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 study 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

DECLARING THE MAJOR

Students may declare the major by meeting with the major advisor to discuss the requirements and a course plan.

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

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 30 credits in residence, overall

Experience 30 credits in residence after the 90th credit

Minimum 2,000 in all coursework at UW–Madison

GPAs 2,000 in intermediate/advanced coursework at UW–Madison

NON-L&S STUDENTS PURSUITING 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)

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.

**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.

### REQUIREMENTS FOR THE MAJOR

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td><strong>Mathematics</strong></td>
<td>Select one of the following: 5-10</td>
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<tr>
<td>MATH 171 &amp; MATH 217</td>
<td>Calculus with Algebra and Trigonometry I and Calculus with Algebra and Trigonometry II</td>
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<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry 1</td>
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<td><strong>Statistics</strong></td>
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<tr>
<td>STAT 301</td>
<td>Introduction to Statistical Methods</td>
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<tr>
<td>STAT 371</td>
<td>Introductory Applied Statistics for the Life Sciences</td>
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<tr>
<td>STAT/B M I 541</td>
<td>Introduction to Biostatistics</td>
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<tr>
<td><strong>General Chemistry</strong></td>
<td>Select one of the following: 1</td>
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<tr>
<td>CHEM 103 &amp; CHEM 104</td>
<td>General Chemistry I and General Chemistry II</td>
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<td>CHEM 109</td>
<td>Advanced General Chemistry</td>
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<td><strong>Organic Chemistry</strong></td>
<td>Select ALL of the following:</td>
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<td>CHEM 343</td>
<td>Introductory Organic Chemistry</td>
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<td>CHEM 344</td>
<td>Introductory Organic Chemistry Laboratory</td>
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<td>CHEM 345</td>
<td>Intermediate Organic Chemistry</td>
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<tr>
<td><strong>Biology Foundation</strong></td>
<td>Select one of the following: 10-13</td>
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<tr>
<td>BIOLOGY/ BOTANY/ ZOOLOGY 151 &amp; BIOLOGY/ BOTANY/ ZOOLOGY 152</td>
<td>Introductory Biology and Introductory Biology ²</td>
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<td><strong>Microbiology Courses</strong></td>
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<tr>
<td>MICROBIO 303</td>
<td>Biology of Microorganisms</td>
<td>3</td>
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<td>MICROBIO 304</td>
<td>Biology of Microorganisms Laboratory</td>
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<td>MICROBIO 305</td>
<td>Critical Analyses in Microbiology</td>
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<tr>
<td>MICROBIO 450</td>
<td>Diversity, Ecology and Evolution of Microorganisms</td>
<td>3</td>
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<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>
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<tr>
<td>MICROBIO 527</td>
<td>Advanced Laboratory Techniques in Microbiology (FALL ONLY)</td>
<td>2</td>
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<tr>
<td>MICROBIO Capstone (required):</td>
<td>_MICROBIO 551</td>
<td>Capstone Research Project in Microbiology (SPRING ONLY)</td>
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<td><strong>Microbiology Electives</strong></td>
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<td>MICROBIO/ FOOD SCI 324</td>
<td>Food Microbiology Laboratory</td>
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<td>MICROBIO/ FOOD SCI 325</td>
<td>Food Microbiology</td>
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<td>MICROBIO 330</td>
<td>Host-Parasite Interactions</td>
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<tr>
<td>MICROBIO 375</td>
<td>Special Topics</td>
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<td>MICROBIO/ SOIL SCI 425</td>
<td>Environmental Microbiology</td>
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</table>
MICROBIO/ SOIL SCI 523  Soil Microbiology and Biochemistry

MICROBIO/ M 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  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

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

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.

RESIDENCE AND QUALITY OF WORK

- 2.000 GPA in all MICROBIO courses and courses approved for 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

HONORS IN THE MAJOR

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

HONORS IN THE 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 University GPA
- Earn a 3.300 GPA for all courses accepted in the major
- MICROBIO 681 and MICROBIO 682 for a total of 6 credits
- 9 credits of Honors course work (with grade B or better) from:

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<tr>
<td>MICROBIO/M M &amp; I/ PATH-BIO 528</td>
<td>Immunology</td>
<td>3</td>
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<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>
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<td>Plant-Bacterial Interactions</td>
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<td>MICROBIO 632</td>
<td>Industrial Microbiology/Biotechnology</td>
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<td>MICROBIO/ ONCOLOGY/ PL PATH 640</td>
<td>General Virology-Multiplication of Viruses</td>
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UNIVERSITY DEGREE REQUIREMENTS

Total Degree
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.

Residency
Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

Quality of Work
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.

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.

FOUR-YEAR PLAN

SAMPLE MICROBIOLOGY FOUR-YEAR PLAN

Freshman
Fall Credits Spring Credits
CHEM 1031 4 CHEM 104 5
MATH 2212 5 BIOLOGY/BOTANY/ ZOOLOGY 1513 5
Communication A 3 Foreign Language (if needed) 4
Foreign Language (if needed) 4 Literature Breadth 3

Sophomore
Fall Credits Spring Credits
CHEM 343 3 CHEM 345 3
BIOLOGY/BOTANY/ ZOOLOGY 152 2
Directed Study / Research 2 MICROBIO 303 3
Ethnic Studies/Social Science 3 MICROBIO 305 1
Literature Breadth 3 Directed Study / Research 2
Social Science Breadth 3

Junior
Fall Credits Spring Credits
PHYSICS 1036 4 PHYSICS 104 4
BIOCHEM 5015 3 MICROBIO 450 3
MICROBIO 304 2 MICROBIO 526 3
MICROBIO 470 3 STAT 371 3
Directed Study / Research 2 Directed Study / Research 2

Senior
Fall Credits Spring Credits
MICROBIO 527 2 MICROBIO 551 2
Microbiology Elective- Set A 3 Microbiology Elective- Set B 3
Directed Study / Research 3 Directed Study / Research 3
Humanities Breadth 3 Humanities Breadth 3
Social Science Breadth 3 Social Science Breadth 3

Total Credits 120

1. There are two options to complete General Chemistry; consult the Requirements page for details.
2. Math course determined by placement scores. Consult the Requirements page for details about the math requirements for the major.
3. There are three options for completing Introductory Biology. Consult the Requirements page for details.
4. Students are encouraged to find and participate in Directed Study opportunities, in a faculty-mentored research lab, for several semesters.
5. Students interested in graduate study in the biological sciences are advised to take BIOCHEM 507 - BIOCHEM 508.

ADVISING AND CAREERS

Current UW–Madison students can schedule initial advising (https://calendar.wisc.edu/scheduling-assistant/schedule/RAUHT2YI/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/Careers/Career-Planning) 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). In short, SuccessWorks helps students in the College of Letters & Science discover themselves, find opportunities, and develop the skills they need for success after graduation.

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.

Students should set up their profiles in Handshake (https://careers.ls.wisc.edu/handshake) to take care of everything they need to explore career events, manage their campus interviews, and apply to jobs and internships from 200,000+ employers around the country.

- 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)
- INTER-LS 215 Communicating About Careers (3 credits, fulfills Com B General Education Requirement)
- Handshake (https://careers.ls.wisc.edu/handshake)
- 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, Jue "Jade" Wang, Karen Wassarman, and Jae-Hyuk Yu

Associate Professor Garret Suen

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