

## MICROBIOLOGY AND MOLECULAR GENETICS

## MMG

### Department of Microbiology and Molecular Genetics College of Natural Science

- 101 Preview of Microbiology**  
Fall. 1(1-0) R: Open only to freshmen or sophomores. SA: MPH 101  
Overview of modern microbiology, emphasizing impact on society.
- 103 Frontiers of Microbiology**  
Spring. 1(2-0) R: Open only to freshmen and sophomores.  
Current microbiology research: significance to modern biological science and impact on society.
- 111L Cell and Molecular Biology Laboratory**  
Fall, Spring, Summer. 2(1-3) Interdepartmental with Biological Science; Plant Biology; Zoology. Administered by College of Natural Science. P:M: (BS111 or concurrently) Not open to students with credit in LBS 159H.  
Principles and applications of common techniques used in cell and molecular biology.
- 201 Fundamentals of Microbiology**  
Spring. 3(3-0) RB: (CEM 141 or ISP 201 or ISP 207 or ISP 209 or ISP 217) SA: MMG 105, MMG 205  
Microbial structure, function, growth, control, and diversity. Role of microbes in health, industry, and the environment.
- 301 Introductory Microbiology**  
Fall, Spring. 3(3-0) P:M: (BS 111 or LBS 145 or LBS 149H) and (CEM 251 or concurrently or CEM 351 or concurrently or CEM 143) SA: MPH 301  
Fundamentals of microbiology, including microbial structure and function, nutrition and growth, death and control. Importance and applications of major microbial groups.
- 302 Introductory Microbiology Laboratory**  
Spring. 1(0-3) P:M: (MMG 201 or concurrently or MMG 301 or concurrently) SA: MPH 302, MIC 302  
Methodology of microbiology: microscopy, staining, aseptic technique, culture media, quantification, and laboratory safety.
- 408 Advanced Microbiology Laboratory (W)**  
Fall. 3(1-6) P:M: (MMG 302 and MMG 431 or concurrently) and completion of Tier I writing requirement. R: Open only to students in the Department of Microbiology and Molecular Genetics or LBS Environmental Biology/Microbiology or Microbiology coordinate major. SA: MPH 408  
Microbiological techniques and procedures to study physiology and genetics of bacteria and bacteriophages. Collection and critical assessment of quantitative data and written communication of results.
- 409 Eukaryotic Cell Biology**  
Spring. 3(3-0) P:M: (BS 111 or LBS 145 or LBS 149H) and (BMB 401 or concurrently or BMB 462 or concurrently) SA: MIC 403, MPH 403  
Structure and function of nucleated cells. Emphasis on the molecular mechanisms that underlie cell processes.
- 413 Virology**  
Spring. 3(3-0) P:M: (BMB 462 or concurrently) RB: (MMG 409) SA: MPH 403  
Viruses and modern molecular biology. Viral replication and gene expression of the major classes of viruses. Virus-cell interactions and viral diseases.
- 421 Prokaryotic Cell Physiology**  
Fall. 3(3-0) P:M: (MMG 301 and BMB 461 or concurrently) SA: MIC 401, MPH 401  
Prokaryotic cell structure and function. Growth and replication. Macromolecular synthesis and control.
- 425 Microbial Ecology**  
Spring. 3(3-0) Interdepartmental with Crop and Soil Sciences. RB: (MMG 301) SA: MPH 425  
Microbial population and community interactions. Microbial activities in natural systems, including associations with plants or animals.
- 426 Biogeochemistry**  
Summer. 3 credits. Summer: Given only at W.K. Kellogg Biological Station. Interdepartmental with Crop and Soil Sciences; Geological Sciences; Zoology. RB: (BS 110 or LBS 144 or LBS 148H or BS 111 or LBS 145 or LBS 149H) and (CEM 143 or CEM 251) SA: MPH 426  
Integration of the principles of ecology, microbiology, geochemistry, and environmental chemistry. Societal applications of research in aquatic and terrestrial habitats.
- 431 Microbial Genetics**  
Fall. 3(3-0) P:M: (BMB 461 or concurrently) RB: (MMG 301 or ZOL 341) SA: MIC 401, MPH 401  
Genetics of bacteria, their viruses, plasmids, and transposons. Emphasis on genetic principles.
- 433 Microbial Genomics**  
Spring. 3(2-3) P:M: (MMG 431) RB: (MMG 421 or BMB 461) and (CSE 101)  
Structure of microbial genomes and implications for growth and evolution of bacteria and fungi. Computer analysis of genome sequence databases. Applications to gene expression and phylogenetic analysis.
- 440 Food Microbiology**  
Spring. 3(3-0) Interdepartmental with Food Science. Administered by Department of Food Science and Human Nutrition. P:M: (MMG 201 or MMG 301) and completion of Tier I writing requirement. R: Not open to freshmen. SA: MPH 440  
Major groups of microorganisms of importance to the food industry. Ecological, physiological, and public health aspects.
- 441 Food Microbiology Laboratory**  
Spring. 2(0-4) Interdepartmental with Food Science. Administered by Department of Food Science and Human Nutrition. P:M: (FSC 440 or concurrently) and completion of Tier I writing requirement. RB: (MMG 206 or MMG 302) SA: MPH 441  
Methods for studying major groups of microorganisms important to the food industry. Isolation, enumeration, characterization, identification, and use of microorganisms.
- 445 Basic Biotechnology**  
Fall. 3(3-0) P:M: (MMG 301 or concurrently) SA: MPH 445  
Growth and genetic improvement of industrial microorganisms. Fermentation fundamentals. Specific classical and recombinant-based bioprocesses and bioconversions of commercial importance.
- 451 Immunology**  
Fall. 3(3-0) P:M: (BS 111 or LBS 145 or LBS 149H) and (BMB 401 or concurrently or BMB 461 or concurrently) RB: (MMG 409) SA: MPH 451  
Structure and function of molecules involved in immune responses. Quantification of immune responses and cellular participants. Immunologic abnormalities. Immunotherapy. Experimental approaches to dissection of immune functions.
- 461 Molecular Pathogenesis**  
Spring. 3(3-0) P:M: (MMG 301) RB: (MMG 431) SA: MPH 461  
Molecular basis of microbial virulence. Nature of determinants and their role in overcoming host defense mechanisms.
- 463 Medical Microbiology**  
Fall. 3(3-0) P:M: (MMG 301 or concurrently) RB: (MMG 451) R: Open only to juniors or seniors in the Department of Microbiology and Molecular Genetics or Clinical Laboratory Sciences or Medical Technology major or LBS Environmental Biology/Microbiology or Medical Technology or Microbiology coordinate major. SA: MPH 463  
Properties of pathogenic bacteria and viruses and their mechanisms of pathogenicity.
- 464 Diagnostic Microbiology Laboratory**  
Fall. 2(0-4) P:M: (MMG 463 or concurrently) R: Open only to juniors or seniors in the Department of Microbiology and Molecular Genetics or Clinical Laboratory Sciences or Medical Technology major or LBS Environmental Biology/Microbiology or Medical Technology or Clinical Laboratory Science or Microbiology coordinate major. SA: MPH 464, MIC 464  
Diagnostic procedures for the identification of pathogenic microbes.
- 490 Special Problems in Microbiology**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department. SA: MPH 490  
Library research or tutorial instruction in advanced laboratory techniques.

## Microbiology and Molecular Genetics—MMG

- 491 Current Topics in Microbiology**  
Spring. 3(4-0) R: Open only to seniors in the Department of Microbiology and Molecular Genetics or LBS Environmental Biology/Microbiology or Microbiology coordinate major. SA: MPH 491  
Capstone experience for microbiology majors. Presentation and discussion of journal articles. Writing of position papers. Topics such as microbial physiology, ecology, genetics, molecular biology, virology, immunology, or pathogenesis.
- 492 Undergraduate Research Seminar**  
Spring. 1(1-0) P:M: (MMG 499 or MMG 499H) R: Open only to seniors in the Department of Microbiology and Molecular Genetics or LBS Environmental Biology/Microbiology or Microbiology coordinate major. SA: MPH 492  
Presentation and group discussion of undergraduate research results.
- 499 Undergraduate Research**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to students in the Department of Microbiology and Molecular Genetics or LBS Environmental Biology/Microbiology or Microbiology coordinate major. SA: MPH 499  
Participation in a laboratory research project.
- 499H Honors Research**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to Honors College students in the Microbiology or Environmental Biology/Microbiology major or LBS Microbiology coordinate major or LBS Environmental Biology/Microbiology coordinate major. SA: MPH 499H  
Research project with thesis and oral report. A portion of Microbiology capstone experience.
- 522 Medical Microbiology and Immunology**  
Spring. 5(4-2) R: Graduate-professional students in colleges of Human and Osteopathic Medicine. SA: MPH 522  
Basic principles of microbiology (bacteriology, virology, mycology and parasitology) and immunology and their relation to disease in humans.
- 561 Veterinary Immunology**  
Fall. 2(2-0) R: Open only to graduate-professional students in the College of Veterinary Medicine. SA: MPH 561, MIC 561  
Concepts of cell biology, immunochemistry, immunobiology, and immunopathology related to the healthy state and the host response to infection and parasitism.
- 567 Veterinary Microbiology and Infectious Diseases I**  
Spring. 5(4-3) R: Open only to graduate-professional students in College of Veterinary Medicine. SA: MIC 563, MIC 565, MPH 563, MPH 565 Not open to students with credit in VM 564.  
Structure, function, and diagnostic characteristics of bacteria and fungi related to pathogenicity, transmission, control, host response, therapy, and management of selected diseases of animals.
- 569 Veterinary Microbiology and Infectious Diseases II**  
Fall. 5(4-3) R: Open only to graduate-professional students in College of Veterinary Medicine. SA: MIC 563, MIC 565, MPH 531C, MPH 531D, MPH 563, MPH 565  
Structure, function, and diagnostic characteristics of viruses, protozoa, and helminths related to pathogenicity, transmission, control, host response, therapy, and management of selected diseases of animals.
- 660 Veterinary Clinical Bacteriology Clerkship**  
Fall, Spring, Summer. 3 credits. RB: Completion of semester 5 of the graduate-professional program in the College of Veterinary Medicine.  
Guided clinical bacteriology experience.
- 662 Clinical Veterinary Virology Clerkship**  
Fall, Spring, Summer. 3 credits. RB: Completion of semester 5 of the graduate-professional program in the College of Veterinary Medicine.  
Guided clinical virology experience.
- 664 Veterinary Clinical Parasitology Clerkship**  
Fall, Spring, Summer. 3 credits. RB: Completion of semester 5 of the graduate-professional program in the College of Veterinary Medicine.  
Guided clinical parasitology experience.
- 690 Veterinary Microbiology Clerkship**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: Completion of 5 semesters of the graduate-professional program in the College of Veterinary Medicine. SA: MPH 690  
Laboratory-based investigation of microbiological problems pertinent to veterinary medicine.
- 801 Integrative Microbial Biology**  
Fall. 4(4-0) Not open to students with credit in MMG 821 or MMG 829 or MMG 841 or MMG 827.  
Structural, metabolic, phylogenetic, and genomic diversity of microbes and microbial communities. Microbial ecology, evolution, and behavior. Regulation of gene expression. Microbial interactions with other microbes, animals, or plants
- 803 Topics in Integrative Microbial Biology**  
Fall, Spring. 2(2-0) A student may earn a maximum of 10 credits in all enrollments for this course. P:M: (MMG 801 or concurrently)  
In-depth study of a particular topic from integrative microbial biology.
- 813 Molecular Virology**  
Spring of even years. 3(3-0) R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources. SA: MPH 813  
Molecular nature and biochemistry of replication of animal viruses. Current advances, research concepts, and the role of viruses in molecular biology research.
- 821 Microbial Physiology**  
Fall of even years. 3(3-0) RB: (MMG 421) R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources. SA: MPH 821  
Molecular architecture, assembly of cell parts, metabolism, and general physiology of typical eubacteria.
- 825 Cell Structure and Function**  
Spring. 3(3-0) Interdepartmental with Biochemistry and Molecular Biology; Physiology. Administered by Department of Biochemistry and Molecular Biology. RB: BMB 401 or BMB 461. SA: BCH 825  
Molecular basis of structure and function. Cell properties: reproduction, dynamic organization, integration, programmed and integrative information transfer. Original investigations in all five kingdoms.
- 827 Diversity of Prokaryotes**  
Fall of odd years. 3(3-0) RB: (BMB 461 and MMG 421 or concurrently) R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources. SA: MPH 827  
Morphological and physiological properties of groups of bacteria and archaea. Relationship of those properties to ecological niche and importance.
- 829 Advanced Microbial Ecology**  
Spring of odd years. 3(3-0) Interdepartmental with Crop and Soil Sciences.  
Functional roles of microorganisms, their population dynamics and interactions, and their mechanisms of evolutionary change in natural communities, laboratory experiments, and mathematical models.
- 833 Microbial Genetics**  
Fall. 3(3-0) R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources. SA: MPH 833  
Gene structure and function. Genetic regulation at classical and molecular levels in prokaryotes and lower eukaryotes.
- 835 Eukaryotic Molecular Genetics**  
Spring. 3(3-0) Interdepartmental with Genetics. RB: (BMB 462 and ZOL 341) R: Open only to graduate students in the colleges of Agriculture and Natural Resources, Engineering, Human Medicine, Natural Science, Osteopathic Medicine, and Veterinary Medicine.  
Gene structure and function in animals, plants, and fungi. Basic aspects of modern human genetics and the genetic basis for disease. Molecular genetic analyses. Eukaryotic modeling systems.
- 841 Soil Microbiology**  
Spring of even years. 3(3-0) Interdepartmental with Crop and Soil Sciences. RB: (MMG 425) SA: MPH 841  
Ecology, physiology, and biochemistry of microorganisms indigenous to soil.

- 851 Immunology**  
Fall of odd years. 3(3-0) R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources. SA: MPH 851  
Functional aspects of immune responses; synthesis, structure, and function of effector molecules; cell-cell interactions; current advances and research techniques.
- 855 Molecular Evolution: Principles and Techniques**  
Fall of odd years. 3(3-0) Interdepartmental with Zoology; Plant Biology. Administered by Department of Zoology. RB: (ZOL 341 or ZOL 445)  
Current techniques used to characterize and compare genes and genomes. Genetic variation, assays of variation. Data analysis and computer use to conduct a phylogenetic analysis to compare organisms and infer relationships.
- 861 Advanced Microbial Pathogenesis**  
Spring of odd years. 3(3-0) RB: (MMG 461 or MMG 409)  
Molecular basis of microbial virulence. Virulence factors of microorganisms and the relationship of these factors to disease; host-pathogen interactions.
- 890 Special Problems in Microbiology**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources. Approval of department. SA: MPH 890  
Individualized laboratory or library research.
- 892 Seminar**  
Fall, Spring. 1(1-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in College of Agriculture and Natural Resources, College of Engineering, College of Human Medicine, College of Natural Science, College of Osteopathic Medicine, or College of Veterinary Medicine. SA: MPH 892  
Student review and presentation of selected topics in microbiology and public health.
- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to graduate students in Microbiology and Public Health. SA: MPH 899  
Master's thesis research.
- 991 Topics in Microbiology**  
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. SA: MPH 991  
Topics are selected from traditional subdisciplines such as bacteriology, virology, cell biology, and immunology or from transecting subdisciplines such as microbial genetics, physiology, molecular biology and ecology.
- 999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course. R: Open only to graduate students in Microbiology and Molecular Genetics. SA: MPH 999  
Doctoral dissertation research.

## MILITARY SCIENCE MS

### Department of Military Science Office of the Provost

- 101B Leadership: The Military Profession**  
Spring. 1(1-2) SA: MS 101 Not open to students with credit in MS 101A.  
Introduction to military leadership and fundamental concepts of leadership. Application of leadership doctrine. The role of the U.S. Army, Army Reserves, and National Guard. Leadership laboratory introduces basic military skills.
- 110 Army Leadership and Officer Development**  
Fall. 1 to 2 credits. SA: MS 101, MS 101A Not open to students with credit in MS 101B.  
Duties and responsibilities of the Army officer and noncommissioned officer. Organizational structure of the Army, Army Reserve, and National Guard. The Army's role in joint operations. Introduction to Army values, leadership, customs, and traditions.
- 120 Introduction to Army Leadership and Problem Solving**  
Spring. 1 to 2 credits. RB: (MS 101A or MS 101B)  
Fundamentals of basic Army leadership. Military problem solving process. Military briefing and writing skills. Goal setting and time management. Introduction to the Army's developmental counseling program.
- 201B Leadership: The Military Leader**  
Spring. 1(1-2) SA: MS 201 Not open to students with credit in MS 201A.  
Introduction to effective leadership. Communications. Value of the United States Army. Responsibilities of military officers and professionalism. Laboratory includes tactics, marksmanship training, and military skills.
- 210 Values and Ethics of Army Leaders**  
Fall. 1 to 2 credits. RB: (MS 120) SA: MS 201, MS 201A Not open to students with credit in MS 201B.  
Application of military case studies. Critical dilemmas in combat situations and the ethical decisions Army leaders make to ensure mission success. Understanding how to improve Army organizations and soldier performance. Introduction to the Army's leadership development program, battle drills, land navigation, and combat decision making.
- 220 Challenges in Army Leadership**  
Spring. 1 to 2 credits. RB: (MS 201A or MS 201B) Not open to students with credit in MS 202A or MS 202B.  
Application of military case studies. Recognizing challenging situations for military leaders and units. Applying sound ethical leadership practices to implement decisions. Understanding basic military small unit tactics.

- 310 Leading and Problem Solving in Army Units**  
Fall. 3 to 4 credits. RB: (MS 101B or MS 110) and (MS 120) and (MS 201B or MS 210) and (MS 220) Completion of basic training, or the leader training course. SA: MS 301  
Planning and executing military activities in small Army units. Recognizing and analyzing problems in challenging situations. Implementing the skills required to communicate decisions and supervise subordinates. Applying fundamentals of map reading and land navigation.
- 320 Army Small Unit Tactics and Leadership**  
Spring. 3 to 4 credits. RB: (MS 310) SA: MS 302  
Fundamentals of military tactics and battle drills. Applying troop leading procedures to military tactical operations. Implementing tactical skills and making decisions to lead small Army units on the battlefield. Integrate terrain analysis into military planning and operations.
- 410 Adaptive Army Leadership**  
Fall. 3 to 4 credits. RB: (MS 320) SA: MS 401  
Application of military case studies. Skills and attributes military leaders use to make decisions in combat situations. Practical exercises in problem solving and crisis counseling. Fundamentals of Army Training Management, the military justice system, and the law of land warfare.
- 420 Army Leadership in a Complex World**  
Spring. 3 to 4 credits. RB: (MS 410) SA: MS 402  
Application of military case studies to the principles of the law of land warfare, and rules of engagement in the face of international terrorism. Importance of ethics in military leadership. Integration of the media into military operations. Evaluation of interaction with non-governmental organizations, civilians, and host nation support on the battlefield.
- 490 Independent Study in Military Science**  
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Open only to juniors or seniors. Approval of department.  
Individual research in areas related to military science.

## MUSIC

## MUS

### School of Music College of Arts and Letters

- 112 Chamber Music**  
Fall, Spring. 1(0-2) A student may earn a maximum of 10 credits in all enrollments for this course. R: Open only to students in the School of Music.  
Rehearsal and performance of a broad range of chamber music literature.
- 113 Philharmonic Orchestra**  
Fall, Spring. 1(0-5) A student may earn a maximum of 10 credits in all enrollments for this course. RB: High school and/or youth orchestra experience/or other college or university ensemble experience R: Audition required.  
Rehearsal and performance of symphonic and operatic repertoire.