535 (1-4) Automotive Design and Construction
Involves designing and building of prototype vehicles. Topics include: vehicle design decisions, rules, budgets, chassis design, body and aerodynamics, drive train choices, construction techniques, and test procedures. An actual experimental car will be built in this class. May be repeated.

568 (4) Automotive Research and Design
Automotive research techniques and equipment form the basis for this course. Environmental measurement, air flow testing, engine dynamometer testing, and vehicle performance measurement are covered. Emphasis is placed on research procedures, data acquisition and interpretation, and technical report writing. Current research projects from the automotive industry are also examined.
Pre: AET 366, STAT 154

592 (1-4) Seminar: Automotive
Selected automotive topics.

637 (1-3) Automotive Emission Design and Measurement
An in-depth laboratory experience involving the evaluation of existing automotive emission control systems and the design or modification of those systems. Emission testing using chemical analysis and chassis dynamometer as required in state and federal test procedures is also included.

638 (1-3) High Performance Engineering
This course is intended for individuals wishing to be employed in professional automotive racing as a product development engineer, technical representative for a race product supplier, or race engineer. An in-depth study of vehicle dynamics and engine design utilizing on-board data acquisition, air flow measurement and the engine dynamometer.

647 (1-3) Advanced Emission Design & Measurement
A continuation of AET 637.

648 (1-3) Advanced High Performance Engineering
A continuation of AET 638.

677 (1-4) Individual Study

692 (1-4) Seminar: Automotive
Selected automotive topics.

694 (1-2) Alternate Plan Paper

697 (1-5) Internship: Automotive
Automotive work experience in an area pertinent to the student's objective. Registration required prior to beginning employment.

699 (2-4) Thesis

BIOLOGY MS

BIOLOGY EDUCATION MS

(DISCIPLINE-BASED)

College of Science, Engineering, & Technology
Biological Sciences Department
S242 Trafton Science Center • 507-389-2786

Chair: Bill Bessler, Ed.D.
Graduate Coordinator: Steve Mercurio, Ph.D.

Daryl Adams, Ph.D., Neil Ballard, Ph.D., Michael Bentley, Ph.D., Hyung Tae Choe, Ph.D., Christopher Conlin, Ph.D., John Frey, D.A., Merrill Frydendall, Ph.D., Fred Goetz, Ph.D., Don Gordon, Ph.D., Ronald Hybertson, Ph.D., Keith Klein, Ph.D., Penny Knoblich, DVM, Ph.D, Robert Lebowitz, Ph.D., Mark Lyte, Ph.D., Gregg Marg, Ph.D., Donovan Nielsen, Ph.D., Bertha Proctor, Ph.D., Henry Quade, Ph.D., Edward Williams, Ph.D., Dorothy Wrigley, Ph.D.

The Biologicial Sciences graduate program is designed flexibly to allow students, with their advisors, to mold and focus their program of study on professional interests and specific needs. To do this, students can draw from a broad range of graduate courses and select from a diverse and well-trained faculty for direction in research.

The Biology Department is located in Trafton Hall - one of the best science buildings in the state university system. Trafton presents an open, collaborative atmosphere for graduate study and research, and includes well-equipped research and classroom laboratories. Another attractive feature is Biology's proximity to other science departments, whose faculty members provide opportunities for multidisciplinary study in chemistry, mathematics, computer science, physics and electrical engineering.

The department's modern facilities provide opportunities for research and teaching, with 13 research laboratories, plus support areas. Among those are a media kitchen, environmental chambers, animal complex, greenhouse, dishwashing facility, herbarium, museum and a garage for field equipment. The department's equipment is suitable for biological investigations ranging from ecosystem analysis to subcellular physiology.

Instrumentation available includes transmission and scanning electron microscopes, ICP, ultracentrifuges, diode array spectrophotometers, graphite furnace AA, scintillation counter, gas chromatographs with FID, ECD and MSD, ultrafreezers, computer-controlled physiology data acquisition, Coulter counter, fermentation facility, freeze dryers, thermocyclers (PCR) and other equipment necessary for modern biological research opportunities.

All members of the biology graduate faculty hold doc-

torates and have extensive research experience. Areas of concentration in research and teaching are Biology Education, Microbiology, Human Biology/Physiology, Environmental Biology and Plant Sciences. Sub areas of teaching specialization include cellular biology, developmental biology, plant and animal ecology, genetics, parasitology, immunology, entomology, horticulture and aquatic biology.

Approximately 25 graduate teaching assistantships (TA) are available each year to qualified applicants. A minimum 3.0 GPA in undergraduate courses in math, chemistry, biology and physics and a 600 TOEFL are required for consideration of a TA. Research assistantships are also offered, depending on external funding. Applications should be submitted by February 3 to the Biological Sciences Department. Although the first selection of assistantships occurs in March for the following academic year, the department encourages applications year-round because periodic openings occur.

Admission. In addition to completing the minimum requirements for the College of Graduate Studies, admission to the Biology program must be approved by the Biology Graduate Committee prior to completion of 16 credits of graduate coursework.

For admission to the Biology Program, applicants must provide a one-page statement of career interests and goals. In addition, the applicant must have an undergraduate degree in Biology from an accredited, four-year institution or in another field of science with evidence of having had the following equivalent undergraduate biology core: Biology I (BIO 105), Biology II (BIO 106), Genetics (BIO 211), and two of the following: General Ecology (BIO 215), Cell Biology (BIO 320) or physiology course including laboratory. Students lacking one or more of the above courses may be admitted to the program on the condition that the deficiencies will be rectified during their first year in the program.

In addition, a booklet, "Graduate Studies in Biology," is issued to help each student and advisor keep the graduate program on schedule.

BIOLOGY MS
(Thesis Plan - 30 cr)
(Alternate Plan Paper - 34 cr)

Required Core (11 cr)

BIOL	601	Biometrics (2)
BIOL	602	Research Methods/Proposal (2)
BIOL	695	Graduate Seminar (1) (3 Seminar cr required)
BIOL	619	Selected Topics (2-3) (4 Selected Topics cr required)
ENVI	619	Selected Topics (3) (may be taken to satisfy 3 credits of the BIOL 619 requirement)

Required Electives (19-23 cr)
Choose any 500/600 level Biology courses in consultation with an advisor

Required Thesis or Alternate Plan Paper

BIOL	694	APP (1-2)
BIOL	699	Thesis (3-6)

BIOLOGY EDUCATION MS
(DISCIPLINE-BASED)
(Thesis Plan - 30 cr)
(Alternate Plan Paper - 34 cr)

Teaching licensure is a prerequisite to pursuing this degree which is for teachers interested in enrichment in a teaching area. This degree does not lead to initial teaching licensure. Students who desire initial licensure should consult the Master of Arts in Teaching (M.A.T.) program. Please see the section concerning the M.A.T. program that is listed in this bulletin.

Required Core (11 cr)

BIOL	601	Biometrics (2)
BIOL	602	Research Methods/Proposal (2)
BIOL	695	Graduate Seminar (1) (3 Seminar cr required)
BIOL	619	Selected Topics (2-3) (4 Selected Topics cr required)
ENVI	619	Selected Topics (3) (may be taken to satisfy 3 credits of the BIOL 619 requirement)

Required Biology Electives (7-11 cr)
Choose any 500/600 level Biology courses in consultation with an advisor

Required Professional Education (6 cr)
Choose 6 credits of professional education courses in consultation with an advisor

Required Related Science Electives (6)
Choose 6 credits of related science courses in consultation with an advisor

Required Thesis or Alternate Plan Paper

BIOL	694	Alternate Plan Paper (1-2)
BIOL	699	Thesis (3-6)

COURSE DESCRIPTIONS

502 (4) Stream Limnology (Alt-S)
Study of flowing water on environment. Lab (fieldwork) included.
Pre: BIOL 105, 106, 215, or Consent

503 (4) Wildlife Management (F)
Methods and techniques of wildlife and habitat management. Lab (field trips) included.
Pre: BIOL 105, 106, 215, 316, or Consent

504 (3) Wetlands (S)
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.
Pre: BIOL 105, 106, 215, or Consent

505 (3) Fisheries Biology (F)
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; management topics.
Pre: BIOL 105, 106, 215, or Consent

510 (3) Human Ecology (S)
The human species' place in the biological world, effects on various communities and potential methods of correcting the detrimental effects with economic and social implications.
Pre: BIOL 105, 106, 215, or Consent

511 (2) Evolution for Teachers (S)
This course is designed for students preparing to become science teachers in grades 5-12. It will expand on the genetics and evolution background material contained in the biology core. Special emphasis will be given to dealing with the controversial nature of the concept. Hands-on activities and exercises will be stressed.
Pre: BIOL 105 and 106

512 (4) Soil Ecology (S)
Soil ecology will focus on the physical soil properties 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, 106, 215, or Consent

517 (3) Biology of Aging and Chronic Diseases (S)
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 105

518 (4) Macro and Microscopic Imaging (F)
Properties and physical principles underlying biological images. The course provides a survey of macro-imaging techniques (such as x-ray tomography, magnetic resonance imaging, positron emission tomography, and ultrasound) and micro-imaging techniques (such as light microscopy, transmission and scanning electron microscopy, fluorescence microscopy, laser scanning confocal microscopy and atomic force microscopy).
Pre: One Year of Physics

519 (2-3) Special Topics in Instrumentation (F)
Instruction in specialized biological instrumentation.
Pre: BIOL 105 and 106

520 (3) Diagnostic Parsitology (F)
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 105, BIOL 106 recommended

521 (3) Entomology (Alt-F)
Morphological, ecological, medical, and economic significance of insects. Lab included.
Pre: BIOL 105 and 106

526 (4) Ornithology (S)
Taxonomic, morphological, ecological distribution and behavioral study of birds with emphasis on local species. Lab (field trips) included.
Pre: BIOL 105, 106, 215, 316, or Consent

530 (4) Hematology/Introduction to Immunology (S)
Collection, examination, evaluation, morphology, function and diseases of blood cells. Hemostasis/coagulation of blood. Immunology theory is presented. Lab included.
Pre: BIOL 230

531 (3) Comparative Animal Physiology (Alt-F)
Examination of the manner in which diverse organisms perform similar functions. Lab included.
Pre: BIOL 105, 106 and 1 Year of Chemistry

532 (4) Limnology (F)
Biotic, physical and chemical characteristics of lakes. Lab (fieldwork) included.
Pre: BIOL 105, 106, 215, or Consent

533 (3) Cardiovascular Physiology (S)
This course is a functional study of the heart and circulatory system.
Pre: BIOL 230

534 (3) Development and Human Embryology (F)
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 105

535 (4) Histology (S)
Study of types, arrangements and special adaptations of human tissues. Lab included.
Pre: BIOL 220

536 (4) Animal Behavior (S)
Mechanisms of behavior with emphasis on social organization, communications, and ecological behavior. Lab included.
Pre: BIOL 105, 106, 316 or Consent

538 (3) General Endocrinology (S)
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 105

539 (4) Mammalogy (F)
Study of mammals with emphasis on their habitats, habits, distribution, behavior, and ecological role in

this region. Lab (field trips) included.
Pre: BIOL 105, 106, 215, 316 or Consent

540 (4) Horticulture (F)
Fundamental principles of horticulture: classification, structure, growth and reproduction, technology including propagation, mineral nutrition, training and pruning, growth regulation and protection, horticultural crops and esthetic horticulture. Lab included.
Pre: BIOL 105 and 106

541 (4) Plant Physiology (S)
Plant functions such as water relations, mineral nutrition, translocation, metabolisms, photosynthesis, photorespiration, fat and protein metabolisms, respiration, growth and development, phytohormones, reproduction and environmental physiology. Lab included.
Pre: BIOL 105, 106, 217, and 1 Semester Organic Chemistry

542 (4) Plant Taxonomy (F)
Scientific classification and identification of vascular plants with emphasis on local flora. Methods of collection, preservation and preparation of herbarium specimens included. Lab (field trips) included.
Pre: BIOL 105, 106, or Consent

545 (4) Economic Botany (S)
Introduction to useful plants and plant products: Useful plants of economic value such as fruits and nuts, cereal grains, legumes, medicinal plants, herbs, spices, perfumes, vegetable oils, hydrogels, latex, resins, psychoactive drugs, poisons, stimulating beverages, fibers, dyes, and tannins. Lectures, discussion and lab. Open to non-science majors.
Pre: BIOL 100 or 105

546 (3) Plant Diseases (S)
Study of plant diseases with an emphasis on those common to the upper Midwest. Course will focus on types of pathogens, their plant host range and methods of prevention.
Pre: BIOL 105, 106, or Consent

549 (2) Computers, Networks, and Science (Alt-F)
This course provides students with the necessary skills to explore and utilize computer resources for scientific purposes. Students learn techniques for communicating with the world scientific community electronically, accessing internal computer networks, and locating computer-based scientific resources through a hands-on, problem solving approach.

552 (3) Biological Instrumentation (S)
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 ISO9000 practices.
Pre: BIOL 105, 106, or Consent

553 (3) Biological Engineering Analysis I (F)
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

554 (3) Biological Engineering Analysis II (S)
Continuation of Biological Engineering Analysis I. The application of engineering principles and skills as applied to fermentation and to biological product recovery.
Pre: BIOL 553

556 (4) Biotechnology Project/Laboratory I (F)
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 553

557 (4) Biotechnology Project/Laboratory II (S)
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 556, Concurrent enrollment in BIOL 554

560 (3) Introduction to Toxicology (Alt-F)
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, 106, and 1 year of General Chemistry

561 (4) Environmental Toxicology (Alt-S)
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 460/560

562 (1) Toxicology Seminar (Alt-F)
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, 106, and General Chemistry

564 (3) Methods of Applied Toxicology (Alt-F)
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, 106, and General Chemistry

565 (3) Applied Toxicology Project (Alt-S)
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 464/564

566 (3) Principles of Pharmacology (Alt-F)
A lecture course that examines mechanisms of drug action, physiological responses and adverse reactions from sensitivities or allergies through overdose.
Pre: BIOL 105, 106, 230, and 1 year of General Chemistry

567 (3) Industrial Hygiene (Alt-S)
A lecture course that examines Mankato State University 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, 106, and 1 year of General Chemistry

572 (4) Microbial Ecology and Bioremediation (Alt-F)
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, 106, and 270

574 (4) Immunology (F)
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, 106, and 270

575 (4) Medical Microbiology (F)
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.

576 (5) Microbial Physiology and Genetics (S)
This course presents the physiology and genetics of microorganisms emphasizing those aspects unique to bacteria and archea. 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.
Pre: BIOL 105, 106, 270

578 (4) Food Microbiology and Sanitation (S)
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, 106 and 270

579 (4) Molecular Biology (S)
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, 106, or Consent

580 (2) 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. Major biological concepts will be covered and classroom-ready examples provided to illustrate each concept.
Pre: BIOL 100 and C&I 322

584 (2) Teaching Methods for Middle and Junior High School Sciences (F)
The life science component of a series of concurrently taught methods courses designed to prepare prospective science teachers to become licensed in grades 5-9. Students enrolled in this class must also be enrolled in the other special methods classes for middle school/junior high physical and earth science.
Pre: EDFN 345

585 (3) Biology Teaching Methods & Materials (F)
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 and EDFN 345

586 (3) Field-Based Teaching Methods and Materials (Alt-S)
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 485/585

590 (3) Workshop (F,S)

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.

591 (1-4) In-Service (F,S)

601 (2) Biometrics (F)
This course will focus on the application of biometric principles to the planning and analysis of biological research similar to the student's thesis research. Completion of this course will aid the student in planning and completing her/his thesis.

602 (2) Research Methods (S)
The design, planning, and writing of a research proposal will be discussed in terms of problem selection, objectives, and appropriate methods. The students will apply information from the class to prepare their thesis proposals.

612 (3) Practicum in Electron Microscopy (S)
A laboratory course of basic training in the instrumentation and methodology use in scanning and transmission electron microscopy. With a hand-on approach, students will learn instrument operation and techniques necessary to process and examine a variety of samples, and whenever possible, to examine specimens related to their own research interests.
Pre: BIOL 418/518

619 (2-3) Selected Topics in Biology (F,S)
Selected study of graduate level topics. May be repeated for different titled topic.
All 677 courses are offered in the Fall and Spring:
677 (1-5) Individual Study
Pre: Consent

677-01 (1-5) Individual Study: Biology Education
Pre: Consent

677-02 (1-5) Individual Study: Biology
Pre: Consent

677-03 (1-5) Individual Study: Plant Biology
Pre: Consent

677-04 (1-5) Individual Study: Animal Biology
Pre: Consent

677-05 (1-5) Individual Study: Microbiology
Pre: Consent

677-06 (1-5) Individual Study: Cardiac Rehabilitation
Pre: Consent

677-07 (1-5) Individual Study: Ecology
Pre: Consent

677-08 (1-5) Individual Study: Physiology
Pre: Consent

677-09 (1-5) Individual Study: Biotechnology
Pre: Consent

677-10 (1-5) Individual Study: Electron Microscopy
Pre: Consent

677-11 (1-5) Individual Study: Genetics
Pre: Consent

677-12 (1-5) Individual Study: Anatomy
Pre: Consent

677-13 (1-5) Individual Study: Cell Biology
Pre: Consent

677-14 (1-5) Individual Study: Immunology
Pre: Consent

681 (1-2) Lab Supervision (F,S)
Practical experience in preparing and teaching laboratory courses.
Pre: Consent

685 (2) Teaching Assistant Methods (F)
This course is design to provide Teaching Assistants with the knowledge and skills needed to prepare and teach college-level science courses. Special emphasis will be placed on the attainment of skills that maximize the effectiveness of material that will be presented to students.

691 (1-5) In-Service (F,S)

694 (1 or 2) Alternate Plan Paper (F,S)

695 (1) Seminar (F,S)
Students will attend and critique seminars presented by other students, faculty, and by people from external agencies and institutions.
Pre: None

697 (1-12) Internship (F,S)

699 (3-6) Thesis (F,S)

BUSINESS ADMINISTRATION MBA

College of Business
150 Morris Hall • 507-389-5426

Admissions to the MBA program are currently suspended. Courses may be used as electives in other programs, or as part of a multidisiplinary program.

COURSE DESCRIPTIONS

MBA

500 (0) Introduction of MBA
MBA requirements, plan of study, advisor and examining committee; business responsibility to the