

# Microbiology

Interdepartmental Undergraduate Major

## Undergraduate Study

Undergraduate study for the bachelor of science degree with a major in microbiology. In the Microbiology curriculum, principal emphasis is placed on understanding microorganisms and their interrelationships with other organisms in nature, the application of microbiology in medicine, agriculture and industry, and the study of fundamental life processes as exemplified by microorganisms. Some fields of microbiology, especially advanced research, may require further training. Undergraduate work in the program is designed to provide sound preparation for graduate study, training for bachelors-level employment, and admission to professional programs such as medicine, veterinary medicine and dentistry.

Graduates of the Interdepartmental Undergraduate Microbiology Program will learn about the diversity and complexity of microbial life represented by prokaryotes, eucaryotes and viruses. In addition to being able to explain fundamental principles of microbial growth, physiology, genetics, biochemistry, and ecology, students will be able to evaluate the impact that the microbial world has on human, animal and plant health, as well as on environmental quality, industry and biotechnology. Graduates are able to design and implement experimental approaches to address specific questions. In addition, graduates are able to communicate scientifically, using a variety of media.

Students graduating in microbiology find career opportunities in a wide variety of areas including: hospital and clinical laboratories; federal, state, and local government agencies; research and development; dairy and food processing industries; and the pharmaceutical and fermentation industries.

Preveterinary preparation may be accomplished through the curriculum major in this program (see College of Veterinary Medicine, Admission Requirements ).

## Minor

The program offers a minor in microbiology which may be earned by accumulating a minimum of 15 credits of microbiology courses.

## Graduate Study

The program offers work for the degrees master of science and doctor of philosophy in microbiology and for a minor for students majoring in other programs. The interdepartmental microbiology major is offered through faculty housed in twelve departments, including Agronomy; Animal Science; Biochemistry, Biophysics and Molecular Biology; Civil, Construction and Environmental Engineering; Entomology; Food Science and Human Nutrition; Genetics, Developmental and Cell Biology; Geological and Atmospheric Sciences; Plant Pathology and Microbiology; Veterinary Diagnostic and Production Animal Medicine; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology. Faculty coordinate graduate education and research in a wide range of topics fundamental to the discipline of microbiology. Specific information about individual faculty and their research areas is available at [www.micro.iastate.edu](http://www.micro.iastate.edu).

Prerequisites to graduate study include a sound undergraduate background in chemistry, mathematics and biology, including microbiology and genetics.

Graduates in the Microbiology Graduate program have a broad-based knowledge in the fundamentals of microbiology as well as advanced knowledge in specific areas as determined by their areas of research focus. Students completing the thesis have the technical, research, critical-thinking, problem-solving, and computer skills to design, implement, and conduct research using a variety of current techniques and equipment. They are also able to communicate research results effectively with scientific peer groups in both oral and written formats.

## Curriculum in Microbiology

[www.micro.iastate.edu](http://www.micro.iastate.edu)

Administered by an interdepartmental committee.

**Total Degree Requirement: 128 cr.**

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

**International Perspective: 3 cr.**

**U.S. Diversity: 3 cr.**

**Electives: 7-12**

**Communications Proficiency:**

English composition - with a C or better	6
Speech fundamentals - with a C or better	3

**Communication/Library:**

ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3
SP CM 212	Fundamentals of Public Speaking	3
One course from the following:		3
ENGL 302	Business Communication	
ENGL 309	Report and Proposal Writing	
ENGL 312	Biological Communication	
ENGL 314	Technical Communication	
LIB 160	Information Literacy	1

Total Credits 13

**Humanities and Social Sciences:**

Approved Humanities list	3
Approved Social Science list	3

**Ethics: 3 cr.**

3 cr. from approved list.

**Mathematical Sciences:**

One of the following:		7-8
MATH 142 & MATH 160	Trigonometry and Analytic Geometry and Survey of Calculus	
MATH 165 & MATH 166	Calculus I and Calculus II	
MATH 181 & MATH 182	Calculus and Mathematical Modeling for the Life Sciences I and Calculus and Mathematical Modeling for the Life Sciences II	
One of the following:		3-4
STAT 101	Principles of Statistics	
STAT 104	Introduction to Statistics	

Total Credits 10-12

**Physical Sciences:**

CHEM 177	General Chemistry I	4
CHEM 177L	Laboratory in General Chemistry I	1
CHEM 178	General Chemistry II	3
PHYS 111	General Physics	5
PHYS 112	General Physics	5
CHEM 331	Organic Chemistry I	3
CHEM 331L	Laboratory in Organic Chemistry I	1
CHEM 332	Organic Chemistry II	3
One of the following:		3-6
BBMB 404 & BBMB 405 or BBMB 301	Biochemistry I and Biochemistry II and Survey of Biochemistry	

Total Credits 28-31

**Biological Sciences:**

BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
BIOL 313	Principles of Genetics	3
BIOL 313L	Genetics Laboratory	1
BIOL 314	Principles of Molecular Cell Biology	3

Total Credits 15

**Microbiology:**

Core courses:

MICRO 110	Orientation in Microbiology	0.5
MICRO 302	Biology of Microorganisms	3
MICRO 302L	Microbiology Laboratory	1
MICRO 310	Medical Microbiology	3
MICRO 310L	Medical Microbiology Laboratory	1
MICRO 320	Molecular and Cellular Bacteriology	4
MICRO 440	Laboratory in Microbial Physiology, Diversity, and Genetics	4
MICRO 450	Undergraduate Seminar	2
MICRO 451	Senior Survey in Microbiology	R
One of the following:		3
MICRO 430	Prokaryotic Diversity and Ecology	
MICRO 456	Principles of Mycology	
MICRO 477	Bacterial-Plant Interactions	
Nine credit hours from the following:		9
MICRO 374	Insects and Our Health	
MICRO 402	Microbial Genetics and Genomics	
MICRO 407	Microbiological Safety of Foods of Animal Origins	
MICRO 408	Virology	
MICRO 419	Foodborne Hazards	
MICRO 420	Food Microbiology	
MICRO 421	Food Microbiology Laboratory	
MICRO 456	Principles of Mycology	
MICRO 475	Immunology	
MICRO 475L	Immunology Laboratory	
MICRO 485	Soil and Environmental Microbiology	
MICRO 487	Microbial Ecology	
MICRO 490	Independent Study	
V PTH 478	Medical Protozoology	
Microbiology elective - only 3 cr. lab courses allowed		
Total Credits		30.5

**Courses primarily for undergraduates:****MICRO 101. Microbial World.**(3-0) Cr. 3. F. *Prereq: High school biology or equivalent*

Introduction to the importance of viruses, bacteria, fungi, archaea and parasites both to humans and to the biosphere. Topics include past and present microbial impact on humans and society, ecology and diversity of microbes, biotechnology and microbial impact on the biosphere.

**MICRO 110. Orientation in Microbiology.**

(1-0) Cr. 0.5. F.

Orientation to the discipline of microbiology, the curriculum in microbiology, and educational research opportunities within the department. Offered on a satisfactory-fail basis only.

**MICRO 201. Introduction to Microbiology.**(2-0) Cr. 2. F.S. *Prereq: One semester of college-level biology*

Selected topics in microbiology with emphasis on the relationship of microorganisms to human and animal health, agricultural technology, and the environment. With written petition to the chair of the supervisory committee, students who obtain a grade of B or better may substitute 201 for 302 in advanced courses.

**MICRO 201L. Introductory Microbiology Laboratory.**

(0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in MICRO 201 or MICRO 302*  
Basic microbiology laboratory techniques for non-microbiology majors. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

**MICRO 302. Biology of Microorganisms.**(3-0) Cr. 3. F.S. *Prereq: BIOL 211, credit or enrollment in BIOL 212; 1 semester of chemistry*

Basic cell biology, physiology, metabolism, genetics and ecology of microorganisms, with an emphasis on prokaryotes and viruses, as well as the roles of microorganisms in the environment, disease, agriculture, and industry.

**MICRO 302L. Microbiology Laboratory.**(0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in MICRO 302*

Basic microbiology laboratory techniques for majors in microbiology, biological sciences and related fields. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

**MICRO 310. Medical Microbiology.**(3-0) Cr. 3. F. *Prereq: MICRO 302 (or MICRO 201 if a B or better was obtained)*

Study of infection and immunity by bacterial and viral pathogenic agents of humans. Nonmajor graduate credit.

**MICRO 310L. Medical Microbiology Laboratory.**(0-3) Cr. 1. F. *Prereq: MICRO 201 or MICRO 302; MICRO 201L or MICRO 302L, credit or enrollment in MICRO 310*

Isolation and identification of human bacterial pathogens using basic staining techniques and biochemical tests. Brief introduction to techniques in cell culture and virology.

**MICRO 320. Molecular and Cellular Bacteriology.**(4-0) Cr. 4. S. *Prereq: MICRO 302, BIOL 313, credit or enrollment in CHEM 332*

Introductory course integrating physiological and genetic principles influencing bacterial growth, survival, and cellular differentiation. Emphasis is on prokaryotes although unicellular eukaryotes are also discussed. Topics include the structure, function, and assembly of cell components, bioenergetics and metabolism, regulation of gene expression, genetic adaptation, stress tolerance, biofilms, and cell-cell interactions and communication.

**MICRO 353. Introductory Parasitology.**(Cross-listed with BIOL, V PTH). (3-0) Cr. 3. S. *Prereq: BIOL 212*

Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

**MICRO 374. Insects and Our Health.**

(Cross-listed with ENT). (3-0) Cr. 3. S. *Prereq: 3 credits in biological sciences*  
Bartholomay. Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease. Nonmajor graduate credit.

Meets International Perspectives Requirement.

**MICRO 374L. Insects and Our Health Laboratory.**(Cross-listed with ENT). (0-3) Cr. 1. Alt. S., offered 2014. *Prereq: Credit or enrollment in ENT 374*

Bartholomay. Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

**MICRO 381. Environmental Systems I: Introduction to Environmental Systems.**

(Dual-listed with MICRO 581). (Cross-listed with BIOL, ENV S, ENSCI). Cr. 3-4. F.

*Prereq: 12 credits of natural science including biology and chemistry*  
Introduction to the structure and function of natural environmental systems. Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

**MICRO 402. Microbial Genetics and Genomics.**(Dual-listed with MICRO 502). (3-0) Cr. 3. Alt. F., offered 2012. *Prereq: MICRO 302, Biol 313*

The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

**MICRO 407. Microbiological Safety of Foods of Animal Origins.**(Dual-listed with MICRO 507). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq: MICRO 420*

Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

**MICRO 408. Virology.**(Dual-listed with MICRO 508). (3-0) Cr. 3. F. *Prereq: BIOL 313 or BBMB 301, BIOL 314 recommended*

The molecular virology and epidemiology of human, animal, plant and insect viruses.

**MICRO 410. Insect-Virus Interactions: a Molecular Perspective.**

(Dual-listed with MICRO 510). (Cross-listed with ENT). (3-0) Cr. 3. Alt. F., offered 2013. *Prereq: Permission of an instructor.*

Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

**MICRO 419. Foodborne Hazards.**

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: MICRO 201 or MICRO 302, a course in biochemistry*

Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Nonmajor graduate credit. Only one of FS HN 419 and FS HN 519 may count toward graduation.

**MICRO 420. Food Microbiology.**

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. F. *Prereq: MICRO 201 or MICRO 302*

Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

**MICRO 421. Food Microbiology Laboratory.**

(Cross-listed with FS HN). (0-6) Cr. 3. F. *Prereq: MICRO 201 or MICRO 302; MICRO 201L or MICRO 302L. Credit or enrollment in FS HN/MICRO 420*

Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction. Nonmajor graduate credit.

**MICRO 430. Prokaryotic Diversity and Ecology.**

(Dual-listed with MICRO 530). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: MICRO 302, MICRO 302L*

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

**MICRO 440. Laboratory in Microbial Physiology, Diversity, and Genetics.**

(Cross-listed with BBMB). (2-6) Cr. 4. F. *Prereq: MICRO 302, MICRO 302L, CHEM 332, BIOL 313L*

Study of the fundamental techniques and theory of studying the cellular mechanisms and diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for the phylogenetic characterization, and genetic manipulation of diverse species of bacteria.

**MICRO 450. Undergraduate Seminar.**

(2-0) Cr. 2. S. *Prereq: SP CM 212 and senior standing in Microbiology*  
Required of all undergraduate majors in microbiology. Discussion of current papers in microbiology and immunology, issues in scientific conduct, and bioethics in microbiology. Students present current papers in a journal club format and gain experience in writing grant proposals.

**MICRO 451. Senior Survey in Microbiology.**

Cr. R. F. *Prereq: Junior or Senior standing in Microbiology*

Preparations for graduation. Topics include job search strategies, career information, mock interviews, graduate and professional school application processes and guidelines as well as outcomes assessment activities.

**MICRO 456. Principles of Mycology.**

(Cross-listed with BIOL). (2-3) Cr. 3. F. *Prereq: 10 credits in biological sciences*  
Morphology, diversity, and ecology of fungi; their relation to agriculture, industry, and human health. Nonmajor graduate credit.

**MICRO 475. Immunology.**

(Cross-listed with V MPM). (3-0) Cr. 3. S. *Prereq: MICRO 310*

An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 475 or V MPM 520, but not both, may be applied to graduation.

**MICRO 475L. Immunology Laboratory.**

(1-4) Cr. 1. S. *Prereq: Credit or enrollment in MICRO 475 or MICRO 575*

Techniques in primary culture and tumor cell growth, measures of lymphocyte function, and flow cytometry. Half semester course.

**MICRO 477. Bacterial-Plant Interactions.**

(Dual-listed with MICRO 577). (Cross-listed with PL P). (3-0) Cr. 3. Alt. S., offered 2014. *Prereq: 3 credits in microbiology or plant pathology*

Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth promotion, and biological control.

**MICRO 478. Medical Protozoology.**

(Dual-listed with MICRO 578). (Cross-listed with ENT, V PTH). (2-1) Cr. 3. F. *Prereq: MICRO 302 or BIOL 314, or equivalent*

Medically important protozoa: their ecology and biology and the diseases they cause in humans and animals. Emphasis is on the protozoa, with some consideration of parasitic nematodes. Topics include: infection and immunity, computational biology/bioinformatics, unique/special subcellular systems (pathways and organelles), vector-parasite-host interactions, disease prevention/treatment strategies, developmental biology. Nonmajor graduate credit.

**MICRO 485. Soil and Environmental Microbiology.**

(Dual-listed with MICRO 585). (Cross-listed with ENSCI, AGRON). (2-3) Cr. 3. F. *Prereq: AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)*

Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

**MICRO 487. Microbial Ecology.**

(Dual-listed with MICRO 587). (Cross-listed with ENSCI, BIOL). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry*

Dual-listed with EEOB 587. Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems. Nonmajor graduate credit.

**MICRO 490. Independent Study.**

Cr. 1-5. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor*  
A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

**MICRO 490H. Independent Study, Honors.**

Cr. 1-5. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor*  
A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

**MICRO 495. Internship.**

Cr. 1-2. F.S. *Prereq: At least 6 credits of 300-level or above coursework in microbiology, approval of academic adviser*

Participation in the Cooperative Extension Intern Program or an equivalent work experience. Written report of activities required. Offered on a satisfactory-fail basis only.

**Courses primarily for graduate students, open to qualified undergraduates:****MICRO 502. Microbial Genetics and Genomics.**

(Dual-listed with MICRO 402). (3-0) Cr. 3. Alt. F., offered 2012. *Prereq: MICRO 302, BIOL 313*

The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

**MICRO 507. Microbiological Safety of Foods of Animal Origins.**

(Dual-listed with MICRO 407). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq: MICRO 420*

Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

**MICRO 508. Virology.**

(Dual-listed with MICRO 408). (3-0) Cr. 3. F. *Prereq: BIOL 313 or BBMB 301, BIOL 314 recommended*

The molecular virology and epidemiology of human, animal, plant, and insect viruses.

**MICRO 509. Plant Virology.**

(Cross-listed with PL P). (2-6) Cr. 4. Alt. S., offered 2013. *Prereq: PL P 408, BIOL 454, BBMB 405, CHEM 211*

Hill. Plant viruses and the diseases they cause. Emphasis on epidemiology and control. Structure, function, and biochemical-biophysical properties of plant viruses.

**MICRO 510. Insect-Virus Interactions: a Molecular Perspective.**

(Dual-listed with MICRO 410). (Cross-listed with ENT). (3-0) Cr. 3. Alt. F., offered 2013. *Prereq: Permission of an instructor*

Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

**MICRO 530. Prokaryotic Diversity and Ecology.**

(Dual-listed with MICRO 430). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: MICRO 302, MICRO 302L*

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

**MICRO 540. Livestock Immunogenetics.**

(Cross-listed with AN S, V MPM). (2-0) Cr. 2. Alt. S., offered 2013. *Prereq: AN S 561 or MICRO 575 or V MPM 520*

Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

**MICRO 551. Microbial Diversity and Phylogeny.**

(1-0) Cr. 1. F. *Prereq: MICRO 302, BIOL 313*

Comparisons among the three kingdoms of life (Bacteria, Archaea, and Eukarya). Topics will include metabolism, adaptation, methods of phylogenetic analysis, and comparative genomics.

**MICRO 552. Bacterial Molecular Genetics and Physiology.**

(1-0) Cr. 1. F. *Prereq: MICRO 302, BIOL 313*

Review of the molecular genetics and physiology of model organisms.

**MICRO 553. Pathogenic Microorganisms.**

(1-0) Cr. 1. F. *Prereq: MICRO 302, BIOL 313*

Review and contrast/comparison of common bacterial pathogens of plants and animals and their mechanisms of virulence, including toxins, protein secretion, host invasion and iron acquisition strategies. An overview of eukaryotic cell biology that is relevant to pathogenesis will also be included.

**MICRO 554. Virology.**

(1-0) Cr. 1. S. *Prereq: MICRO 302, BIOL 313*

Introduction to virus life cycles including entry, gene expression strategies, replication, and mechanisms to modify and overcome host defenses. The roles of specific viruses and sub-viral agents in animal and plant disease will also be included.

**MICRO 555. Fungal Biology.**

(1-0) Cr. 1. S. *Prereq: MICRO 302, BIOL 313*

Ecology, genetics, physiology and diversity of fungi, from yeasts to mushrooms, and their importance in human affairs.

**MICRO 556. Microbial Ecology and Environmental Monitoring.**

(1-0) Cr. 1. S. *Prereq: MICRO 302, BIOL 313*

Examination of microorganisms in their natural habitats, including aquatic, terrestrial and extreme environments, community and biofilm development, microbe-microbe interactions, and current and traditional methods of microbial analysis in natural environments.

**MICRO 575. Immunology.**

(3-0) Cr. 3. S. *Prereq: MICRO 310*

An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 575 or V MPM 520, but not both, may be applied toward graduation.

**MICRO 577. Bacterial-Plant Interactions.**

(Dual-listed with MICRO 477). (Cross-listed with PL P). (3-1) Cr. 3. Alt. S., offered 2014. *Prereq: 3 credits in microbiology or plant pathology*

Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth and biological control.

**MICRO 578. Medical Protozoology.**

(Dual-listed with MICRO 478). (Cross-listed with ENT, V PTH). (2-1) Cr. 3. F. *Prereq: MICRO 302 or BIOL 314, or equivalent*

Medically important protozoa: their ecology and biology and the diseases they cause in humans and animals. Emphasis is on the protozoa, with some consideration of parasitic nematodes. Topics include: infection and immunity, computational biology/bioinformatics, unique/special subcellular systems (pathways and organelles), vector-parasite-host interactions, disease prevention/treatment strategies, developmental biology. Nonmajor graduate credit.

**MICRO 581. Environmental Systems I: Introduction to Environmental Systems.**

(Dual-listed with MICRO 381). (Cross-listed with BIOL, ENV S, ENSCI). Cr. 3-4. F. *Prereq: 12 credits of natural science including biology and chemistry*

Introduction to the structure and function of natural environmental systems. Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

**MICRO 585. Soil and Environmental Microbiology.**

(Dual-listed with MICRO 485). (Cross-listed with ENSCI, AGRON). (2-3) Cr. 3. F. *Prereq: AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)*

Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

**MICRO 586. Medical Bacteriology.**

(Cross-listed with V MPM). (4-0) Cr. 4. F. *Prereq: Permission of instructor*

Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

**MICRO 587. Microbial Ecology.**

(Dual-listed with MICRO 487). (Cross-listed with ENSCI, EEOB). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry*

(Dual-listed with Biol 487.) Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

**MICRO 590. Special Topics.**

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

**Courses for graduate students:****MICRO 604. Seminar.**

(1-0) Cr. 1. Repeatable. F.S.

Course will expose students to the breadth of subdisciplines within microbiology, offer opportunities for direct interaction between the students and the faculty members within the Interdepartmental Microbiology Graduate Program, and promote interactions among the students within the program. Offered on a satisfactory-fail basis only.

**MICRO 608. Molecular Virology.**

(Cross-listed with V MPM, PL P). (3-0) Cr. 3. Alt. F., offered 2014. *Prereq: BBMB 405 or GDCB 511*

Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

**MICRO 615. Molecular Immunology.**

(Cross-listed with BBMB, V MPM). (3-0) Cr. 3. Alt. F., offered 2013. *Prereq: BBMB 405 or BBMB 502*

Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signaling pathways leading to expression of genes that control and activate immune function.

**MICRO 625. Mechanisms of Bacterial Pathogenesis.**

(Cross-listed with V MPM). (4-0) Cr. 4. Alt. S., offered 2013. *Prereq: Credit in Biochemistry and Microbiology*

Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

**MICRO 626. Advanced Food Microbiology.**

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: FS HN 420 or FS HN 421 or FS HN 504*

Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

**MICRO 627. Rapid Methods in Food Microbiology.**

(Cross-listed with FS HN, TOX). (2-0) Cr. 2. Alt. S., offered 2012. *Prereq: FS HN 420 or FS HN 421 or FS HN 504*

Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

**MICRO 679. Light Microscopy.**

(Cross-listed with GDCB, EEOB). (2-9) Cr. 5. *Prereq: Permission of instructor*  
Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and digital macro- and micrography. Limit of 10 students.

**MICRO 680. Scanning Electron Microscopy.**

(Cross-listed with GDCB, EEOB). (2-9) Cr. 5. *Prereq: Permission of instructor*  
Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation. Limit of 10 students.

**MICRO 681. Transmission Electron Microscopy.**

(Cross-listed with GDCB, EEOB). (2-9) Cr. 5. *Prereq: GDCB 679 and permission of instructor*

Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation.

**MICRO 685. Advanced Soil Biochemistry.**

(Cross-listed with AGRON, ENSCI). (2-0) Cr. 2. Alt. S., offered 2012. *Prereq: AGRON 585*

Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

**MICRO 690. Current Topics.**

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*  
Colloquia or advanced study of specific topics in a specialized field.

**MICRO 690A. Current Topics: Microbiology.**

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*  
Colloquia or advanced study of specific topics in a specialized field.

**MICRO 690B. Current Topics: Immunology.**

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*  
Colloquia or advanced study of specific topics in a specialized field.

**MICRO 690C. Current Topics: Infectious Diseases.**

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*  
Colloquia or advanced study of specific topics in a specialized field.

**MICRO 692. Molecular Biology of Plant-Pathogen Interactions.**

(Cross-listed with PL P). (3-0) Cr. 3. Alt. F., offered 2012. *Prereq: PL P 506 or BBMB 405 or GEN 411 or MICRO 402 or strong background in molecular biology*  
Bogdanove, Whitham. Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete an interinstitutional research proposal writing and peer review exercise.

**MICRO 697. Graduate Research Rotation.**

Cr. arr. Repeatable. F.S.  
Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Microbiology major.

**MICRO 698. Seminar in Molecular, Cellular, and Developmental Biology.**

(Cross-listed with BBMB, GDCB, MCDB, V MPM). (2-0) Cr. 1-2. Repeatable. F.S.  
Student and faculty presentations.

**MICRO 699. Research.**

Cr. arr. Repeatable.