

BIOLOGY

Biology

College of Science, Engineering & Technology
Department of Biological Sciences
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Website: www.cset.mnsu.edu/biology/

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The Department of Biological Sciences offers programs for students preparing for careers in education, laboratory and field research, biotechnology, environmental sciences, clinical laboratory sciences, cytotechnology, food science technology and pre-professional programs including pre-medicine, and pre-veterinary medicine.

The biology major offers a core program intended to develop a common background in biology and additional upper level courses designed to provide specialized options. Students typically take a broad based general biology major or an emphasis in one of the following: general biology, cytotechnology, ecology, biomedical sciences, microbiology, plant science, toxicology, or zoology. Programs in biotechnology, environmental sciences, food science technology and science teaching are also offered.

POLICIES/INFORMATION

Admission to Major is granted by the department. Admission requirements are 32 earned semester hours including BIOL 105, BIOL 106, BIOL 211, and CHEM 201 with a grade of "C" or better; completed General Education Goal Area 4 (Mathematics); completed General Education Goal Area 1, Part A (English Composition); and a minimum cumulative GPA of 2.2, with a cumulative GPA in Biology courses of 2.0.

Residency requirement for the Major. At least 50% of courses 300 level and up that are required for the major must be taken at Minnesota State University, Mankato.

Graduation with a Biology Major requires a minimum cumulative GPA of 2.0; and a minimum cumulative GPA in Biology courses of 2.0.

P/N Grading Policy. All courses leading to a major or a minor in biology must be taken for letter grades. Any exception to this policy must be approved by the chairperson of the department.

Refer to the College regarding required advising for students on academic probation.

GPA Policy. In programs where not specifically noted, a minimum GPA of 2.0 must be maintained in biological sciences. A minimum GPA of 2.6 in the sciences must be maintained to meet student teaching requirements.

Several biology scholarships are available for entering first year students and currently enrolled Minnesota State Mankato students who meet the requirements. Application deadline is March 31 of each year.

The Department of Biological Sciences offers a well-balanced summer school program. For details concerning the courses being offered consult the summer catalog.

BIOLOGY BS

Degree completion = 120 credits

Students may elect to complete the general non-specialized biology major or select one of the alternative specialized options or emphases.

Required General Education

BIOL	105	General Biology I (4)
CHEM	201	General Chemistry I (5)
ENG	271W	Technical Communication (4)

Major Common Core

BIOL	106	General Biology II (4)
BIOL	211	Genetics (4)

Major Emphasis: General, Non-Specialized

Students may elect to complete the general, non-specialized biology major or select one of the alternative specialized emphases. All emphases require BIOL 105, BIOL 106, BIOL 211, CHEM 201, and ENG 271W.

Math Requirement (choose 3-4 credits)

MATH	113	Trigonometry (3)
MATH	115	Precalculus Mathematics (4)
MATH	121	Calculus I (4)

Physics Requirement (choose 3-4 credits)

PHYS	101	Introductory Physics (3)
PHYS	211	Principles of Physics I (4)
PHYS	221	General Physics I (4)

Statistics Requirement (choose 3 credits)

HLTH	475	Biostatistics (3)
STAT	154	Elementary Statistics (3)

Emphasis Common Core (choose 20 credits)

BIOL	215	General Ecology (4)
BIOL	301	Evolution (2)
BIOL	320	Cell Biology (4)
CHEM	202	General Chemistry II (5)
CHEM	322	Organic Chemistry I (4)
CHEM	323	Supplemental Organic Functional Group Chemistry (1)

Physiology Requirement--Choose ONLY ONE of the four following pairs of courses (6 to 9 credits total). Emphasis Restricted Electives plus Emphasis Unrestricted Electives must total at least 18 credits to fulfill the 40-credit major requirement.

Human

BIOL	220	Human Anatomy (4)
BIOL	330	Principles of Human Physiology (4)

Plant

BIOL	217	Plant Science (4)
BIOL	441	Plant Physiology (4)

Microbiology

BIOL	270	Microbiology (4)
BIOL	476	Microbial Physiology and Genetics (5)

Animal

BIOL	316	Animal Diversity (3)
BIOL	431	Comparative Animal Physiology (3)

Emphasis Unrestricted Electives (choose 9 - 12 credits)

(choose additional upper-division courses so you have a total of 40 credits in Biology. At least 7 of these elective credits must be from courses with a laboratory component.)

BIOL 300 - BIOL 499

Recommended Support Courses (choose 0-8 credits)

CHEM	360	Principles of Biochemistry (4)
CHEM	460	Biochemistry I (3)
CHEM	465	Biochemical Techniques I (1)

Required Minor: None

Major Emphasis: Biomedical Sciences

The purpose of this option is to prepare the student for a career in biomedicine. The emphasis fulfills the science course requirements for most medical, osteopathic, dental, and chiropractic schools as well as the science course requirements for graduate education in biomedicine. If you are interested in applying for a specific medical school, please contact that school for their specific requirements. All emphases require BIOL 105, BIOL 106, BIOL 211, CHEM 201, and ENG 271W.

Emphasis Required General Education (4 credits)

PHYS	211	Principles of Physics I (4)
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Math Requirement (choose 3-4 credits)

MATH	113	Trigonometry (3)
MATH	115	Precalculus Mathematics (4)
MATH	121	Calculus I (4)

BIOLOGY CONTINUED

Emphasis Common Core (choose 37 credits)

BIOL	220	Human Anatomy (4)
BIOL	270	Microbiology (4)
BIOL	320	Cell Biology (4)
BIOL	330	Principles of Human Physiology (4)
BIOL	424	Developmental Biology (3)
CHEM	202	General Chemistry II (5)
CHEM	305	Analytical Chemistry (4)
CHEM	322	Organic Chemistry I (4)
CHEM	323	Supplemental Organic Functional Group Chemistry (1)
PHYS	212	Principles of Physics II (4)

Emphasis Restricted Electives

Biochemistry (choose 4 credits)

CHEM	360	Principles of Biochemistry (4)
CHEM	460	Biochemistry I (3)
CHEM	465	Biochemical Techniques I (1)

Additional Math/Stats Requirement (choose 3-4 credits)

MATH 121 cannot be counted in this category if previously counted in the Math Requirement.

HLTH	475	Biostatistics (3)
MATH	121	Calculus I (4)
STAT	354	Concepts of Probability & Statistics (3)

Emphasis Unrestricted Electives (choose 9 credits)

At least one course must have a laboratory component. Choose a maximum of 4 credits from BIOL 497 or BIOL 499.

BIOL	324	Neurobiology (3)
BIOL	410	Global Change Biology (3)
BIOL	417	Biology of Aging and Chronic Diseases (3)
BIOL	420	Diagnostic Parasitology (3)
BIOL	430	Hematology/Introduction to Immunology (4)
BIOL	433	Cardiovascular Physiology (3)
BIOL	435	Histology (4)
BIOL	438	General Endocrinology (3)
BIOL	452	Biological Instrumentation (3)
BIOL	460	Introduction to Toxicology (3)
BIOL	466	Principles of Pharmacology (3)
BIOL	474	Immunology (4)
BIOL	475	Medical Microbiology (4)
BIOL	479	Molecular Biology (4)
BIOL	497	Internship I (1-12)
BIOL	499	Individual Study (1-4)

Required Minor: None.

Major Emphasis: Biology Cytotechnology

A cytotechnologist is an allied health professional and is involved in the microscopic study of cells for evidence of disease and cancer. Cytotechnologists are trained to accurately identify precancerous, malignant, and infectious conditions using cytological techniques. The "Pap test" (an evaluation of cells from the uterine cervix) is the best known test in this field. The four-year curriculum consists of three years spent at the university completing the required courses and the fourth year is a 32 credit internship spent in professional education. Agencies participating in the cytotechnology program include, but are not limited to: Mayo School of Health Sciences in Rochester, MN. Admission into the fourth year hospital clinical internship is competitive. Therefore, admission to the program does not ensure placement into the fourth year internship. The BS degree is awarded by the university after successful completion of the internship year. Graduates are then eligible to take the certifying examination. Cytotechnologists are employed in hospital laboratories, universities, and private laboratories. Adjunct faculty at the clinical sites include: Kara Hansing, CT (ASCP). Students accepted into the clinical internship will be responsible for: Proof of Medical / Hospitalization / Health Insurance; Health Physical Exam; Tuberculosis (TB) testing; and Proof of Immunization which may include the following: Hepatitis B, Measles, Mumps, Rubella, Tetanus, Chickenpox (Varicella), and Influenza. Students may also be required to submit to Drug Screen Testing. Internship sites are required by law to do Background Checks on all students admitted to their cytotechnology programs. All emphases require BIOL 105, 106, 211, CHEM 201, and ENG 271W.

Emphasis Required General Education (choose 4 credits)

MATH	112	College Algebra (4)
MATH	113	Trigonometry (3)
MATH	115	Precalculus Mathematics (4)
MATH	121	Calculus I (4)

Emphasis Required Support Courses (choose 13 credits)

Choose from the following to total at least 13 additional credits in Chemistry.

CHEM	202	General Chemistry II (5)
CHEM	305	Analytical Chemistry (4)
CHEM	322	Organic Chemistry I (4)
CHEM	323	Supplemental Organic Functional Group Chemistry (1)
CHEM	360	Principles of Biochemistry (4)

Emphasis Core Courses (choose 16 credits)

BIOL	220	Human Anatomy (4)
BIOL	270	Microbiology (4)
BIOL	320	Cell Biology (4)
BIOL	330	Principles of Human Physiology (4)

Emphasis Restricted Electives (choose 3-4 credits)

BIOL	424	Developmental Biology (3)
BIOL	430	Hematology/Introduction to Immunology (4)
BIOL	435	Histology (4)
BIOL	479	Molecular Biology (4)

Professional Education (choose 32 credits)

BIOL	493	Cytotechnology Clinical Internship I (1-12)
BIOL	494	Cytotechnology Clinical Internship II (1-12)
BIOL	495	Cytotechnology Clinical Internship III (1-12)
BIOL	496	Cytotechnology Clinical Internship IV (1-12)

Major Emphasis: Ecology

Ecology is the study of relationships between organisms and their environment. The emphasis consists of fundamental courses in biology and related sciences, mid-level study in genetics, evolution, and statistics, and an array of upper-division electives that emphasize fieldwork, data analysis, and writing. Many students collaborate with faculty in their research or conduct independent research projects. Career titles available with this emphasis include ecologist, naturalist, wildlife biologist, natural resource manager, fish biologist, marine biologist, conservational training or graduate school. For more information about the emphasis and the ecology faculty, select "ecology" at the department page (see www.mnsu.edu/dept/biology). All emphases require BIOL 105, BIOL 106, BIOL 211, CHEM 201, and ENG 271W.

Emphasis Common Core (choose 17 credits)

BIOL	215	General Ecology (4)
BIOL	301	Evolution (2)
BIOL	408	Vertebrate Ecology (4)
BIOL	443	Plant Ecology (4)
HLTH	475	Biostatistics (3)
<u>Chemistry Requirement</u> (choose 5 credits)		
CHEM	111	Chemistry of Life Processes (5)
CHEM	202	General Chemistry II (5)

Emphasis Required General Education Courses

Physics

PHYS	211	Principles of Physics I (4)
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Math

(choose 3-4 credits)

MATH	113	Trigonometry (3)
MATH	115	Precalculus Mathematics (4)

Emphasis Restricted Electives: Physiology Requirement (COMPLETE ONE GROUP)

Animal Physiology

BIOL	316	Animal Diversity (3)
BIOL	431	Comparative Animal Physiology (3)

Microbial Physiology

BIOL	270	Microbiology (4)
BIOL	476	Microbial Physiology and Genetics (5)

BIOLOGY CONTINUED

Plant Physiology

BIOL 217	Plant Science (4)
BIOL 441	Plant Physiology (4)

Emphasis Unrestricted Electives

Choose courses to total 40 credits in biology. Courses other than those listed are allowed with consent of your advisor. A limit of 4 total credits is allowed from BIOL 492, BIOL 497, and BIOL 499 combined.

BIOL 320	Cell Biology (4)
BIOL 404	Wetlands (4)
BIOL 405	Fisheries Biology (3)
BIOL 409	Advanced Field Ecology (4)
BIOL 410	Global Change Biology (3)
BIOL 412	Soil Ecology (4)
BIOL 431	Comparative Animal Physiology (3)
BIOL 432	Lake Ecology (4)
BIOL 436	Animal Behavior (4)
BIOL 441	Plant Physiology (4)
BIOL 442	Flora of Minnesota (4)
BIOL 460	Introduction to Toxicology (3)
BIOL 472	Microbial Ecology and Bioremediation (4)
BIOL 479	Molecular Biology (4)
BIOL 492	Honors Research (1-3)
BIOL 497	Internship I (1-12)
BIOL 499	Individual Study (1-4)

Required Minor: None

Major Emphasis: Microbiology

Microorganisms impact every area of life. The emphasis exposes students to a variety of topics in microbiology and teaches numerous skills needed to work with microorganisms. Training in microbiology prepares students for employment in industry (ex. quality assurance, vaccine production) and government (ex. laboratory technicians). Currently, employment opportunities abound in applied areas of microbiology such as biological products/pharmaceuticals, food processing, environmental assessment. It also prepares a student for continuing education in microbiology, immunology, and cell and molecular biology. Students may elect to work on research projects with faculty who work in the areas of food microbiology, immunology, microbial genetics, and molecular biology. All emphases require BIOL 105, BIOL 106, BIOL 211, CHEM 201, and ENG 271W.

Math Requirement (choose 3-4 credits)

MATH 112	College Algebra (4)
MATH 113	Trigonometry (3)
MATH 115	Precalculus Mathematics (4)
MATH 121	Calculus I (4)

Emphasis Common Core (choose 18 credits)

BIOL 270	Microbiology (4)
CHEM 202	General Chemistry II (5)
CHEM 305	Analytical Chemistry (4)
CHEM 322	Organic Chemistry I (4)
CHEM 323	Supplemental Organic Functional Group Chemistry (1)

Emphasis Restricted Electives (choose 4-5 credits)

BIOL 476	Microbial Physiology and Genetics (5)
CHEM 360	Principles of Biochemistry (4)
CHEM 460	Biochemistry I (3)
CHEM 465	Biochemical Techniques I (1)

Emphasis Unrestricted Electives (choose 25 credits)

BIOL 476, CHEM 360, CHEM 460, and CHEM 465 can satisfy this category

IF they are not used in the Emphasis Restricted Electives.

BIOL 420	Diagnostic Parasitology (3)
BIOL 452	Biological Instrumentation (3)
BIOL 472	Microbial Ecology and Bioremediation (4)
BIOL 474	Immunology (4)

BIOL 475	Medical Microbiology (4)
BIOL 476	Microbial Physiology and Genetics (5)
BIOL 478	Food Microbiology and Sanitation (4)
BIOL 479	Molecular Biology (4)
BIOL 497	Internship I (1-12)
BIOL 499	Individual Study (1-4)

Recommended General Electives (choose 0-7 credits)

HLTH 475	Biostatistics (3)
MATH 121	Calculus I (4)

Required Minor: None.

Major Emphasis: Plant Science

The Plant Science emphasis includes the study of cells, genetics, anatomy, physiology, taxonomy, and ecology of terrestrial and aquatic vascular plants, mosses, algae and fungi. The courses emphasize plant structure and function, diversity, evolutionary and anatomical adaptations and interactions between plants and their environment. An emphasis in plant sciences prepares undergraduate students for careers in education, biotechnology, field biology, pharmaceutical companies and government agencies. In addition, the emphasis prepares students for Master's and Doctoral degrees in Plant Science. All emphases require BIOL 105, BIOL 106, BIOL 211, CHEM 201, and ENG 271W.

Physics Requirement (choose 4 credits)

PHYS 211	Principles of Physics I (4)
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Math Requirement (choose 3-4 credits)

MATH 113	Trigonometry (3)
MATH 115	Precalculus Mathematics (4)

Emphasis Common Core (choose 20 credits)

BIOL 215	General Ecology (4)
BIOL 217	Plant Science (4)
BIOL 441	Plant Physiology (4)
BIOL 442	Flora of Minnesota (4)
BIOL 443	Plant Ecology (4)

Emphasis Restricted Electives

Chemistry Requirement (choose one course)

CHEM 111	Chemistry of Life Processes (5)
CHEM 202	General Chemistry II (5)

Statistics Requirement (choose one course)

HLTH 475	Biostatistics (3)
STAT 154	Elementary Statistics (3)

Emphasis Unrestricted Electives

(choose at least 12 credits from the following list of electives)

At least two of the courses must have laboratory components. A MAXIMUM of 4 credits may be selected from BIOL 492, BIOL 497, and BIOL 499 combined.

BIOL 301	Evolution (2)
BIOL 320	Cell Biology (4)
BIOL 404	Wetlands (4)
BIOL 409	Advanced Field Ecology (4)
BIOL 410	Global Change Biology (3)
BIOL 412	Soil Ecology (4)
BIOL 432	Lake Ecology (4)
BIOL 451	Plant Biotechnology (4)
BIOL 460	Introduction to Toxicology (3)
BIOL 479	Molecular Biology (4)
BIOL 492	Honors Research (1-3)
BIOL 497	Internship I (1-12)
BIOL 499	Individual Study (1-4)

Recommended Support Courses

IT 100	Introduction to Computing and Applications (4)
MATH 121	Calculus I (4)

Required Minor: None.

BIOLOGY CONTINUED

Major Emphasis: Toxicology

Toxicology is the study of the harmful effects of chemicals, radiation, and other stressors on biological systems. This is a wide-ranging course of study, allowing students to connect their background on chemistry, biology, physics, mathematics, etc. to understand all aspects of how an exposure may or may not yield a toxic result. Then students can do elementary risk assessment and environmental or medical analyses. The purpose of this emphasis is to train students in the theory and hands-on research techniques of an interdisciplinary biological science at the undergraduate level in a field where there are few programs in the United States. Since toxins can be antibiotics, antiviral, or other chemotherapeutic medications, antidotes, agricultural chemicals, industrial chemicals, radiation, or just stressors such as poor ergonomics, graduates can and have proceeded into research and testing of pharmaceuticals, pesticides, and environmental toxicology in industry, government, or academic institutions. Additionally, training in risk assessments leads to additional opportunities for statistical modeling, which is employed in the areas mentioned above and industrial hygiene. All emphases require BIOL 105, BIOL 106, BIOL 211, CHEM 201, and ENG 271W.

Emphasis Required General Education

MATH	121	Calculus I (4)
PHYS	211	Principles of Physics I (4)

Emphasis Common Core

BIOL	215	General Ecology (4)
BIOL	220	Human Anatomy (4)
BIOL	270	Microbiology (4)
BIOL	330	Principles of Human Physiology (4)
BIOL	460	Introduction to Toxicology (3)
BIOL	461	Environmental Toxicology (4)
BIOL	462	Toxicology Seminar (1)
BIOL	464	Methods of Applied Toxicology (3)
BIOL	465	Applied Toxicology Project (3)
BIOL	466	Principles of Pharmacology (3)
BIOL	467	Industrial Hygiene (3)
CHEM	202	General Chemistry II (5)
CHEM	305	Analytical Chemistry (4)
CHEM	322	Organic Chemistry I (4)
CHEM	324	Organic Chemistry II (3)
CHEM	460	Biochemistry I (3)
CHEM	461	Biochemistry II (3)
CHEM	465	Biochemical Techniques I (1)
CHEM	466	Biochemical Techniques II (2)
HLTH	475	Biostatistics (3)

Required Minor: None

Major Emphasis: Zoology

Zoology is a major branch of the biological sciences that involves the study of animals. Study in this area focuses on organismal diversity, animal structures and the functions, genetics, development, evolution, behavior, and ecological interactions. Occupations that may be available to graduate include: Animal Husbandry, Museum/Zoo Guide, Animal Laboratory Technician, Animal Trainer, Pest Control Technician, Museum Curator, Entomologist, Environmental Consultant, Field Researcher, Science Writer, Physician, Veterinarian, Wildlife Rehabilitator, Zoo Keeper, and Zoologist. Advanced training in professional or graduate schools is required in many of these areas and acceptance for advanced training is competitive. Success in this career field typically requires: a thorough knowledge of general biology, the ability to work and relate with animals, proficiency in reading and writing and the ability to collect and analyze data, and an interest in problem solving and decision making. All emphases require BIOL 105, BIOL 106, BIOL 211, CHEM 201, and ENG 271W.

Emphasis Required General Education (choose 8 credits)

MATH	112	College Algebra (4)
MATH	113	Trigonometry (3)
MATH	115	Precalculus Mathematics (4)
PHYS	211	Principles of Physics I (4)

Emphasis Core Courses (choose 19 credits)

BIOL	215	General Ecology (4)
BIOL	301	Evolution (2)
BIOL	316	Animal Diversity (3)
BIOL	408	Vertebrate Ecology (4)
BIOL	424	Developmental Biology (3)
BIOL	431	Comparative Animal Physiology (3)

Emphasis Restricted Electives (choose 6-7 credits)

BIOL	420	Diagnostic Parasitology (3)
BIOL	421	Entomology (3)
BIOL	436	Animal Behavior (4)
BIOL	438	General Endocrinology (3)

Emphasis Unrestricted Electives (choose 6 credits)

Other courses may apply with advisor's consent. A MAXIMUM of four credits may be used from BIOL 492, BIOL 497, and BIOL 499 combined.

BIOL	320	Cell Biology (4)
BIOL	324	Neurobiology (3)
BIOL	403	Conservation Biology (3)
BIOL	409	Advanced Field Ecology (4)
BIOL	410	Global Change Biology (3)
BIOL	412	Soil Ecology (4)
BIOL	420	Diagnostic Parasitology (3)
BIOL	435	Histology (4)
BIOL	438	General Endocrinology (3)
BIOL	460	Introduction to Toxicology (3)
BIOL	472	Microbial Ecology and Bioremediation (4)
BIOL	479	Molecular Biology (4)
BIOL	492	Honors Research (1-3)
BIOL	497	Internship I (1-12)
BIOL	499	Individual Study (1-4)

Emphasis Required Support Courses

Chemistry (choose one)

CHEM	111	Chemistry of Life Processes (5)
CHEM	202	General Chemistry II (5)

Statistics (choose one)

HLTH	475	Biostatistics (3)
STAT	154	Elementary Statistics (3)

Recommended Support Courses

IT	100	Introduction to Computing and Applications (4)
MATH	121	Calculus I (4)

Required Minor: None

LIFE SCIENCE TEACHING BS

See the SCIENCE TEACHING section of this catalog.

BIOLOGY MINOR

Minor Core

BIOL	106	General Biology II (4)
BIOL	211	Genetics (4)
(choose 4 credits)		
BIOL	105	General Biology I (4)
BIOL	105W	General Biology I (4)

Minor Elective

In addition to the course chosen from the list below add any 200-level or above biology course to total 17 credits in the minor.

(choose one course from the following)

BIOL	215	General Ecology (4)
BIOL	217	Plant Science (4)
BIOL	220	Human Anatomy (4)
BIOL	270	Microbiology (4)

BIOLOGY CONTINUED

COURSE DESCRIPTIONS

BIOL 100 (4) Our Natural World

Introductory course designed for students not majoring in science. Focuses on basic biological principles with special emphasis on the human species. Includes scientific problem solving, biodiversity, human and social aspects of biology, ecology, cellular processes and organ function, human reproduction, pre-natal development, and heredity. Lecture, laboratory, and small group discussions.

Fall, Spring

GE-3

BIOL 101 (2-4) Biological Perspectives

Students focus on specific biological perspectives, including environmental science, biology of women, biotechnology, human heredity, etc. May be repeated for credit under different sub-titles.

Fall, Spring

BIOL 102 (3) Biology of Women

An introduction to biological topics of special interest to women with emphasis on anatomic and physiologic changes over the course of a woman's lifetime. Designed for students not majoring in science. Presents fundamental biologic concepts within this specialized context and provides opportunity to collect, evaluate, and analyze data.

Fall, Spring

GE-3

BIOL 103W (3) Introduction to Biotechnology

An introductory course designed for students not majoring in science. Focuses on basic biological principles as applied to biotechnology. Includes basic natural science principles, scientific problem solving, and human and social aspects of biotechnology. Lecture, laboratory, and small group discussions.

Fall

WI, GE-3

BIOL 105 (4) General Biology I

Study of biological processes at the suborganismal level including cell chemistry, metabolism, reproduction, genetics, and complex tissue physiology. Laboratory and discussion sessions stress problem solving and experimental design.

Fall, Spring

GE-3

BIOL 105W (4) General Biology I

Study of biological processes at the suborganismal level including cell chemistry, metabolism, reproduction, genetics, and complex tissue physiology. Laboratory and discussion sessions stress problem solving and experimental design.

Fall, Spring

WI, GE-3

BIOL 106 (4) General Biology II

Study of biological processes at the organismal level including a survey of life forms (viruses, bacteria, protists, fungi, plants, and animals), their evolution, and ecology. Laboratory and discussion sessions stress problem solving and experimental design.

Pre: BIOL 105

Fall, Spring

BIOL 175 (1) Orientation to Clinical Laboratory Science

An introduction to the health care profession with special emphasis on clinical laboratory personnel. Course includes presentations by professionals in some of the major health care fields, especially medical technology. Includes lectures, field observations.

Spring

BIOL 211 (4) Genetics

Introduction to genetic analysis. Topics covered include those both classical and modern genetics: population genetics, molecular genetics, genetic manipulation of organisms and selection. Central to this course will be the primacy of the trait as the object of genetics and the development/refinement of the concept of the gene. Lab included.

Pre: BIOL 105, BIOL 106, and MATH 112

Fall, Spring, Summer

BIOL 215 (4) General Ecology

Principles of the study of relationships between organisms and the environment. Topics include flow of energy and materials, organism-level interactions, growth and evolution of populations, and community ecology. Field trips to prairie, lake, stream, and forest communities, training in data collection and analysis, use of equipment, and report writing. Lab included.

Pre: BIOL 105 and BIOL 106 or consent

Fall

BIOL 217 (4) Plant Science

Biology of plants including unique features of plant cells, life histories, metabolism, anatomy, physiology, and ecology. The course emphasizes plants' remarkable adaptations to their environments, their diversity, and the vital roles they play in ecological interactions. For biology and environmental science majors and minors. Lab included.

Pre: BIOL 105 and BIOL 106 or consent

Spring

BIOL 220 (4) Human Anatomy

Systems approach to the structure of the human body. The course is designed for students majoring in biology or health related programs. Lab included.

Fall, Spring

BIOL 270 (4) Microbiology

An introduction to the general principles and methods used in the study of microorganisms. Lab included.

Pre: One BIOL course and one semester of chemistry from among CHEM 104, CHEM 106, CHEM 111, or CHEM 201

Fall, Spring, Summer

GE-3

BIOL 283 (1) MAX Scholar Seminar

This class provides MAX scholars with an opportunity to explore a set of topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. NOTE: Credit does not apply to any major.

Pre: Recipient of a MAX scholarship or instructor consent.

Fall, Spring

BIOL 301 (2) Evolution

Evolution is a unifying theory of biology. Students are provided the history of evolutionary thought and the Darwinian revolution, evidence for evolution, mechanics of evolution, and an array of special topics such as speciation, molecular evolution, conservation, and extinction. Readings will include book chapters and journal articles. Lecture/discussion.

Pre: BIOL 105, BIOL 106, BIOL 211

Spring

BIOL 310 (4) Basics of Human Physiology

Principles of functions of human cells, organs, and systems with an emphasis on organ/system interactions. Designed for majors that do not require a strong medical and research emphasis. Includes an active learning laboratory to facilitate learning the complex lecture material.

Pre: BIOL 220, CHEM 104 or CHEM 106 or CHEM 111 or CHEM 201

Fall, Spring, Summer

BIOL 316 (3) Animal Diversity

A comprehensive phylogenetic survey of both invertebrate and vertebrate animals. Emphasis on evolutionary relationships among phyla, the evolution of organ systems, animal organization and function, animal adaptations, and zoogeographical considerations. Research and inquiry of animal unity and diversity will include using the Internet. Lab included.

Pre: BIOL 105 and BIOL 106

Fall

BIOL 320 (4) Cell Biology

An examination of eukaryotic cellular structure, organization and physiology. Lab included.

Pre: BIOL 105 and BIOL 106, BIOL 211

Fall

BIOLOGY CONTINUED

BIOL 324 (3) Neurobiology

Basic anatomy and physiology of the nervous system. The course is designed for students majoring in biology, psychology or health related programs.

Pre: BIOL 220

Fall

BIOL 330 (4) Principles of Human Physiology

Principles of functions of human cells, organs, and systems with an emphasis on organ/system interactions. This course is designed for students majoring in biology, chemistry, or related sciences, and medically-related areas. Includes a laboratory with a research and medical emphasis.

Pre: BIOL 220, CHEM 104 or CHEM 106 or CHEM 111 or CHEM 201

Fall, Spring, Summer

BIOL 380 (3) Blood Banking/Urinalysis

Basic understanding of the principles of immunohematology applied to the area of blood banking including major blood group systems, principles for antigen/antibody detection and identification, donor blood collection, transfusion evaluation, theory of renal function in health and disease, specimen collection, handling, and processing, and components of routine urinalysis.

Spring

BIOL 402 (4) Stream Ecology

The structure and function of stream ecosystems are presented with emphasis on adaptations of organisms to stream life and connections between stream organisms, the aquatic environment, and the surrounding watershed. Includes lab, field work, and team projects.

Pre: BIOL 105, BIOL 106, BIOL 215 or consent

Summer

BIOL 403 (3) Conservation Biology

Applications of principles from ecology, genetics, behavior, demography, economics, philosophy, and other fields to the conservation and sustainable use of natural populations of plants and animals. Lectures and discussions address topics such as habitat fragmentation, parks and reserves, genetic diversity, population viability, and extinction.

Pre: BIOL 215 or consent

Spring

BIOL 404 (4) Wetlands

To provide students the values and functions of wetlands and to use wetlands as an example of the relationship of ecology to management, and the impact that classification systems have politically. Lab (fieldwork) included.

Pre: BIOL 105, BIOL 106, BIOL 215, or consent

Spring

BIOL 405 (3) Fisheries Biology

An introduction to fish biology and fisheries management, diversity, form and function in the aquatic environment, functional physiology, evolution and speciation, identification and use of keys, ecology, and management topics.

Pre: BIOL 105, BIOL 106, BIOL 215, or consent of instructor

ALT-Fall

BIOL 408 (4) Vertebrate Ecology

A field course in the ecology of birds, mammals, amphibians, reptiles, and fishes. Students are trained in sampling techniques such as mark-and-recapture, population size estimation and monitoring, and species identification of live and preserved specimens. Lectures encompass evolution and adaptation, origins, energetics, mating systems, morphology, geographical distributions, and population-level phenomena. Lecture and Laboratory.

Pre: BIOL 105, BIOL 106, BIOL 215 or consent

Fall

BIOL 409 (4) Advanced Field Ecology

A field course focused on the function and dynamics of various North American ecosystems. Emphases will be on natural history, critical thought, and experimental design. Students will be trained in a variety of soil, plant, and animal sampling techniques. Depending on enrollment, there may be additional costs (e.g., camping fees) for the course.

Pre: BIOL 105, BIOL 106, BIOL 215 or consent

Summer (On-Demand)

BIOL 410 (3) Global Change Biology

This class examines the effects of natural and human-induced changes in climate on terrestrial and marine ecosystems. The course focuses on the science behind global change issues that have biological, social, and economic implications.

Pre: BIOL 105, BIOL 106, BIOL 215 or consent

Fall

BIOL 412 (4) Soil Ecology

Soil ecology will focus on the genesis and classification of soils, the physical properties of soil as they relate to habitat formation, niches, interactions that exist among soil organisms, human impact on soil systems relative to population pressures and management practices. Lab included.

Pre: BIOL 105, BIOL 106, BIOL 215, or consent

Spring

BIOL 417 (3) Biology of Aging and Chronic Diseases

Emphasis is placed on the biomedical aspects of aging and chronic disease. The course is designed for students majoring in biology, gerontology programs, or other health related programs.

Pre: BIOL 100 or BIOL 105

Fall, Spring

BIOL 419 (2-3) Special Topics in Instrumentation

Instruction in specialized biological instrumentation.

Pre: BIOL 105 and BIOL 106

Fall

BIOL 420 (3) Diagnostic Parasitology

Clinically important parasites. Protozoans, Flukes, Tapeworms, Roundworms, Ticks, Mites and Insects. Designed for Medical Technology, Pre-Med, Pre-Vet and Biology majors. Identification, clinical disease, epidemiology and ecology are covered. Lab included.

Pre: BIOL 100 or BIOL 105, BIOL 106 recommended

Spring

BIOL 421 (3) Entomology

Morphological, physiological, medical, and economic significance of insects.

Pre: BIOL 105 and BIOL 106 or consent

ALT-Fall

BIOL 424 (3) Developmental Biology

Understanding the process of cell differentiation and development. These principles are then applied to the descriptive study of human embryology including the basis of congenital malformations.

Pre: BIOL 100 or BIOL 105

Fall

BIOL 425 (1) Development Biology Lab

Biology 425 is an optional 1-credit laboratory in addition to Developmental Biology, Biology 424. In the laboratory component, students will be exposed to modern techniques used to examine developmental processes in several key model systems. Laboratory exercises consist of experiments designed to demonstrate fundamental concepts in development and to familiarize students with experimental approaches utilized in studying developmental biology and embryology.

Fall

Pre: BIOL 211

Coreq: BIOL 424

BIOL 430 (4) Hematology/Introduction to Immunology

Collection, examination, evaluation, morphology, function and diseases of blood cells. Hemostasis/coagulation of blood. Immunology theory is presented. Lab included.

Spring

BIOL 431 (3) Comparative Animal Physiology

A comparison of adaptation mechanisms, from cell to organ-system, used by animals in response to "changes in" environmental conditions such as oxygen, carbon dioxide, food availability, temperature, water, solutes, pressure and buoyancy.

Pre: BIOL 105, BIOL 106 or consent

Fall

BIOLOGY CONTINUED

BIOL 432 (4) Lake Ecology

This course is an introduction to the physical, chemical, and biological characteristics and interactions of inland freshwater lakes. Labs will emphasize field work, including data collection from five local lakes, analysis, and discussion.
ALT-Fall

BIOL 433 (3) Cardiovascular Physiology

This course is a functional study of the heart and circulatory system.
Fall

BIOL 435 (4) Histology

Study of types, arrangements and special adaptations of human tissues. Lab included.
Pre: BIOL 220
Spring

BIOL 436 (4) Animal Behavior

An exploration of behavioral strategy, communication, learning, and social systems of animals, with emphases placed on the causes, evolution, ecological implications, and function of behavior at the individual and population level. Lab included.
Pre: BIOL 105, BIOL 106, BIOL 215
Spring

BIOL 438 (3) General Endocrinology

This course provides the basis for understanding hormones and the mechanisms of their actions in both the normal and pathological states. Sample topics to be included are diabetes, osteoporosis, hormones of reproduction and current social and medical issues related to the course.
Pre: BIOL 100 or BIOL 105
Spring

BIOL 441 (4) Plant Physiology

Plant functions such as water relations, mineral nutrition, translocation, metabolism, photosynthesis, photorespiration, fat and protein metabolisms, respiration, growth and development, phytohormones, reproduction and environmental physiology. Lab included.
Pre: BIOL 105, BIOL 106, BIOL 217, one semester organic chemistry recommended.
Spring

BIOL 442 (4) Flora of Minnesota

Field identification of plants with emphasis on local flora. History systematic, techniques, plant biogeography, methods of plant collection, preservation, preparation of herbarium specimens are covered. Lab and field trips included.

BIOL 443 (4) Plant Ecology

Expands upon general principles of ecology to focus on the factors that regulate the distribution and abundance of plants, analysis of plant populations, and dynamics of plant communities. Lecture and lab (fieldwork) included.
Pre: BIOL 105, BIOL 106, BIOL 215 or consent. BIOL 217 strongly recommended.
Fall

BIOL 451 (4) Plant Biotechnology

Lecture/laboratory course that presents an integrated view of plant biology, crop science, and current issues in biotechnology. Course focuses on issues of global concern such as sustainable food production, biofuels, genetically modified crops, molecular pharming, and tissue culture.
Pre: BIOL 105, BIOL 106
Fall

BIOL 452 (3) Biological Instrumentation

The principle and operation of instruments and their application to biological research. Types of instrumentation examined include spectroscopic, chromatographic, electroanalytic, radiographic, and imaging. Laboratory Information Management systems (LIMS) will also be examined. Emphasis is placed on GLP, GMP, and ISO 9000 practices.
Pre: BIOL 105, BIOL 106, or consent

BIOL 453 (4) Biological Engineering Analysis I

The application of engineering principles and skills as applied to fermentation and to biological product recovery.
Pre: BIOL 270 and one semester each of calculus, physics, and organic chemistry, taken concurrently with BIOL 456.
Fall

BIOL 454 (4) Biological Engineering Analysis II

Continuation of Biological Engineering Analysis I. The application of engineering principles and skills as applied to fermentation and to biological product recovery.
Pre: BIOL 453, taken currently with BIOL 457
Spring

BIOL 456 (3) Biotechnology Project/Laboratory I

Practical laboratory experience in biotechnology through the selection and development of a research project. Students are expected to spend an average of 12 hours per week on the project.
Pre: Concurrent enrollment in BIOL 453
Fall

BIOL 457 (3) Biotechnology Project/Laboratory II

Continuation of Biotechnology Project/Laboratory I. Practical laboratory experience in biotechnology through the selection and development of a research project. Students are expected to spend an average of 12 hours per week on the project.
Pre: BIOL 456, taken concurrently with BIOL 454
Spring

BIOL 460 (3) Introduction to Toxicology

A lecture course covering basic principles of toxicity evaluation in living organisms, mechanisms of responses to chemicals or physical agents within an overview of practical medical, environmental and science policy implications. Presentation of comparisons of specific organ and tissue reactions to toxins in a variety of species follow these introductory concepts.
Pre: BIOL 105, BIOL 106, and 1 year of General Chemistry
ALT-Fall

BIOL 461 (4) Environmental Toxicology

A lecture/laboratory course that focuses on anthropogenic and natural toxicants, mathematical modeling of the dispersion of chemical and physical agents in the environment, effects on species and ecosystems with a special section on aquatic risk assessment. The laboratory includes techniques in environmental toxicity and a genuine research project.
Pre: BIOL 460
ALT-Spring

BIOL 462 (1) Toxicology Seminar

A seminar course that involves critical evaluation of published studies in toxicology, student presentations of a selected published manuscript and requires students to write a paper on one aspect of the course's topic area that semester. Topic areas vary each time the course is offered.
Pre: BIOL 105, BIOL 106, and General Chemistry
ALT-Fall

BIOL 464 (3) Methods of Applied Toxicology

A lecture/laboratory course focusing on the steps necessary to start a research project from project definition through methods testing and evaluation, and a final report that includes a project flow chart. Third year students will have senior and/or graduate mentors.
Pre: BIOL 105, BIOL 106, and General Chemistry
ALT-Fall

BIOL 465 (3) Applied Toxicology Project

A lecture/laboratory course where students perform all aspects of their own designed research topic in toxicology while critically evaluating the progress of other projects as well. Students will be expected to keep timelines or develop modified timelines as necessary. The inverted triangle approach of project design will be examined and then included in all designs.
Pre: BIOL 464
ALT-S

BIOL 466 (3) Principles of Pharmacology

A lecture course that examines mechanisms of drug action, physiological responses and adverse reactions from sensitivities or allergies through overdose.
Pre: BIOL 105, BIOL 106, and 1 year of General Chemistry
ALT-Spring

BIOLOGY CONTINUED

BIOL 467 (3) Industrial Hygiene

A lecture course that examines Minnesota State Mankato, as your own work place to develop reports on a selected group of chemical and physical hazards of the workplace. Evaluation methods and solutions to existing problems are developed with concise reporting skills.

Pre: BIOL 105, BIOL 106, and 1 year of General Chemistry
ALT-Fall

BIOL 472 (4) Microbial Ecology and Bioremediation

Role of microorganisms in soil, air, water, sewage processes as well as methods of measurement and detection. Special emphasis on the role of microorganisms in bioremediation. Lab included.

Pre: BIOL 105, BIOL 106, and BIOL 270
ALT-Spring

BIOL 474 (4) Immunology

Fundamental principles of humoral and cell mediated immunity and the application of these principles. Current experimental work in the different areas of immunology will be discussed. Lab included.

Pre: BIOL 105, BIOL 106, and BIOL 270
Fall

BIOL 475 (4) Medical Microbiology

This course will cover bacterial, fungal, and viral human pathogens: what diseases they cause, how they cause disease, and how humans defend against and prevent those diseases. In the laboratory the student will isolate and identify pathogenic microorganisms using microbiological, biochemical, and immunological techniques.

Pre: BIOL 270

BIOL 476 (5) Microbial Physiology and Genetics

This course presents the physiology and genetics of microorganisms emphasizing those aspects unique to bacteria and archaea. Topics include: energy production; biosynthesis of small molecules and DNA, RNA, and proteins; the formation of cell walls and membranes; microbial differentiation and behavior; and the genetic and biochemical regulation of these processes. Lab included.

Pre: BIOL 105, BIOL 106, BIOL 270
Spring

BIOL 478 (4) Food Microbiology and Sanitation

The role microbes play in production and spoilage of food products, as prepared for mass market. Topics include foodborn pathogens, epidemiology and control, essential principles in sanitation including Hazard Analysis/Critical Control Point and ISO 9000 requirements. Lab included.

Pre: BIOL 105, BIOL 106 and BIOL 270
Spring

BIOL 479 (4) Molecular Biology

This course will cover both eukaryotic and prokaryotic molecular biology including: DNA and RNA structure, transcription, regulation of gene expression, RNA processing, protein synthesis, DNA replication, mutagenesis and repair, recombination, and insertion elements. A number of important techniques used in recombinant DNA technology will be discussed and practiced.

Pre: BIOL 105, BIOL 106, BIOL 211
Spring

BIOL 480 (3) Biological Laboratory Experiences for Elementary Teachers

Provides experience with a wide variety of biological laboratory exercises to prepare prospective elementary teachers. Emphasis is on building knowledge, skills, and confidence. The course will cover major biological concepts and environmental education through classroom-ready examples selected to illustrate each concept.

Fall, Spring

BIOL 481 (1) Lab Supervision and Maintenance

Experience in maintaining and supervising laboratories. For individuals desiring additional experience with students in laboratory situations.

Fall, Spring

BIOL 483 (1) MAX Scholar Seminar

This class provides MAX scholars with an opportunity to explore a set of topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Students will be required to participate

in mentoring of lower division MAX scholarship recipients and provide written and oral presentations of various topics during the semester.

Pre: Recipient of a MAX scholarship or instructor consent.
Fall, Spring

BIOL 485 (4) Biology Teaching Methods and Materials

A basic science methods course designed to prepare prospective junior and senior high life science teachers. Course will cover science teaching methods and support materials as they apply to life science teaching situations.

Pre: 16 credits BIOL
Fall

BIOL 486 (3) Field-Based Teaching Methods and Materials

A lecture/laboratory course that provides opportunity for prospective junior and senior high life science teachers to observe, practice, and refine their teaching skills. Students will work in a school setting and experience actual classroom.

Pre: BIOL 485
ALT-Spring

BIOL 490 (1-4) Workshop

A variable topic course designed for a selected topic in Biology. Workshops provide an intensive learning experience on a new topic in the Biological Sciences and/or hands-on experiences in a current area not covered by other course offerings. The course involves background reading, demonstrations, and laboratory or field experiences.

Fall, Spring

BIOL 491 (1-4) In-Service

Fall, Spring

BIOL 492 (1-3) Honors Research

Fall, Spring

BIOL 493 (1-12) Cytotechnology Clinical Internship I

The clinical internship and training includes lectures, demonstrations, laboratory sessions, and clinical practicum in the area of cytotechnology. Instructor permission required.

Fall, Spring

BIOL 494 (1-12) Cytotechnology Clinical Internship II

Continuation of Cytotechnology Clinical Internship I. The clinical internship and training includes lectures, demonstrations, laboratory sessions, and clinical practicum in the area of cytotechnology. Instructor Permission required.

Fall, Spring

BIOL 495 (1-12) Cytotechnology Clinical Internship III

Continuation of Cytotechnology Clinical Internship II. The clinical internship and training includes lectures, demonstrations, laboratory sessions, and clinical practicum in the area of cytotechnology. Instructor Permission required.

Fall, Spring

BIOL 496 (1-12) Cytotechnology Clinical Internship IV

Continuation of Cytotechnology Clinical Internship III. The clinical internship and training includes lectures, demonstrations, laboratory sessions, and clinical practicum in the area of cytotechnology. Instructor Permission required.

Fall, Spring

BIOL 497 (1-12) Internship I

Experience in applied biology according to a prearranged training program for a minimum of five 40-hour weeks.

Pre: Consent
Fall, Spring

BIOL 498 (1-12) Internship II

Experience in applied biology according to a prearranged training program for a minimum of five 40 hour weeks. Only four credits can be applied to the major.

Pre: Consent
Fall, Spring

BIOL 499 (1-4) Individual Study