Microbiology and Immunology

Chair

- Li Wu

Director, Undergraduate Studies

- Aloysius J. Klingelhutz

Director, Graduate Studies

- Craig D. Ellermeier

Undergraduate major: microbiology (BS)

Undergraduate minor: microbiology

Graduate degrees: MS in microbiology; PhD in microbiology

Faculty: https://microbiology.medicine.uiowa.edu/profile/leadership

Website: https://microbiology.medicine.uiowa.edu/

Study in the Department of Microbiology and Immunology is dedicated to the branch of biological sciences that investigates the smallest living things: microbes that include bacteria, archaea, fungi, algae, protozoa, and viruses. It is coupled with immunology that includes the study of the protective responses of higher organisms to disease-causing microbes and cancers, and mistakes in immune function. Microbiology and immunology often interact in humans through the microbiome, those microbes that live with humans on their skin and mucosal surfaces, and yet must be restricted from causing diseases by the immune system.

Microbiology and immunology are at the forefront of the modern biological revolution. Microbes are experimental subjects of choice for examining genetic and biological phenomena because of their small size, rapid growth rate, relative simplicity, and variety of characteristics that allow them to cause many kinds of infections and alter normal body functions. Immunology often makes use of microbes and cancer cells to study the critical and complex human responses to eliminate microbes and cancers. A significant portion of contemporary biochemical research employs microbiological and immunological methods.

Current research is making theoretical and practical advances concerning microbes that infect animals, including humans, and the immune response to those microbes; the use of comparative genomics, gene expression profiling, and recombinant DNA methods to analyze biological processes and generate valuable products, such as antibiotics and antibodies; genetics and regulation of metabolic processes; and the genetics and regulation of the immune response, including characterization of mechanisms used by microbes to signal one another and characterization of interactions between different types of immune cells and their targets.

The Department of Microbiology and Immunology offers an undergraduate major and a minor, and graduate majors leading to an MS and a PhD, and determines the curricula for those programs. Undergraduates majoring in microbiology receive their degrees (Bachelor of Science) from the College of Liberal Arts and Sciences and are governed by that college's undergraduate academic policies. The graduate degrees are awarded by the Graduate College.

Programs

Undergraduate Programs of Study

Major

- Major in Microbiology (Bachelor of Science)

Minor

- Minor in Microbiology

Graduate Programs of Study

- Master of Science in Microbiology
- Doctor of Philosophy in Microbiology

Facilities

The Department of Microbiology and Immunology is situated on the University of Iowa health sciences campus, where it shares the Bowen Science Building with the departments of Anatomy and Cell Biology, Biochemistry and Molecular Biology, Molecular Physiology and Biophysics, and Neuroscience and Pharmacology. Laboratory space and modern equipment are available for teaching and research.

Courses

Microbiology and Immunology Courses

MICR:2157 General Microbiology **3 s.h.**
Principles of bacterial and viral diversity, structure, genetics, physiology, and metabolism in contexts of molecular biology, immunology, infectious disease, and environmental microbiology; for students majoring in microbiology and biology-related fields and students pursuing health professions and research-focused graduate programs. Prerequisites: BIOL:1411 and CHEM:1110.

MICR:2158 General Microbiology Laboratory **2 s.h.**
Practice of basic techniques commonly used today for study of easy-to-grow microorganisms; variety of individual and group lab activities that challenge students to apply observations about bacteria and viruses. Corequisites: MICR:2157, if not taken as a prerequisite.

MICR:3145 Honors in Microbiology Thesis Preparation **1 s.h.**
Guidance and constructive criticism on written and oral presentation of honors research project; submission of thesis introduction; multiple presentations and updates of research project in preparation for final oral presentation at departmental Undergraduate Research Symposium; for honors in the major students and taken final semester before graduation. Prerequisites: MICR:4171.

MICR:3147 Immunology and Human Disease **3 s.h.**
Important principles and key concepts in immunology with a focus on the involvement of the immune system in disease pathogenesis; overview of innate and adaptive immune systems and their functions at cellular and molecular levels. Prerequisites: BIOL:1412 with a minimum grade of C or MICR:2157 with a minimum grade of C.

MICR:3159 Bacteria and Human Disease 3 s.h.
Infection and replication strategies of diverse bacteria with an emphasis on how host-pathogen interactions facilitate disease and pathogenesis. For students interested in microbiology or other biological sciences including epidemiology and/or health-related occupations. Prerequisites: MICR:2157 with a minimum grade of C.

MICR:3162 Bacterial Physiology and Cell Biology 2 s.h.
Bacterial physiology and its consequences for health and disease; examines the structure, metabolism, growth, and regulatory mechanisms of bacteria, focusing on how they acquire energy and nutrients to live and reproduce. Students will integrate biochemistry, genetics, and cell biology to gain an appreciation for the fundamental processes that drive bacterial life and discuss how these fundamental life processes dictate interactions with the microbial world. Prerequisites: MICR:2157 with a minimum grade of C.

MICR:3164 Microbiology and Human Health 4 s.h.
Microbiology for nursing, pharmacy, and certain other health professions. Prerequisites: (BIOL:1411 or BIOL:1140 or BIOL:1141 with a minimum grade of C) and (CHEM:1070 or CHEM:1110 with a minimum grade of C).

MICR:3165 Genetics of Bacterial Pathogens Lab and Discussion 3 s.h.
Use of bacterial genetics and molecular biology techniques and methodologies to study bacteria which cause human disease; development of skills in data analysis and presentation, reading scientific literature, and writing scientific abstracts; for students interested in microbiology or other biological sciences, epidemiology, and/or health-related occupations. Prerequisites: MICR:2157 with a minimum grade of C and MICR:2158 with a minimum grade of C. Corequisites: MICR:3159 or MICR:3170, if not taken as a prerequisite.

MICR:3168 Viruses and Human Disease 3 s.h.
Infection and replication strategies of viruses with an emphasis on human disease; for microbiology majors as well as students interested in pre-medicine, biological sciences, epidemiology, and/or other health-related occupations. Prerequisites: BIOL:1412 with a minimum grade of C or MICR:2157 with a minimum grade of C. Recommendations: basic understanding of molecular biology and immunology.

MICR:3170 Bacterial Genetics 3 s.h.
Genetics of bacteria and bacteriophages including classical, molecular, and genome-wide approaches. Prerequisites: BIOL:2512 with a minimum grade of C or MICR:2157 with a minimum grade of C.

MICR:3177 Virology Discussion 2 s.h.
Students read, present, and discuss papers from virology literature that address classic and current issues in virology research. Students will learn how to critically evaluate and present methods and results from virology research papers. Prerequisites: MICR:3168 with a minimum grade of C.

MICR:3178 Virology Laboratory 2 s.h.
Practical approaches to studying viruses; basic techniques in virology including virus detection, virus growth measurement, and virus genetics; introduction to bioinformatic analysis of virus genomes and infections. Prerequisites: MICR:2157 with a minimum grade of C and MICR:2158 with a minimum grade of C. Corequisites: MICR:3168 (if not taken as a prerequisite).

MICR:3182 From Data to Discovery: Hands-On Code-Free Computational Biology 2 s.h.
Learning and applying user-friendly and coding-free computational tools to analyze and manipulate protein structures, analyze large datasets of DNA and protein sequences, and utilize machine learning algorithms to computationally address biological questions. Prerequisites: BIOL:1411 with a minimum grade of C and CHEM:1110 with a minimum grade of C. Recommendations: major in biomedical science-related field.

MICR:4161 Undergraduate Research in Microbiology arr.
Experimental research under faculty supervision. Prerequisites: BIOL:1411.

MICR:4171 Honors Undergraduate Research in Microbiology arr.
Experimental research under faculty supervision. Prerequisites: BIOL:1411. Requirements: microbiology major, junior or senior standing, 3.33 overall GPA, and 3.33 GPA in microbiology courses.

MICR:4175 Topics in Parasitism 1 s.h.
Molecular and immunologic mechanisms by which bacteria, viruses, and protozoa cause human diseases; based on manuscript readings and/or student presentations. Requirements: junior or higher standing in microbiology or related discipline, and current or prior research in a microbiology and immunology laboratory.

MICR:5218 Microscopy for Biomedical Research arr.
Basic microscopy methods for research including optics, preparation, and analysis of biomedical specimens; light, fluorescence, confocal, transmitting electron, scanning electron, atomic force microscopes, elemental analysis; immunochemistry and stereology techniques; individualized laboratory instruction. Prerequisites: BIOL:2723. Same as ACB:5218, BIOL:5218.

MICR:5264 Directed Study in Microbiology arr.
Advanced-level experimental research or teaching under faculty supervision.

MICR:5875 Perspectives in Biotechnology 1 s.h.
Topics related to careers in biotechnology with an emphasis on preparing graduate students for careers outside of academia; discussions led by a series of guest speakers from leading biotech industries; understanding the societal impact of basic research; participation in round-table discussions; and presentation of student research findings. Requirements: graduate standing and good academic standing in a participating department supported by the Predoctoral Training Program in Biotechnology. Same as BMB:5875, CBE:5875, CEE:5875, CHEM:5875, PHAR:5875.

MICR:6201 Graduate Immunology 3 s.h.
Immune cell ontogeny, activation, and function of T lymphocytes and B lymphocytes; innate immune effector mechanisms; major histocompatibility complex; antigen presentation; thymocyte positive and negative selection; signaling of T lymphocytes and B lymphocytes; emphasis on experimental methods for analysis of these processes and how they have led to current advanced concepts in immunology. Prerequisites: MICR:3147 or MICR:6247. Requirements: for IMMU:6201—college biology, general chemistry, and introductory immunology courses; for MICR:6201—courses in college biology, genetics, general chemistry, and introductory immunology. Recommendations: for IMMU:6201—courses in biochemistry and genetics; for MICR:6201—biochemistry course. Same as IMMU:6201.

MICR:6247 Graduate Immunology and Human Disease 4 s.h.
Important principles and key concepts in immunology with a focus on the involvement of the immune system in disease pathogenesis; overview of innate and adaptive immune systems and their functions at cellular and molecular levels; learning enhanced by case-based, small-group discussion and writing exercises. Same as IMMU:6247.

MICR:6250 Mechanisms of Parasitism Journal Club 1 s.h.
Reviews of recent publications in molecular parasitology research and thesis research by training grant or journal club students; for students pursuing graduate thesis research in microbiology or a related discipline. Same as MMED:6250.

MICR:6255 Graduate Experimental Approaches to Molecular Microbiology 2 s.h.
Exposure to common experimental approaches through examination of primary literature and facilitated discussions on application of those approaches to advance scientific inquiry. Requirements: microbiology graduate standing.

MICR:6259 Graduate Bacteria and Human Disease 3-4 s.h.
Infection and replication strategies of diverse bacteria with an emphasis on human disease and interactions with the host and environment.

MICR:6262 Graduate Bacterial Physiology and Cell Biology 2 s.h.
Bacterial physiology and its consequences for health and disease; examines the structure, metabolism, growth, and regulatory mechanisms of bacteria, focusing on how they acquire energy and nutrients to live and reproduce. Students will integrate biochemistry, genetics, and cell biology to gain an appreciation for the fundamental processes that drive bacterial life and discuss how these fundamental life processes dictate interactions with the microbial world.

MICR:6265 Introduction to Grant Writing 2 s.h.
How to think and write like scientists and become familiar with the elements of a research proposal; writing a grant proposal modeled on a National Institutes of Health Exploratory/ Developmental Research Grant Award (NIH R21); students critique proposals written by other students; faculty read proposals and provide constructive criticism; lectures describe elements of a grant proposal and strategies for effective writing. Requirements: enrollment in microbiology graduate program, or enrollment in a graduate program training in a microbiology and immunology department laboratory, or enrollment in a biological science graduate program and not working in a microbiology and immunology department laboratory for thesis project.

MICR:6267 Graduate Viruses and Human Disease 3 s.h.
Infection and replication strategies of viruses with an emphasis on human disease. Recommendations: concurrent enrollment in MICR:6269.

MICR:6268 Biology and Pathogenesis of Viruses 2 s.h.
Molecular biology of animal DNA and RNA viruses, viral immunology and pathogenesis, and interaction of these viruses with eukaryotic cells; mechanisms of viral latency, persistence, cellular transformation, oncogenesis; virology literature. Prerequisites: MICR:3168 or MICR:6267.

MICR:6269 Graduate Virology Discussion 1 s.h.
Discussion of primary virology literature from a range of topics, may include techniques used for studying viruses, viral entry and replication, evasion of immune responses by viruses, vaccines, and viral pathogenesis; short presentations; development of specific aims for a mock grant proposal on a virology-related topic. Recommendations: completion of a virology course.

MICR:6270 Graduate Bacterial Genetics 3 s.h.
Genetics of bacteria and bacteriophages including classical, molecular, and genome-wide approaches.

MICR:6282 Graduate From Data to Discovery: Hands-On Code-Free Computational Biology 2 s.h.
Learning and applying user-friendly and coding-free computational tools to analyze and manipulate protein structures, analyze large datasets of DNA and protein sequences, and utilize machine learning algorithms to computationally address biological questions.

MICR:6310 Biology of Bacteria and Interactions With the Host 2 s.h.
Discussion of primary literature based on molecular biology of bacteria, bacterial pathogenesis, bacterial gene regulation and stress responses, bacterial cell biology, bacterial behaviors, antimicrobial resistance, interaction of bacteria with host cells, interactions of bacteria with immune system; how bacteria adapt to different environments, including in a eukaryotic host or complex polymicrobial community. Requirements: microbiology graduate standing. Recommendations: MICR:6270 or MICR:6259.

MICR:7207 Advanced Topics in Immunology 3 s.h.
In-depth analysis of selected areas. Prerequisites: IMMU:6201 or MICR:6201. Same as IMMU:7221.

MICR:7261 Graduate Research in Microbiology arr.
Requirements: microbiology graduate standing.

MICR:7263 Graduate Student Research Seminar 1 s.h.
Presentation of thesis work in progress. Requirements: microbiology graduate standing.

MICR:7265 Topics in Virology Literature 1 s.h.
Papers of current interest in primary virology literature.

MICR:8230 Dental Microbiology 3 s.h.
Medical microbiology: bacteriology, immunology, pathogenic bacteriology, virology, mycology, parasitology. Requirements: DDS enrollment.

MICR:8402 Teaching Elective in Microbiology 2 s.h.
Expand knowledge and understanding in medical education by preparing and implementing five teaching interactions with year two medical and physician assistant students (M2/PA2) during the microbiology lab portion of MED:8223. Students can also develop interactive classroom exercises or sessions to improve memory and develop critical analysis skills. Requirements: MD standing and enrollment in teaching distinction track.