### MICROBIOLOGY, B.A. (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/RAUHTYt/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/#requirementsforundergraduatestudystudenttext) section of the Guide.

**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 ARTS (B.A.)

Students pursuing a bachelor of arts 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 ARTS DEGREE REQUIREMENTS

**Mathematics**

- Fulfilled with completion of University General Education requirements Quantitative Reasoning a (QR A) and Quantitative Reasoning b (QR B) coursework. Please note that some majors may require students to complete additional math coursework beyond the B.A. mathematics requirement.

**Foreign Language**

- Complete the fourth unit of a foreign language; OR
- Complete the third unit of a foreign language and the second unit of an additional 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 one 3+ credit course in the biological sciences; must include one 3+ credit course in the physical sciences

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. Please note that the following special degree programs are not considered majors so are not available to non–L&S degree-seeking candidates:

- Applied Mathematics, Engineering and Physics (Bachelor of Science–Applied Mathematics, Engineering and Physics)
- Journalism (Bachelor of Arts–Journalism; Bachelor of Science–Journalism)
- Music (Bachelor of Music)
- Social Work (Bachelor of Social Work)

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>
<td></td>
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<tr>
<td>Select one of the following:</td>
<td></td>
<td>5-10</td>
</tr>
<tr>
<td>MATH 171 &amp; MATH 217</td>
<td>Calculus with Algebra and Trigonometry I and Calculus with Algebra and Trigonometry II</td>
<td></td>
</tr>
<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry I</td>
<td></td>
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<tr>
<td><strong>Statistics</strong></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Select one of the following:</td>
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<tr>
<td>STAT 301</td>
<td>Introduction to Statistical Methods</td>
<td></td>
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<tr>
<td>STAT 371</td>
<td>Introductory Applied Statistics for the Life Sciences</td>
<td></td>
</tr>
<tr>
<td>STAT/B M I 541</td>
<td>Introduction to Biostatistics</td>
<td></td>
</tr>
<tr>
<td><strong>General Chemistry</strong></td>
<td></td>
<td>5-9</td>
</tr>
<tr>
<td>Select one of the following: 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 103 &amp; CHEM 104</td>
<td>General Chemistry I and General Chemistry II</td>
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<tr>
<td><strong>Chemistry</strong></td>
<td></td>
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<tr>
<td>Select one of the following:</td>
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<tr>
<td>CHEM 109</td>
<td>Advanced General Chemistry</td>
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</table>

Organic Chemistry

Select ALL of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<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>
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</table>

Biology Foundation

Select one of the following: 10-13

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOLOGY/ BOTANY/ ZOOLOGY 151 &amp; BIOLOGY/ BOTANY/ ZOOLOGY 152</td>
<td>Introductory Biology and Introductory Biology</td>
<td>2</td>
</tr>
<tr>
<td>BIOCORE 381 &amp; BIOCORE 382 &amp; BIOCORE 383 &amp; BIOCORE 384 &amp; BIOCORE 485</td>
<td>Evolution, Ecology, and Genetics and Evolution, Ecology, and Genetics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>ZOOLOGY/ BIOLOGY 101 &amp; ZOOLOGY/ BIOLOGY 102 &amp; BOTANY/ BIOLOGY 130</td>
<td>Animal Biology and General Botany</td>
<td></td>
</tr>
</tbody>
</table>

Physics

Select one of the following: 8-10

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 103 &amp; PHYSICS 104</td>
<td>General Physics and General Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYSICS 207 &amp; PHYSICS 208</td>
<td>General Physics and General Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYSICS 201 &amp; PHYSICS 202</td>
<td>General Physics and General Physics</td>
<td></td>
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</tbody>
</table>

Biochemistry

Select one of the following: 3-6

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>BIOCHEM 501</td>
<td>Introduction to Biochemistry</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 507 &amp; BIOCHEM 508</td>
<td>General Biochemistry I and General Biochemistry II</td>
<td></td>
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</tbody>
</table>

Microbiology Courses

Microbiology Core (all required):

Except where noted, all Microbiology Core courses are offered every fall and spring semester.

<table>
<thead>
<tr>
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<tbody>
<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>
</tr>
<tr>
<td>MICROBIO 450</td>
<td>Diversity, Ecology and Evolution of Microorganisms</td>
<td>3</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 (FALL ONLY)</td>
<td>2</td>
</tr>
</tbody>
</table>

Microbiology Capstone (required):
MICROBIO 551 Capstone Research Project in Microbiology (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: 3-6
- MICROBIO/FOOD SCI 324 Food Microbiology Laboratory
- MICROBIO/FOOD SCI 325 Food Microbiology
- MICROBIO 330 Host-Parasite Interactions
- MICROBIO/SOIL SCI 425 Environmental Microbiology
- MICROBIO/SOIL SCI 523 Soil Microbiology and Biochemistry
- MICROBIO/M & I/PATH-BIO 528 Immunology
- MICROBIO/ONCOLOGY 545 Topics in Biotechnology (topics vary by semester)
- MICROBIO/GENETICS 607 Advanced Microbial Genetics
- MICROBIO/BIOCHEM/GENETICS 612 Prokaryotic Molecular Biology
- MICROBIO/PL PATH 622 Plant-Bacterial Interactions
- MICROBIO 632 Industrial Microbiology/Biotechnology
- MICROBIO/ONCOLOGY/PL PATH 640 General Virology-Multiplication of Viruses
- MICROBIO/BOTANY/GENETICS/M M & I/PL PATH 655 Biology and Genetics of Fungi
- MICROBIO/BMOLCHEM 668 Microbiology at Atomic Resolution

Set B: 0-3
- 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/BI M I 576 Introduction to Bioinformatics
- F&W ECOL/SURG SCI 548 Diseases of Wildlife
- FOOD SCI 550 Fermented Foods and Beverages
- M M & I 301 Pathogenic Bacteriology
- M M & I/ENTOM/PATH-BIO/ZOOLOGY 350 Parasitology
- M M & I 410 Medical Mycology
- M M & I 554 Emerging Infectious Diseases and Bioterrorism
- M M & I/POP HLTH 603 Clinical and Public Health
- Microbiology

Total Credits 64-87

1. The completion of CHEM 115 Chemical Principles I and CHEM 116 Chemical Principles II also satisfies the General Chemistry requirement.
2. (BIOLOGY/BOTANY/ZOOLOGY 151 and BIOLOGY/BOTANY/ZOOLOGY 152) or (BIOCORE 381 / BIOCORE 382 / BIOCORE 383 / BIOCORE 384 / BIOCORE 485) are recommended.
3. (PHYSICS 103 / PHYSICS 104) or (PHYSICS 207 / PHYSICS 208) are recommended.

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 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 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>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>
</tbody>
</table>
LEARNING OUTCOMES

1. Develop a fundamental understanding of the principles of microbiology and the necessary skills for a professional career in microbiology.

2. Apply the scientific method to questions. Formulate a hypothesis, gather data, and analyze that data to assess the degree to which their work supports the hypothesis.

3. Demonstrate proficiency in the techniques used in microbiology and an ability to critically analyze data and integrate ideas for problem solving.

4. Access the primary and secondary literature and, in combination with their own findings, effectively communicate their ideas both orally and in written form.

5. 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) in the microbiology major with Katy France.

Prospective/future UW–Madison students should send an email to Katy France, katy.france@wisc.edu, 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.

L&S CAREER RESOURCES

SuccessWorks at the College of Letters & Science helps students leverage the academic skills learned in their major, certificates, and liberal arts degree; explore and try out different career paths; participate in internships; prepare for the job search and/or graduate school applications; and network with professionals in the field (alumni and employers).

SuccessWorks can also assist students in career advising, résumé and cover letter writing, networking opportunities, and interview skills, as well as course offerings for undergraduates to begin their career exploration early in their undergraduate career.

- SuccessWorks (https://careers.ls.wisc.edu)
- Set up a career advising appointment (https://careers.ls.wisc.edu/make-an-appointment)
- INTER-LS 210 L&S Career Development: Taking Initiative (1 credit, targeted to first- and second-year students)—for more information, see Inter-LS 210: Career Development, Taking Initiative (https://careers.ls.wisc.edu/inter-ls-210-career-development-taking-initiative)
- Learn how we’re transforming career preparation: L&S Career Initiative (http://ls.wisc.edu/lsci)

PEOPLE

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

Associate Professor Garret Suen

Assistant Professors Daniel Amador-Noguez, Karthik Anantharaman, Briana Burton, Federico Rey, and Kalin Vetsigian