recombinant DNA technology, and a survey of genomics and bioinformatics.
Prerequisite(s/Corequisite(s): Prerequisite(s): Chem 112 and Biol 211. Recommend Chem 313.

Gene 320. Hereditary and Population Genetics
3 Credits
Covers fundamental principles of reproduction, variation, and heredity in plants and animals including: Mendelian inheritance, mitosis, meiosis, genetic linkage, random mating, genetic drift, natural selection, inbreeding, migration, mutation, interrelationships between individuals, populations and communities and the environment.
Prerequisite(s): Chem 111g & Biol 211g.

Gene 391. Genetics Laboratory
1-6 Credits (1-6)
Professional work experience in genetics under the joint supervision of an employer and a faculty member. Documentation of proposed internship activities must be submitted prior to the start of the internship. A written report is required after the internship is completed. No more than 6 credits toward a degree. May be repeated up to 6 credits. Consent of instructor required.

Gene 440. Genetics Seminar
1 Credit
Organization, preparation, and presentation of genetic studies in model microorganism, plant, or animal systems that have been used to solve problems in molecular, cellular, and developmental biology. Consent of instructor required.
Prerequisite(s): Seniors only; Gene 315 & Gene 320.

Gene 449. Special Problems
1-3 Credits (1-3)
Research problem, experience training, or other special study approved by a faculty adviser. Maximum of 3 credits per semester and a grand total of 3 credits toward a degree. Consent of instructor required.

Gene 450. Special Topics
1-3 Credits (1-3)
Specific subjects to be announced in the schedule of classes. Maximum of 3 credits per semester and a total of 3 credits toward a degree. Consent of instructor required.

Gene 452. Applied Bioinformatics
3 Credits
Survey and application of publicly available bioinformatic tools that treat genomic DNA, cDNA, and protein sequences, RNA abundance, as well as tools that allow inference based on phylogenetic relationships.
Prerequisites: Agro/Ansc/Biol/Hort 305 or Gene 315 and Gene 320, and BCHE 341, or BCHE 395.

Gene 486. Genes and Genomes
3 Credits
Extensive coverage of nuclear and organelle genome structure in plants and animals, genome restructuring including duplication, aneuploidy, chromosome translocations and inversions, comparative genomics, and molecular systematics.
Prerequisites: Agro/Ansc/Biol/Hort 305 or Gene 315, and Gene 320.

Gene 488. Gene Regulation
3 Credits
Extensive coverage of signal transduction processes and approaches used to monitor large scale changes in gene regulation and protein synthesis that occur during development and in response to environmental changes.
Prerequisites: Agro/Ansc/Biol/Hort 305 or Gene 315.

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