Microbiology, B.S. (L&S)

Microbiology, the study of microorganisms, helps us understand our world and solve major problems. Microorganisms, or microbes, were the first life forms on earth and influence our lives and our planet in innumerable ways. The field of microbiology is constantly expanding as we learn more about the role of microbes in infectious disease, environmental remediation, bioenergy, food safety, antibiotic resistance, biotechnology and much more. Communities of microbes (or "microbiomes") are critically important in human health, global warming, agricultural yield, criminal justice, economic development and other issues of national concern.

The microbiology major, offered by the Department of Bacteriology, is a rigorous path of study, providing a curriculum packed with deep knowledge on broad aspects of microbiology and emphasizing modern laboratory skills. The core courses focus on the diversity, genetics, biochemistry, and physiology of microorganisms. A variety of elective courses provide the opportunity to study environmental microbiology, food microbiology, microbial pathogenesis, immunology, virology, microbiomes and microbial biotechnology, as well as advanced topics in microbial genetics and physiology. In the instructional laboratory courses, students learn beginning through advanced laboratory techniques—gaining the type of hands-on experiences with modern equipment that employers and graduate schools seek. Additionally, students can conduct mentored and independent research projects in faculty laboratories.

The bachelor's degree provides a strong background in the biological sciences for students planning to enter medical, dental, veterinary or other professional schools, as well as those planning graduate studies in any branch of microbiology or other biological sciences such as biochemistry, pathology, or molecular cell biology.

Students who end their training with a bachelor's degree are well-prepared for a variety of career opportunities, including laboratory positions in pharmaceutical and biotechnology firms and in university and government laboratories. They also work as specialists in industrial quality testing and control, and as regulatory workers in government agencies and public health laboratories. Exposure to the scientific process as well as training in microbiology allows microbiology graduates to enter fields as diverse as business, technical service, sales, and technical writing.

How to Get In

Incoming or current students in good academic standing may declare the microbiology major at any time.

Schedule an appointment (https://calendar.wisc.edu/scheduling-assistant/schedule/RAUHTzyt/view.html;jsessionid=89D5FEA38114F159C48E4959F05B91E1.primary) with Katy France to discuss the microbiology major, appropriate coursework, how to declare, and so on.

Requirements

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatetestudytext) section of the Guide.

Requirements Detail

General Education

- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE BREADTH AND DEGREE REQUIREMENTS: BACHELOR OF SCIENCE (B.S.)

Students pursuing a bachelor of science degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum. View a comparison of the degree requirements here. (https://pubs.wisc.edu/home/archives/ug15/images/babs2009.pdf)

BACHELOR OF SCIENCE DEGREE REQUIREMENTS

Requirements Detail

Mathematics

- Two (2) 3+ credits of intermediate/advanced level MATH, COMP SCI, STAT
- Limit one each: COMP SCI, STAT

Foreign Language

- Complete the third unit of a foreign language
- Note: A unit is one year of high school work or one semester/term of college work.

L&S Breadth

- Humanities, 12 credits: 6 of the 12 credits must be in literature
- Social Sciences, 12 credits
- Natural Sciences, 12 credits: must include 6 credits in biological science; and must include 6 credits in physical science
Liberal Arts and Science Coursework

- 108 credits
- Depth of Intermediate/Advanced work: 60 intermediate or advanced credits
- Major: Declare and complete at least one (1) major
- Total Credits: 120 credits
- UW-Madison Experience: 30 credits in residence, overall
- Minimum GPAs: 2.000 in all coursework at UW–Madison
- 2.000 in intermediate/advanced coursework at UW–Madison

NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements and do not need to complete the L&S breadth and degree requirements above.

REQUIREMENTS FOR THE MAJOR

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 171</td>
<td>Calculus with Algebra and Trigonometry I</td>
<td>10</td>
</tr>
<tr>
<td>&amp; MATH 217</td>
<td>and Calculus with Algebra and Trigonometry II</td>
<td></td>
</tr>
<tr>
<td>MATH 211</td>
<td>Calculus</td>
<td>5</td>
</tr>
<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry 1</td>
<td>5</td>
</tr>
<tr>
<td>STAT 301</td>
<td>Introduction to Statistical Methods</td>
<td>3</td>
</tr>
<tr>
<td>STAT 371</td>
<td>Introductory Applied Statistics for the Life Sciences</td>
<td>3</td>
</tr>
<tr>
<td>STAT/B M I 541</td>
<td>Introduction to Biostatistics</td>
<td>3</td>
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</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>CHEM 103</td>
<td>General Chemistry I</td>
<td>9</td>
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<tr>
<td>&amp; CHEM 104</td>
<td>and General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 109</td>
<td>Advanced General Chemistry</td>
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**Statistics**

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 343</td>
<td>Introductory Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 344</td>
<td>Introductory Organic Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 345</td>
<td>Intermediate Organic Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

**Organic Chemistry**

**Microbiology Courses**

*Microbiology Core (all required):*

- Except where noted, all Microbiology Core courses are offered every fall and spring semester.
- MICROBIO 303: Biology of Microorganisms
- MICROBIO 304: Biology of Microorganisms Laboratory
- MICROBIO 305: Critical Analyses in Microbiology
- MICROBIO 450: Diversity, Ecology and Evolution of Microorganisms
- MICROBIO 470: Microbial Genetics & Molecular Machines
- MICROBIO 526: Physiology of Microorganisms
- MICROBIO 527: Advanced Laboratory Techniques in Microbiology (Note: fall only)

*Microbiology Capstone (required):*
MICROBIO 551  Capstone Research Project in Microbiology (Note: spring only)  2

**Microbiology Electives:**

Select at least 6 credits; at least 3 credits must come from Set A. Note that not all elective courses are offered every semester.

**Set A:**

- MICROBIO/FOOD SCI 324  Food Microbiology Laboratory  2
- MICROBIO/FOOD SCI 325  Food Microbiology  3
- MICROBIO 330  Host-Parasite Interactions  3
- MICROBIO 375  Special Topics (topics and pre-requisites vary by semester)  1-4
- MICROBIO/SOIL SCI 425  Environmental Microbiology  3
- MICROBIO/SOIL SCI 523  Soil Microbiology and Biochemistry  3
- MICROBIO/ONCOLOGY 545  Topics in Biotechnology (topics vary by semester)  1
- MICROBIO/GENETICS 607  Advanced Microbial Genetics  3
- MICROBIO/BIOCHEM/GENETICS 612  Prokaryotic Molecular Biology  3
- MICROBIO/ONCOLOGY/PL PATH 640  General Virology-Multiplication of Viruses  2
- MICROBIO/BOTANY/GENETICS/M M & I/PL PATH 655  Biology and Genetics of Fungi  3

**Set B:**

- BIOCHEM/ M M & I 575  Biology of Viruses  2
- BIOCHEM 601  Protein and Enzyme Structure and Function  2
- BOTANY 330  Algae  3
- BOTANY/PL PATH 332  Fungi  4
- BOTANY/ENTOM/PL PATH 505  Plant-Microbe Interactions: Molecular and Ecological Aspects  3
- CHEM 565  Biophysical Chemistry  4
- COMP SCI/B M I 576  Introduction to Bioinformatics  3
- F&W ECOL/SURG SCI 548  Diseases of Wildlife  3
- M M & I 301  Pathogenic Bacteriology  2
- M M & I 341  Immunology  3
- M M & I/ENTOM/PATH-BIO/ZOOLOGY 350  Parasitology  3
- M M & I 410  Medical Mycology  2
- M M & I 554  Emerging Infectious Diseases and Bioterrorism  2
- M M & I/BIOCHEM/GENETICS 612  Prokaryotic Molecular Biology  3

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<td>M M &amp; I/BIOCHEM 575</td>
<td>Biology of Viruses</td>
<td>2</td>
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<tr>
<td>M M &amp; I/POH HLTH 603</td>
<td>Clinical and Public Health Microbiology</td>
<td>5</td>
</tr>
<tr>
<td>MICROBIO/M M &amp; I/PATH-BIO 528</td>
<td>Immunology</td>
<td>3</td>
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</table>

**L&S RESIDENCE AND QUALITY OF WORK**

2.000 GPA in all MICROBIO courses and courses counting toward the major

2.000 GPA on 15 upper-level major credits, in residence

15 credits of MICROBIO or courses counting toward the major, taken on campus

1 MICROBIO 300 through 699 count as upper level in the major, excluding MICROBIO 303 and MICROBIO 304. Intermediate- and advanced-level courses outside of MICROBIO that count for the major are also considered upper level.

**HONORS IN THE MAJOR**

Students may declare Honors in the Microbiology Major in consultation with the Microbiology undergraduate advisor.

**HONORS IN THE MICROBIOLOGY MAJOR REQUIREMENTS**

To earn the B.A. or B.S. with Honors in the Major in Microbiology students must satisfy both the requirements for the major (above) and the following requirements:

- Earn a 3.300 overall university GPA
- Earn a 3.300 GPA for all MICROBIO courses, and all courses accepted in the major
- Complete 15 credits, taken for Honors, with individual grades of B or better. 6 credits must come from a two-semester Senior Honors Thesis in MICROBIO 681 Senior Honors Thesis and MICROBIO 682 Senior Honors Thesis. Select remaining courses from the following list:

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### UNIVERSITY DEGREE REQUIREMENTS

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<tr>
<th>Requirements</th>
<th>Detail</th>
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<tbody>
<tr>
<td><strong>Total Degree</strong></td>
<td>To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.</td>
</tr>
<tr>
<td><strong>Residency</strong></td>
<td>Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. &quot;In residence&quot; means on the UW–Madison campus with an undergraduate degree classification. &quot;In residence&quot; credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.</td>
</tr>
<tr>
<td><strong>Quality of Work</strong></td>
<td>Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.</td>
</tr>
</tbody>
</table>

### LEARNING OUTCOMES

1. Students will develop a fundamental understanding of the principles of microbiology and the necessary skills for a professional career in microbiology.
2. Students will apply the scientific method to questions. They will formulate a hypothesis, gather data, and analyze that data to assess the degree to which their work supports the hypothesis.
3. Students will demonstrate proficiency in the techniques used in microbiology and an ability to critically analyze data and integrate ideas for problem solving.
4. Students will be able to access the primary and secondary literature and, in combination with their own findings, effectively communicate their ideas both orally and in written form.
5. Students will learn about and demonstrate personal and professional ethics.

### ADVISING AND CAREERS

Current UW–Madison students can schedule initial advising ([https://calendar.wisc.edu/scheduling-assistant/schedule/RAUHT2Yt/view.html](https://calendar.wisc.edu/scheduling-assistant/schedule/RAUHT2Yt/view.html)) in the microbiology major with Katy France.

Prospective/future UW–Madison students should email (katy.france@wisc.edu) Katy France to set up an appointment, which can be conducted in person or via phone call.


Learn more about health-related careers through the ExploreHealthCareers.org ([https://explorehealthcareers.org](https://explorehealthcareers.org)) website.

### PEOPLE

Professors Charles Kaspar (chair), Jean-Michel Ané, Cameron Currie, Timothy Donohue, Marcin Filutowicz, Katrina Forest, Richard Gourse, Eric Johnson, John Mansfield, Katherine "Trina" McMahon, Michael Thomas, Karen Wassarman, and Jae-Hyuk Yu

Associate Professor Jue "Jade" Wang

Assistant Professors Daniel Amador-Noguez, Briana Burton, Federico Rey, Garret Suen, and Kalin Vetsigian