Microbiology

Chair
• Patrick M. Schlievert

Undergraduate major: microbiology (B.S.)
Undergraduate minor: microbiology
Graduate degrees: M.S. in microbiology; Ph.D. in microbiology
Faculty: http://www.medicine.uiowa.edu/dept_primary_apr.aspx?appointment=Microbiology
Web site: http://www.medicine.uiowa.edu/microbiology/

Study in the Department of Microbiology is dedicated to the branch of biological sciences that deals with the smallest living things: bacteria, archaea, fungi, algae, protozoa, and viruses. It is coupled with immunology, the study of the response of higher organisms to foreign substances.

Microbiology and immunology are at the forefront of the modern biological revolution. Microbes are often the experimental subjects of choice for examining basic genetic and biological phenomena because of their small size, rapid growth rate, and relative simplicity. A significant portion of contemporary biochemical research employs microbiological and immunological methods.

Current research is making theoretical and practical advances concerning microbial species and viruses that infect animals, including man, plants, and other microbes; the use of comparative genomics, gene expression profiling, and recombinant DNA methods to analyze basic biological processes and generate valuable products; the nature and occurrence of microbial life in extreme or unusual environments; microbial synthesis and modification of antibiotics and other natural products; the role of microbes in stabilization of the biosphere by recycling and detoxifying waste products; the genetics and regulation of the immune response, including characterization of mechanisms used by bacteria to signal one another and characterization of interactions between different types of immune cells and their targets.

The Department of Microbiology offers an undergraduate major, an undergraduate minor, and graduate degree programs 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. Graduate degrees in microbiology are conferred by the Graduate College.

Undergraduate Programs of Study

• Major in microbiology (Bachelor of Science)
• Minor in microbiology

Microbiology is an excellent major for undergraduate students who want a good general education with emphasis on an important and interesting branch of biological sciences. Graduates find employment opportunities in government, hospitals, public health laboratories, research laboratories, and industrial laboratories (food, dairy, chemical, pharmaceutical, and biotechnology companies). Those who pursue advanced degrees have more advanced career opportunities in these same areas as well as in college and university teaching.

Bachelor of Science

The Bachelor of Science with a major in microbiology requires a minimum of 120 s.h., including 63-64 s.h. of work for the major (21 s.h. in microbiology and 42-43 s.h. in supporting course work). Students must maintain a g.p.a. of at least 2.00 in all courses for the major and in all UI courses for the major. They also must complete the College of Liberal Arts and Sciences General Education Program.

Students must complete at least 12 s.h. of the required 21 s.h. in microbiology courses at the University of Iowa.

The major in microbiology requires the following course work.

M ICROBI OLOGY COURSES

Students earn 21 s.h. in microbiology courses, as follows.

MICR:2157 General Microbiology (with a grade of C or higher) 5 s.h.
MICR:4163 Seminar: Microbiology (taken during the last two semesters before graduation) 2 s.h.

Additional microbiology courses, with at least 14 s.h. in courses numbered MICR:3147 or above, excluding MICR:3164 and MICR:5220 14 s.h.

Students must earn a grade of C or higher in MICR:2157 in order to take more advanced microbiology courses.

Students must take MICR:4163 once for credit during their last two semesters before graduation. They may apply a maximum of 2 s.h. earned in the course toward the major, but they are encouraged to take it for 0 s.h. during other semesters after they have completed MICR:2157.

A maximum of 4 s.h. earned in MICR:4161 Undergraduate Research in Microbiology may be counted toward the major. However, honors students must complete 23 s.h. of microbiology courses for the major and may count 6 s.h. earned in MICR:4171 Honors Undergraduate Research in Microbiology; see “Honors in the Major” below.

SUPPORTING COURSE WORK

In addition to the required 21 s.h. in microbiology, the major requires the supporting course work listed below. These courses may not be taken pass/nonpass.

All of these:

BIOC:3120 & BIOL:3310 Biochemistry and Molecular Biology I-II 6 s.h.
BIOL:1411-BIOL:1412 Foundations of Biology - Diversity of Form and Function 8 s.h.
CHEM:1110 & CHEM:1120 Principles of Chemistry I-II 8 s.h.
CHEM:2210 & CHEM:2220 Organic Chemistry I-II 6 s.h.
CHEM:2410 Organic Chemistry Laboratory 3 s.h.

One of these sequences:

PHYS:1511-PHYS:1512 College Physics I-II 8 s.h.
PHYS:1611-PHYS:1612 Introductory Physics I-II 8 s.h.
The joint program permits students to count 12 s.h. of credit toward both the B.S. and Ph.D. degree requirements before they have been granted the B.S. degree. Contact the Department of Microbiology for more information.

**Minor**

The minor in microbiology requires a minimum of 15 s.h. in microbiology courses, including 12 s.h. in courses considered advanced for the minor taken at the University of Iowa. Courses numbered MICR:3147 Survey of Immunology and above are considered advanced for the minor, except MICR:3164 Nursing Microbiology. Students must maintain a g.p.a. of at least 2.00 in all courses for the minor and in all UI courses for the minor. Course work in the minor may not be taken pass/nonpass.

Students may count a maximum of 2 s.h. earned in MICR:4161 Undergraduate Research in Microbiology or MICR:4171 Honors Undergraduate Research in Microbiology and a maximum of 2 s.h. earned in MICR:4163 Seminar: Microbiology toward the minor. They may count MICR:5218 Microscopy for Biomedical Research toward the minor but not MICR:5220 Advanced Microscopy for Biomedical Research.

**Graduate Programs of Study**

- Master of Science in microbiology
- Doctor of Philosophy in microbiology

Graduate study in microbiology is designed to help students become highly qualified in microbiology research and teaching. Admitted graduate students usually pursue the Ph.D.

Graduate study is offered in six subdisciplines: pathogenic bacteriology, microbial genetics, immunology, microbial physiology, animal virology, and bioinformatics. Several areas involve interdisciplinary training both within and outside the department, so students gain broad experience during their course of study. Students also may pursue interdisciplinary Ph.D. programs in genetics, immunology, and molecular and cellular biology.

During their first year, students rotate in up to three laboratories of their choice and are advised by the Graduate Student Advisory Committee. At the end of May of the first year, they choose a research supervisor who chairs their advisory committee. The committee provides intellectual and research guidance for the student's training.

The Department of Microbiology cooperates with other University of Iowa departments to give students ample access to diverse course offerings, seminars, and research programs. For example, microbiology students may participate in courses and seminars in immunology, genetics, molecular and cellular biology, biocatalysis/biotechnology, and electron microscopy.

All students admitted to advanced degree programs are expected to assist in departmental teaching.

**Master of Science**

The Master of Science program in microbiology requires a minimum of 30 s.h. of graduate credit. M.S. students are required to earn a minimum of 12 s.h. in microbiology courses chosen from three of the department's six subdisciplines. They may substitute a course they have already taken (at the University of Iowa or elsewhere) for a course requirement, with the M.S. advisory committee's
approval. Additional course requirements depend on students' interests and the advice of the examining committee.

Students must write a thesis based on their own research and defend it satisfactorily in an oral examination. No more than 9 s.h. of credit for thesis research may be counted toward the 30 s.h. required for the Master of Science.

Doctor of Philosophy

The Doctor of Philosophy program in microbiology requires a minimum of 72 s.h. of graduate credit. Ph.D. students are required to earn approximately 10 s.h. of credit in graduate-level microbiology courses. They may substitute a course they have already taken (at the University of Iowa or elsewhere) for a course requirement, with the Ph.D. advisory committee's approval.

Students must pass a comprehensive examination before the end of their fourth semester in the program and write a thesis based on their own research. The thesis must be defended satisfactorily in an oral examination.

Admission

Applicants must meet the admission requirements of the Graduate College; see the Manual of Rules and Regulations of the Graduate College. They should have a cumulative g.p.a. of at least 3.00 and must have completed courses in biology, chemistry (inorganic and organic), mathematics including calculus, and physics. Those admitted with deficiencies must complete the relevant course work during their first year of graduate study. Admission is determined through a review and formal vote by the faculty. Preference is given to students applying for the Ph.D. program.

Facilities

The Department of Microbiology 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, Molecular Physiology and Biophysics, and Pharmacology. Laboratory space and modern equipment are available for teaching and research.

Courses

Lower-Level Undergraduate

**MICR:1006 The Microbial World** 3 s.h.
Basic principles of microbial world for nonscience majors; introduction to bacteria, viruses, and fungi; how they differ from more complex cells, how they are found in every environment on earth and on every human body, their uses to benefit humans, their ability to cause illness in humans and animals.

**MICR:2157 General Microbiology** 5 s.h.
Principles of bacterial and viral diversity, structure, genetics, physiology and metabolism; in contexts of molecular biology, immunology, infectious disease, and environmental microbiology; laboratory emphasis on basic techniques. Prerequisites: BIOL:1411.

Upper-Level Undergraduate and Graduate

**MICR:3112 Pharmacy Microbiology** 4 s.h.
Medical microbiology: bacteriology, immunology, pathogenic bacteriology, virology, mycology, parasitology. Requirements: pre-pharmacy standing.

**MICR:3147 Survey of Immunology** 3 s.h.
Important principles and key concepts in immunology; overview of innate and adaptive immune systems and their functions at cellular and molecular levels. Prerequisites: MICR:2157.

**MICR:3159 Pathogenic Bacteriology** 5 s.h.
Pathogenic bacteria with emphasis on mechanisms of pathogenicity and structure-function; laboratory methods for isolation and identification with emphasis on advanced methods of experimentation. Requirements: grade of C or higher in MICR:2157.

**MICR:3160 Microbial Physiology** 3 s.h.
Bacterial genomes, cell structure, growth, energy metabolism, biosynthesis, mechanisms of signal transduction and regulation. Requirements: biochemistry course and grade of C or higher in MICR:2157.

**MICR:3164 Nursing Microbiology** 4 s.h.
Overview of bacteria, viruses, and eukaryotic microorganisms that cause human disease; microbial structure, growth control and reproduction; immunology in the context of host defense mechanisms. Prerequisites: BIOL:1140 or BIOL:1141 or BIOL:1411. Requirements: pre-nursing standing.

**MICR:3168 Introduction to Animal Viruses** 3 s.h.
Physical, chemical, and biological properties of animal viruses with emphasis on their remarkable strategies for infection and replication and their association with human disease; how to read primary literature. Requirements: grade of C or higher in MICR:2157.

**MICR:3170 Microbial Genetics** 3 s.h.
Genetics of bacteria, bacteriophages. Requirements: grade of C or higher in BIOL:2512 or MICR:2157.

**MICR:3175 Microbial Genetics Laboratory** 3 s.h.
Introductory research experience in bacterial genetics; students generate original data, formulate hypotheses, design and interpret experiments, read primary literature, and write a scientific manuscript on findings. Corequisites: MICR:3170 or MICR:3179, if not taken as a prerequisite.

**MICR:3178 Animal Viruses Laboratory** 2 s.h.
Basic techniques and approaches in animal virology, including virus detection, virus growth measurement, and virus genetics. Corequisites: MICR:3168. Requirements: grade of C or higher in MICR:2157.
MICR:3179 Bacterial Diversity 3 s.h.
Physiological and biochemical basis of microbial diversity; focus on synthetic and systems biology with primary emphasis on roles of small regulatory RNAs and their affects on development of diverse microbial populations, including human microbiome. Prerequisites: MICR:3170 and BIOL:3120.

MICR:3190 Web-Based Nursing Microbiology 4 s.h.
Nursing microbiology, principles of immunology; web-based instruction. Prerequisites: BIOL:1140 or BIOL:1141 or BIOL:1411. Requirements: pre-nursing standing.

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

MICR:4163 Seminar: Microbiology 2 s.h.
Current topics in microbiology, immunology, and virology. Requirements: senior standing and grades of C or higher in at least two of these — MICR:3147 or MICR:3159 or MICR:3160 or MICR:3168 or MICR:3170 or MICR:3179.

MICR:4169 Topics in Viral Biology and Pathogenesis 1 s.h.
Topics include viral life cycles, immune response, antiviral treatments, potential for vaccine, animal models; lectures introducing subject matter; discussion of literature relevant to each week's topic. Prerequisites: MICR:3168.

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 g.p.a., and 3.33 g.p.a. in microbiology courses.

Graduate

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:5220 Advanced Microscopy for Biomedical Research arr.
Technically advanced microscopy and instrumentation for research; individualized laboratory experience with opportunity to explore applications of microscopy methods. Requirements: for ACB:5220 — an introductory microscopy course; for BIOL:5220 — ACB:4156 or ACB:5218 or CBE:4156 or EE:4156 or MICR:5218; for MICR:5220 — an introductory EM course. Same as BIOL:5220, ACB:5220.

MICR:5264 Directed Study in Microbiology arr.

MICR:5875 Perspectives in Biocatalysis 1-3 s.h.
Applied enzymology, protein design, structure-activity relationships, biosensor technology, microbial transformations, biodegradation of environmental pollutants. Requirements: graduate standing in a participating department supported by the Predoctoral Training Program in Biotechnology. Same as CHEM:5875, PHAR:5875, CBE:5875, CEE:5875, BIOL:5875.

MICR:6201 Graduate Immunology 3 s.h.
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, B lymphocytes; emphasis on experimental methods for analysis of these processes. 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 Survey of Immunology 4 s.h.
Important principles and key concepts in immunology; overview of innate and adaptive immune systems and their functions at cellular and molecular levels; learning enhanced by case-based, small-group discussion and written assignment. 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. Same as MCB:6250.

MICR:6259 Graduate Pathogenic Bacteriology 3 s.h.
Pathogenic bacteria with emphasis on mechanisms of pathogenicity, structure-function, and experimental design.

MICR:6260 Graduate Microbial Physiology 3 s.h.
Bacterial genomes, cell structure, growth, energy metabolism, biosynthesis, mechanisms of signal transduction and regulation.

MICR:6267 Graduate Introduction to Animal Viruses 3 s.h.
Physical, chemical, and biological properties of animal viruses with emphasis on their remarkable strategies for infection and replication and their association with human disease; focus on topics and techniques used in primary literature and development of specific aims for a mini-proposal.

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 eucaryotic cells; mechanisms of viral latency, persistence, cellular transformation, oncogenesis; virology literature. Prerequisites: MICR:3168 or MICR:6267.
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
<td>MICR:6270</td>
<td>Graduate Microbial Genetics</td>
<td>3 s.h.</td>
<td>Genetics of bacteria, bacteriophages.</td>
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<tr>
<td>MICR:6279</td>
<td>Graduate Bacterial Diversity</td>
<td>3 s.h.</td>
<td>Physiological and biochemical basis of microbial diversity; focus on synthetic and systems biology with primary emphasis on roles of small regulatory RNAs and their effects on development of diverse microbial populations, including human microbiome; design and presentation of primary research abstracts.</td>
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<tr>
<td>MICR:7207</td>
<td>Advanced Topics in Immunology</td>
<td>3 s.h.</td>
<td>In-depth analysis of selected areas. Prerequisites: IMMU:6201 or MICR:6201. Same as IMMU:7221.</td>
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<tr>
<td>MICR:7217</td>
<td>Integrated Topics in Infectious Diseases</td>
<td>1 s.h.</td>
<td>Clinical cases used to raise questions in host-microbe interactions; case/scientific exposés followed by related journal club discussions at next class session. Same as IMMU:7217.</td>
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<tr>
<td>MICR:7221</td>
<td>Advanced Topics in Prokaryotic Biology Module 1</td>
<td>1-2 s.h.</td>
<td>Development of critical thinking, experimental approach and design, writing, and oral presentation skills through primary literature and course specific assignments (proposal writing, writing manuscript reviews, oral presentations, small group discussions). Requirements: graduate standing in microbiology.</td>
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<tr>
<td>MICR:7222</td>
<td>Advanced Topics in Prokaryotic Biology Module 2</td>
<td>1-2 s.h.</td>
<td>Development of critical thinking, experimental approach and design, writing, and oral presentation skills through exposure to primary literature and assignments (proposal writing, writing manuscript reviews, oral presentations, small group discussions). Requirements: graduate standing in microbiology.</td>
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<tr>
<td>MICR:7223</td>
<td>Advanced Topics in Prokaryotic Biology Module 3</td>
<td>1-2 s.h.</td>
<td>Development of critical thinking, experimental approach and design, writing, and oral presentation skills through exposure to selected topics in microbiology and assignments (proposal writing, writing manuscript reviews, oral presentations, small group discussions). Requirements: graduate standing in microbiology.</td>
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<tr>
<td>MICR:7224</td>
<td>Advanced Topics in Prokaryotic Biology Module 4</td>
<td>1-2 s.h.</td>
<td>Development of critical thinking, experimental approach and design, writing, and oral presentation skills through exposure to selected topics in microbiology and assignments (proposal writing, writing manuscript reviews, oral presentations, small group discussions). Requirements: graduate standing in microbiology.</td>
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<tr>
<td>MICR:7225</td>
<td>Advanced Topics in Prokaryotic Biology Module 5</td>
<td>1-2 s.h.</td>
<td>Development of critical thinking, experimental approach and design, writing, and oral presentation skills through exposure to selected topics in microbiology and assignments (proposal writing, writing manuscript reviews, oral presentations, small group discussions). Requirements: graduate standing in microbiology.</td>
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<tr>
<td>MICR:7226</td>
<td>Advanced Topics in Prokaryotic Biology Module 6</td>
<td>1-2 s.h.</td>
<td>Development of critical thinking, experimental approach and design, writing, and oral presentation skills through exposure to selected topics in microbiology and assignments (proposal writing, writing manuscript reviews, oral presentations, small group discussions). Requirements: graduate standing in microbiology.</td>
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<tr>
<td>MICR:7227</td>
<td>Advanced Topics in Microbiology</td>
<td>1 s.h.</td>
<td>Presentations by graduate students on selected research topics in microbiology; different topics each semester. Offered fall and spring semesters. Requirements: graduate standing in microbiology.</td>
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<tr>
<td>MICR:7261</td>
<td>Graduate Research in Microbiology</td>
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<td>Requirements: microbiology graduate standing.</td>
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<td>MICR:7263</td>
<td>Graduate Student Research Seminar</td>
<td>1 s.h.</td>
<td>Presentation of thesis work in progress. Requirements: microbiology graduate standing.</td>
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<td>MICR:7265</td>
<td>Topics in Virology Literature</td>
<td>1 s.h.</td>
<td>Papers of current interest in primary virology literature.</td>
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<td>MICR:7269</td>
<td>Graduate Topics in Viral Biology and Pathogenesis</td>
<td>1 s.h.</td>
<td>Topics include viral life cycles, immune response, antiviral treatments, potential for vaccine, animal models; lectures introducing subject matter; discussion of literature relevant to each week's topic. Prerequisites: MICR:6267.</td>
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<tr>
<td>MICR:8202</td>
<td>Principles of Infectious Diseases</td>
<td>5 s.h.</td>
<td>Principles and methods essential to study of microorganisms, their isolation and identification; microorganisms in infectious diseases; current immunology concepts. Requirements: M.D. enrollment.</td>
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