

**899. Master's Thesis Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**900. Special Problems**  
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 6 credits. Approval of department.  
Individualized reading and research compatible with the student's interest and ability.

**909. Elastic Thin Shells**  
Spring. 4(4-0) MMM 815 or C E 804 or approval of department; MTH 421. Interdepartmental with and administered by Civil Engineering.  
Elements of differential geometry, membrane theory of shells, Pucher's stress function, deformation and bending of shells of revolution and shallow shells.

**911. Theory of Elastic Stability**  
Winter of odd-numbered years. 4(4-0) MMM 815 or approval of department.  
Theory and methods of determining buckling strength and post-buckling behavior of bar, plate and shell elements and of elastic systems.

**912. Theory of Plates**  
Winter. 4(4-0) MMM 815 or C E 804 or approval of department; MTH 422. Interdepartmental with Civil Engineering.  
Bending of thin elastic plates with various shapes and boundary conditions; application of energy principles and approximate methods of solution; thick plates; large deflection theory; sandwich plates.

**914. Theory of Elasticity II**  
Spring of odd-numbered years. 3(3-0) MMM 813 or approval of department.  
Further topics in linear elasticity including complex variable solutions, elastodynamics, variational principles, St. Venant's principle, anisotropic material behavior.

**915. Theory of Elasticity III**  
Spring of even-numbered years. 3(3-0) MMM 813 or approval of department.  
Introduction to finite elasticity. Kinematics of large deformations, kinetics, constitutive relation - general theory and particular models, solution of basic problems. Non-uniqueness. Singular fields near crack-tips. Material stability.

**916. Fracture Mechanics**  
Fall of even-numbered years. 3(3-0) MMM 813.  
Brittle and ductile fracture in structural materials. Elastic stress fields near cracks, theories of brittle fracture, elastic fracture mechanics. Elastic-plastic analysis of crack extension. Plastic instability. Running cracks.

**917. Fatigue of Engineering Structures**  
Spring of even-numbered years. 3(3-0) MMM 411 or approval of department.  
Theories of cyclic deformation and fatigue. Macro and micro failure. Notched components. Combined loading. High temperature fatigue, environmental effects. Case studies.

**918. Theory of Viscoelasticity**  
Fall of even-numbered years. 3(3-0) MMM 810; MTH 422 or approval of department.  
Fundamental linear viscoelastic stress-strain relations. Model representation. Three dimensional and general deformation laws. Correspondence principle. Quasi-static, dynamic and buckling problems.

**940. Modern Problems in Materials Science**  
Fall, Spring. 3(3-0) May reenroll for a maximum of 9 credits. Approval of department.  
Current field of research in ceramics, martensitic transformations, oxidation and corrosion, electron microscopy, recrystallization and textures.

**941. Crystal Defects**  
Winter of even-numbered years. 3(3-0) MMM 825 or approval of department.  
Defects in thermodynamic equilibrium. Vacancies. Interstitials, color centers. Role of defects in diffusion, radiation damage. Geometrical and elastic properties of dislocations, dislocation reactions, grain boundary structures and kinetics.

**942. Advanced Topics in Phase Transformations**  
Winter of odd-numbered years. 3(3-0) MMM 825 or approval of department.  
Precipitation and ripening, gradient energy term, spinodal decomposition, surface and strain effects, allotropic and polytropic transformations, martensitic transformations, electronic effects, charge density waves, thermoelastic and shape memory alloys.

**999. Doctoral Dissertation Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

## MICROBIOLOGY AND PUBLIC HEALTH MPH

**College of Human Medicine  
College of Natural Science  
College of Osteopathic Medicine  
College of Veterinary Medicine**

**200. Elementary Microbiology**  
Fall, Winter. 4(3-2) Three terms of Natural Science. Primarily for majors outside the College of Natural Science.  
Description of bacteria and related forms of microorganisms, their growth and nature, their application in industry, and their control in public health.

**234. Elementary Medical Microbiology**  
Fall. 5(4-4) CEM 130, B S 211, approval of department.  
Survey of immunology and microbiology with emphasis on pathogenic microorganisms, antimicrobial agents, and laboratory diagnosis.

**301. Introductory Microbiology**  
Fall, Spring, Summer. Given at W. K. Kellogg Biological Station Summer term. Fall, Spring: 3(3-0) Summer: 3 credits. CEM 242, CEM 244 or BCH 200.  
Fundamentals of microbiology. Ranges of cell structure and activities; nutrition, growth, and importance of major microbial groups.

**302. Introductory Microbiology Laboratory**  
Fall, Spring, Summer. Given at W. K. Kellogg Biological Station Summer term. Fall, Spring: 2(0-4) Summer: 2 credits. MPH 301 or concurrently.  
Methodology of microbiology including microscopy, staining, asepsis, cultural media and quantification.

**303. Microbiology I: General**  
Fall. 4(4-0) BCH 451 or concurrently.  
Principles of microbiology emphasizing cell structure and function, metabolism, growth and death, differentiation, diversity, and microbial interaction.

**304. General Microbiology Laboratory I**  
Fall. 3(1-5) MPH 303 or concurrently.  
Techniques and procedures of general microbiology emphasizing the isolation and identification of bacteria, the qualitative aspects of growth and death, and bacterial interactions.

**306. General Microbiology Laboratory II**  
Spring. 3(1-5) MPH 304.  
Continuation of MPH 304 with emphasis on immunologic and genetic techniques and procedures.

**310. Food Safety and Microbiology**  
Fall. 4(3-3) CEM 143 or concurrently or approval of department. Not open to students with credit in FSC 440. Interdepartmental with and administered by Food Science.  
Effects of food handling, preparation and service on food safety. Microorganisms in foods, sanitation, food borne disease and food service regulations.

**400H. Honors Research**  
Fall, Winter, Spring, Summer. 2 credits. May reenroll for a maximum of 8 credits. Approval of department.  
A four-term research project with thesis.

**405. Microbiology II: Immunobiology/Cell Biology**  
(427.) Winter. 4(4-0) MPH 303; BCH 452 or concurrently. Students may not receive credit in both MPH 405 and MPH 461.  
Cell biology of eukaryotic cells with immune system as model. Emphasize structure-function relationships in subcellular organelles, antigen metabolism and regulatory mechanisms of immune responsiveness.

**406. Medical Mycology**  
Fall, Spring. 4(2-6) BOT 402 or approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology.  
Characteristics, habits, and laboratory identification of fungus diseases infecting humans. Emphasis on laboratory techniques and morphological characteristics of the various mycoses.

**407. Microbiology III: Microbial Genetics**  
(423.) Spring. 4(4-0) MPH 405; BCH 453 or concurrently.  
Genetics and molecular biology of bacteria and viruses with emphasis on the genetic principles developed from their study.

**413. Animal Cells and Viruses**  
Fall. 3(3-0) MPH 407.  
Basic features of animal cell structure and function, and of animal viruses as tools to understand eukaryotic gene expression, as pathogens, and as examples of diversity and divergence with cellular mechanisms.

**Descriptions — Microbiology and Public Health  
of  
Courses**

**416. General Parasitology**

Fall, Summer. Given at W. K. Kellogg Biological Station Summer term. Fall: 3(3-0) Summer: 3 credits. B S 210, B S 211, B S 212 or LBS 141. Interdepartmental with the Department of Zoology.

Life history, host-parasite relationships (including physiology, immunology, immunopathology and pathology) and epidemiology of selected groups and species of protozoan, trematode, cestode and nematode parasites.

**418. General Parasitology Laboratory**

(MPH 417.) Fall, Summer. Given at W. K. Kellogg Biological Station Summer term. Fall: 2(0-4) Summer: 2 credits. MPH 416 or concurrently or approval of department. Interdepartmental with the Department of Zoology.

Identification and life histories of representative species of major groups of animal parasites. Selected concepts of host-parasite associations will be tested experimentally.

**420. Biology of Animal Parasites**

Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the departments of Fisheries and Wildlife, and Zoology.

Parasitism of animals by protozoa, helminths and arthropods with emphasis on the interrelationships of host-parasite associations with the natural environments.

Approved through Spring 1986.

**421. Microbial Physiology**

Fall. 3(3-0) MPH 303, MPH 304, BCH 453.

Cell structure and function, macromolecular synthesis and control.

**422. Microbial Physiology Laboratory**

Fall. 2(0-6) MPH 421 or concurrently. Laboratory work based upon the subject matter of MPH 421.

**426. Microbial Ecology**

(MPH 425.) Spring. 3(3-0) MPH 301 or MPH 303, MPH majors must enroll concurrently in MPH 426A. Interdepartmental with the Department of Crop and Soil Sciences.

Microbial activities in natural ecosystems; their association with plants and animals, and their transformations of carbon, nitrogen and sulfur in soil and aquatic habitats.

**426A. Microbial Ecology Recitation**

(MPH 425A.) Spring. 1(1-0) MPH 426 concurrently. Interdepartmental with the Department of Crop and Soil Sciences.

Quantitative aspects of microbial ecology.

**429. Host-Parasite Relationships**

Winter. 3(3-0) MPH 407, MPH 413. Molecular basis of microbial virulence determinants and their role in overcoming mechanisms of host defense.

**437. Introductory Medical Parasitology**

Winter. 5(3-5) B S 210, B S 211, B S 212. Primarily for Medical Technology students. Biology of protozoan, helminth, and arthropod infections of humans. Laboratory diagnosis of these infections.

**440. Food Microbiology**

Spring. 3(3-0) MPH 200 or MPH 301 or approval of department. Interdepartmental with and administered by Food Science.

Major groups of microorganisms of importance to the food industry are studied with emphasis on ecological, physiological, and public health aspects.

**441. Food Microbiology Laboratory**

Spring. 2(0-4) FSC 440 or concurrently or approval of department. Interdepartmental with and administered by Food Science.

Laboratory practice with major groups of microorganisms of importance to the food industry. Concurrent enrollment in FSC 440 recommended.

**444. Environmental Microbiology**

Spring. 3(2-4) MPH 200 or MPH 301. Flora, methods of testing, and purification of environmental air and water. Treatment and disposal of sewage.

**461. Medical Immunology and Microbiology**

(MPH 462., MPH 463.) Winter. 5(5-0) MPH 301, MPH 302. Interdepartmental with Medical Technology.

The immune system, cellular interaction of the in vitro and in vivo reaction, and associated immunopathology. Characterization of infectious agents and their pathogenic processes.

**464. Medical Microbiology and Immunology Laboratory**

Winter. 2(0-6) MPH 461 or concurrently.

Basic immunologic and taxonomic laboratory techniques of selected bacterial pathogens.

**470. Biological Membranes**

(IDC 470.) Spring. 3(3-0) BCH 401. Interdepartmental with the departments of Biochemistry, and Physiology. Administered by the Department of Physiology.

The chemistry, physics and mathematics of the permeability, energy transductions and surface functions of differentiated cell membranes and membranous organelles are compared. A brief discussion of theoretical and experimental models is included.

**490. Special Problems in Microbiology**

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.

Tutorial instruction in laboratory or library research for advanced undergraduates.

**503. Introduction to Medical Biology**

Fall. 5(5-0) Admission to the College of Human Medicine. Interdepartmental with the departments of Biochemistry, Physiology, and Pharmacology and Toxicology.

Principles of medical biology for medical students.

**511. Medical Microbiology and Immunology**

Winter. 1 to 5 credits. May reenroll for a maximum of 5 credits. A biochemistry course. Enrollment in College of Human Medicine or approval of department.

Basic principles of microbiology (bacteriology, virology, mycology and parasitology) and immunology. Selected type-infections relate these principles to disease in humans.

**512. Infectious Diseases**

Spring. 4(3-3) MPH 511, or approval of department. Interdepartmental with the Department of Medicine.

Infectious diseases of humans, including biology of the causative microorganism, epidemiology, pathogenesis, host-parasite relationships, clinical and laboratory diagnosis, and clinical management.

**521. Medical Microbiology and Immunology**

Winter. 1 to 6 credits. May reenroll for a maximum of 6 credits. A biochemistry course. Enrollment in College of Osteopathic Medicine or approval of department.

Basic principles of microbiology (bacteriology, virology, mycology and parasitology) and immunology. Selected type-infections relate these principles to disease in humans.

**531A. Medical Microbiology: Immunology**

Winter. 4(3-2) Second-term Veterinary Medicine students or approval of department.

Basic principles of immunology (immunobiology and immunochemistry) and their relation to disease in animals.

**531B. Medical Microbiology: Bacteriology and Mycology**

Spring. 5(3-6) Third-term Veterinary Medicine students or approval of department.

Basic principles of bacteriology and mycology and their relation to disease in animals.

**531C. Medical Microbiology: Virology**

Fall. 3(2-2) Fourth-term Veterinary Medicine students or approval of department.

General properties of animal viruses; pathogenesis, immune response and immunoprophylaxis in viral diseases; principles of clinical virology.

**531D. Medical Microbiology: Parasitology**

Winter. 4(3-3) Fifth-term Veterinary Medicine students or approval of department.

Basic principles of parasitology (protozoology, helminthology, and entomology) and their relation to disease in animals.

**618. Infectious Disease Clerkship**

Fall, Winter, Spring, Summer. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608. Interdepartmental with and administered by the Department of Medicine.

The clerkship emphasizes acquisition in depth of knowledge and skills essential in solution of clinical problems in infectious and immunologic diseases. Integrated basic science input is afforded through relevant seminars.

**800. Seminar**

Fall, Winter, Spring, Summer. 1(1-0) May reenroll for a maximum of 9 credits. Approval of department.

**810. Topics in Microbiology**

Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 10 credits if different topic is taken. Approval of department.

Topics will be selected from taxonomic subsciences such as bacteriology, virology, protozoology, mycology, and helminthology; from transecting disciplines such as microbial genetics, immunology, physiology, and ecology.

**813. Molecular Virology**

Winter. 4(4-0) Background in biochemistry, and approval of department.

Molecular nature and biochemistry of replication of bacterial and animal viruses. Emphasis is on current advances, research concepts, and the role of viruses in molecular biology research.

**821. Advanced Microbial Physiology**  
*Spring of even-numbered years. 4(4-0)*  
MPH 303.

Mechanism and regulation of physiologic and metabolic activities unique to prokaryotes including fermentation, photosynthesis, respiration and autotrophy.

**823. Microbial Genetics**  
*Winter. 3(3-0) BCH 811.*

Gene structure, gene function, and genetic regulation at the classical and molecular levels in prokaryotes and lower eukaryotes.

**827. Immunochemistry**  
*Spring of even-numbered years. 3(3-0)*  
MPH 405; BCH 452 or ZOL 441; CEM 383 recommended.

Structure and reactivity of antigens and antibodies; synthesis of immunoglobulins. Emphasis is on current advances and research concepts.

**829. Host-Parasite Relationships**  
*Fall. 3(3-0) MPH 427, MPH 429 or approval of department.*

Pathogenesis and host responses to selected bacterial, parasitic, and fungal pathogens. Emphasis is on current research models which exemplify a variety of host-parasite relationships.

**831. Bacterial Diversity**  
*Spring of odd-numbered years. 3(3-0)*  
MPH 303, MPH 304; BCH 401 or BCH 453 or concurrently.

Morphological and physiological properties of diverse groups of bacteria and how these properties relate to their ecological niche and importance.

**832. Bacterial Diversity Laboratory**  
*Spring of odd-numbered years. 2(0-6)*  
MPH 831 or concurrently.

Representative groups of bacteria will be isolated and studied.

**842. Advanced Soil Microbiology**  
*Fall of odd-numbered years. 3(3-0)*  
MPH 425 or approval of department. Interdepartmental with the Department of Crop and Soil Sciences.

Biochemistry, biology, and community ecology of microorganisms indigenous to soil. Emphasis on current research problems.

**843. Soil Microbiology Laboratory**  
*Fall of odd-numbered years. 2(0-6)*  
MPH 842 concurrently or approval of department. Interdepartmental with the Department of Crop and Soil Sciences.

Fundamental techniques of dealing with microorganisms indigenous to soil. Metabolic activity of microorganisms. Interaction between microorganisms and plants.

**890. Special Problems in Microbiology**  
*Fall, Winter, Spring, Summer. 2 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.*

**899. Master's Thesis Research**  
*Fall, Winter, Spring, Summer. Variable credit. Approval of department.*

**900. Topics in Microbiology**  
*Fall, Winter, Spring, Summer. 2(2-0)*  
May reenroll if different topic is taken. Approval of department.

Topics will be selected from taxonomic subsciences such as bacteriology, virology, protozoology, mycology, algology, and helminthology; and from transecting disciplines such as microbial genetics, immunology, physiology, and ecology.

**999. Doctoral Dissertation Research**  
*Fall, Winter, Spring, Summer. Variable credit. Approval of department.*

**MILITARY SCIENCE M S**

**Office of the Provost**

**101. Introduction to the Military Profession**  
*(M S 121.) Fall, Winter, Spring. 1(1-1)*  
Approval of department.

Analysis of the military profession from several academic perspectives. Exploration of the technical, ethical, and personal ramifications of service as an officer in the U.S. Army. Lab introduces military skills.

**102. Military Leadership I**  
*(M S 041A.) Winter. 1(1-1) M S 101 or approval of department.*

Introduction to military leadership. Draws upon examples from military history to illustrate what a military leader must be, know, and do to lead soldiers in battle. Lab includes both military skills and leadership applications.

**103. Army Physical Fitness Training**  
*Spring. 1(0-3) M S 102 or approval of department.*

The leader's role in implementing the Army Physical Fitness Program to provide for the physical well being of subordinates. Individual and group fitness programs are introduced. Includes rappelling and smallbore rifle marksmanship.

**201. Military First Aid**  
*(M S 221.) Fall. 1(1-1) M S 103 or approval of department.*

Emergency first aid techniques including casualty evaluation, lifesaving measures, CPR, and environmental injury prevention. Lab includes military skills and first aid applications.

**202. Military Leadership II**  
*(M S 041B.) Winter. 1(1-1) M S 201 or approval of department.*

Descriptive model of small unit leadership. Provides cadets with a realistic preview of the small unit leader's role in the Army. Lab includes small unit drill and ceremonies.

**203. Land Navigation**  
*(M S 223.) Spring. 1(1-2) M S 202 or approval of department.*

Use of military topographic and special use maps to include intersection, resection, modified resection, and polar coordinates. Development of overlays for tactical operations. Lab includes actual land navigation in the field using the lensatic compass.

**301. Command and Control Communications**  
*Fall. 3(2-3) M S 203 or approval of department.*

Tactical wire and radio communications systems and employment during tactical operations to provide effective control of military operations. Encryption/decryption, use of codes, and electronic warfare. Lab emphasizes practical application of communication skills.

**302. Military Leadership III**  
*Winter. 3(2-3) M S 301 or approval of department.*

Application of the theories and models of the behavioral sciences to leadership as it functions in a military environment. Case studies from military history. Lab emphasizes practical leadership applications.

**303. Small Unit Tactics**  
*(M S 325.) Spring. 3(2-3) M S 302 or approval of department.*

Offensive and defensive military tactics. Incorporates practical exercises which allow cadets to view the modern battlefield through the eyes of the infantry platoon leader. Lab emphasizes tactical employment of the infantry squad and platoon.

**401. Training Management and Unit Administration**  
*(M S 426.) Fall. 3(2-2) M S 303 or approval of department.*

The Army training management system and the leader's role as a trainer. Operations and administration in military units to provide effective personnel management and logistic support. Oral and written military communication. Lab includes practical experience in unit administration.

**402. Military Leadership IV**  
*(M S 041D.) Winter. 3(2-2) M S 401 or approval of department.*

Leadership assessment, development, and training practices. Integration of theory, practice, and self-assessment in leadership. Development of subordinates and the role of the noncommissioned officer. Lab includes leadership development and assessment exercises.

**403. Military Law, Ethics, and Professionalism**  
*(M S 427.) Spring. 3(2-2) M S 402 or approval of department.*

Military legal system and the responsibilities of leaders in the application of military justice. Examination of fundamental values and principles of conduct in the profession of arms. Lab includes practical exercises in professional development.

**499. Independent Study in Military Science**  
*Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department and Juniors.*

Individual research and study in an area related to military science as approved and directed by the Department of Military Science.

**MUSIC MUS**

**College of Arts and Letters**

**112. Chamber Music**  
*Fall, Winter, Spring, Summer. 1(1-0)*  
May reenroll for a maximum of 18 credits. Approval of department.

Performance of works for small ensembles.

**118. Band**  
**A. Marching Band**  
*Fall. 1 credit. May reenroll for credit. Membership determined by audition.*

The Marching Band participates at football games.