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, and molecular or 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=89D5F8A38114F159C48E4959F05B91E1.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

30 credits in residence after the 90th credit

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><strong>Mathematics</strong></td>
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<tr>
<td>Select one of the following:</td>
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<tr>
<td>MATH 171 &amp; MATH 217</td>
<td>Calculus with Algebra and Trigonometry I</td>
<td>10</td>
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<tr>
<td></td>
<td>and Calculus with Algebra and Trigonometry II</td>
<td></td>
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<tr>
<td>MATH 211</td>
<td>Calculus</td>
<td>5</td>
</tr>
<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry I</td>
<td>5</td>
</tr>
<tr>
<td><strong>Statistics</strong></td>
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<tr>
<td>Select one of the following:</td>
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<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>
</tr>
<tr>
<td><strong>General Chemistry</strong></td>
<td></td>
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<tr>
<td>Select one of the following:</td>
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<tr>
<td>CHEM 103 &amp; CHEM 104</td>
<td>General Chemistry I and General Chemistry II</td>
<td>9</td>
</tr>
<tr>
<td>CHEM 109</td>
<td>Advanced General Chemistry</td>
<td>5</td>
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<tr>
<td><strong>Organic Chemistry</strong></td>
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<tr>
<td>Select ALL of the following:</td>
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<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>
<tr>
<td><strong>Microbiology Courses</strong></td>
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<tr>
<td>Microbiology Core (all required):</td>
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<tr>
<td>Except where noted, all Microbiology Core courses are offered every fall and spring semester.</td>
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<tr>
<td>MICROBIO 303</td>
<td>Biology of Microorganisms</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO 304</td>
<td>Biology of Microorganisms Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>MICROBIO 305</td>
<td>Critical Analyses in Microbiology</td>
<td>1</td>
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<tr>
<td>MICROBIO 450</td>
<td>Diversity, Ecology and Evolution of Microorganisms</td>
<td>2</td>
</tr>
<tr>
<td>MICROBIO 470</td>
<td>Microbial Genetics &amp; Molecular Machines</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO 526</td>
<td>Physiology of Microorganisms</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO 527</td>
<td>Advanced Laboratory Techniques in Microbiology (Note: fall only)</td>
<td>2</td>
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</tbody>
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**Microbiology Capstone (required):**

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<tr>
<td>Select one of the following:</td>
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<tr>
<td>BIOLOGY/BOTANY/ ZOOLOGY 151 &amp; BIOLOGY/BOTANY/ ZOOLOGY 152</td>
<td>Introductory Biology and Introductory Biology</td>
<td>10</td>
</tr>
<tr>
<td>BIOCORE 381 &amp; BIOCORE 382 &amp; BIOCORE 383 &amp; BIOCORE 384 &amp; BIOCORE 385</td>
<td>Evolution, Ecology, and Genetics and Evolution, Ecology, and Genetics Laboratory and Cellular Biology and Cellular Biology Laboratory and Organismal Biology</td>
<td>13</td>
</tr>
<tr>
<td>BIOLOGY/ ZOOLOGY 101 &amp; BIOLOGY/ ZOOLOGY 102 &amp; BIOLOGY/ BOTANY 130</td>
<td>Animal Biology and Animal Biology Laboratory and General Botany</td>
<td>10</td>
</tr>
</tbody>
</table>

1 BIOLOGY/BOTANY/ZOOLOGY 151/BIOLOGY/BOTANY/ZOOLOGY 152 or BIOCORE 381/BIOCORE 382/BIOCORE 383/BIOCORE 384/BIOCORE 485 are recommended.
**Microbiology, B.S. (L&S)**

**MICROBIO 551**  
Physiological Diversity of Prokaryotes Laboratory (Note: spring only)  

**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  
- MICROBIO/FOOD SCI 325 Food Microbiology  
- MICROBIO 330 Host-Parasite Interactions  
- MICROBIO 375 Special Topics (topics and prerequisites vary by semester)  
- MICROBIO/SOIL SCI 425 Environmental Microbiology  
- MICROBIO/SOIL SCI 523 Soil Microbiology and Biochemistry  
- MICROBIO/ONCOLOGY 545 Topics in Biotechnology (topics vary by semester)  
- MICROBIO/GENETICS 607 Advanced Microbial Genetics  
- MICROBIO/BIOCHEM/GENETICS 612 Prokaryotic Molecular Biology  
- 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.

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

**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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<td>Biology of Microorganisms Laboratory</td>
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</tr>
<tr>
<td>MICROBIO 330</td>
<td>Host-Parasite Interactions</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO/ SOIL SCI 425</td>
<td>Environmental Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO 450</td>
<td>Diversity, Ecology and Evolution of Microorganisms</td>
<td>2</td>
</tr>
<tr>
<td>MICROBIO 470</td>
<td>Microbial Genetics &amp; Molecular Machines</td>
<td>3</td>
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<tr>
<td>MICROBIO 526</td>
<td>Physiology of Microorganisms</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO/M M &amp; I/ PATH-BIO 528</td>
<td>Immunology</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO/ GENETICS 607</td>
<td>Advanced Microbial Genetics</td>
<td>3</td>
</tr>
<tr>
<td>MICROBIO/ BIOCHEM/ GENETICS 612</td>
<td>Prokaryotic Molecular Biology</td>
<td>3</td>
</tr>
</tbody>
</table>
MICROBIO/PL PATH 622  Plant-Bacterial Interactions  2-3
MICROBIO 632  Industrial Microbiology/Biotechnology  2
MICROBIO/ONCOLOGY/PL PATH 640  General Virology-Multiplication of Viruses  3
MICROBIO/FOOD SCI 650  Advanced Microbiology of Foodborne Pathogens  3
MICROBIO/BMOLCHEM 668  Microbiology at Atomic Resolution  3

**UNIVERSITY DEGREE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Degree</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>Residency</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>Quality of Work</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/RAUHTzYt/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.

Read about and explore possible microbiology careers at the American Society for Microbiology (https://www.asm.org/index.php/learn-about-careers) website.

Learn more about health-related careers through the 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