

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

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 Experience 30 credits in residence, overall
30 credits in residence after the 86th 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. 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/#requirementsforundergraduatestudyttext>) 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

Code	Title	Credits
Mathematics		
Select one of the following:		5-10
MATH 171 & MATH 217	Calculus with Algebra and Trigonometry I and Calculus with Algebra and Trigonometry II	
MATH 221	Calculus and Analytic Geometry I	
Statistics		
Select one of the following:		3
STAT 301	Introduction to Statistical Methods	
STAT 371	Introductory Applied Statistics for the Life Sciences	
STAT/B M I 541	Introduction to Biostatistics	
General Chemistry		
Select one of the following: ¹		5-9
CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	
CHEM 109	Advanced General Chemistry	
Organic Chemistry		
Select ALL of the following:		
CHEM 343	Introductory Organic Chemistry	3
CHEM 344	Introductory Organic Chemistry Laboratory	2
CHEM 345	Intermediate Organic Chemistry	3
Biology Foundation		
Select one of the following:		10-13
BIOLOGY/ BOTANY/ ZOOLOGY 151 & BIOLOGY/ BOTANY/ ZOOLOGY 152	Introductory Biology and Introductory Biology ²	

BIOCORE 381 & BIOCORE 382 & BIOCORE 383 & BIOCORE 384 & BIOCORE 485	Evolution, Ecology, and Genetics and Evolution, Ecology, and Genetics Laboratory and Cellular Biology and Cellular Biology Laboratory and Principles of Physiology ²
---	---

ZOOLOGY/ BIOLOGY 101 & ZOOLOGY/ BIOLOGY 102 & BOTANY/ BIOLOGY 130	Animal Biology and Animal Biology Laboratory and General Botany
---	---

Physics

Select one of the following: 8-10

PHYSICS 103 & PHYSICS 104	General Physics and General Physics ³
PHYSICS 207 & PHYSICS 208	General Physics and General Physics ³
PHYSICS 201 & PHYSICS 202	General Physics and General Physics

Biochemistry

Select one of the following: 3-6

BIOCHEM 501	Introduction to Biochemistry
BIOCHEM 507 & BIOCHEM 508	General Biochemistry I and General Biochemistry II

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	3
MICROBIO 304	Biology of Microorganisms Laboratory	2
MICROBIO 305	Critical Analyses in Microbiology	1
MICROBIO 450	Diversity, Ecology and Evolution of Microorganisms	3
MICROBIO 470	Microbial Genetics & Molecular Machines	3
MICROBIO 526	Physiology of Microorganisms	3
MICROBIO 527	Advanced Laboratory Techniques in Microbiology (FALL ONLY)	2

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 375	Special Topics
MICROBIO/ SOIL SCI 425	Environmental Microbiology

MICROBIO/ SOIL SCI 523	Soil Microbiology and Biochemistry
PATH-BIO/ M M & I 528	Immunology
MICROBIO/ ONCOLOGY 545	Topics in Biotechnology (topics vary by semester)
MICROBIO 607	Advanced Microbial Genetics
MICROBIO/ BIOCHEM/ GENETICS 612	Prokaryotic Molecular Biology
PL PATH 622	Plant-Bacterial Interactions
MICROBIO 632	Industrial Microbiology/ Biotechnology
ONCOLOGY/ PL PATH 640	General Virology-Multiplication of Viruses
PL PATH/ BOTANY/ GENETICS/ M M & I 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/ 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 Microbiology
Total Credits	64-87

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 residence¹
- 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 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:

Code	Title	Credits
MICROBIO 303	Biology of Microorganisms	3
MICROBIO 304	Biology of Microorganisms Laboratory	2
MICROBIO 330	Host-Parasite Interactions	3
MICROBIO/ SOIL SCI 425	Environmental Microbiology	3
MICROBIO 450	Diversity, Ecology and Evolution of Microorganisms	3
MICROBIO 470	Microbial Genetics & Molecular Machines	3
MICROBIO 526	Physiology of Microorganisms	3
PATH-BIO/ M M & I 528	Immunology	3
MICROBIO 607	Advanced Microbial Genetics	3
MICROBIO/ BIOCHEM/ GENETICS 612	Prokaryotic Molecular Biology	3
PL PATH 622	Plant-Bacterial Interactions	2-3
MICROBIO 632	Industrial Microbiology/ Biotechnology	2
ONCOLOGY/ PL PATH 640	General Virology-Multiplication of Viruses	3
MICROBIO/ BMOLCHEM 668	Microbiology at Atomic Resolution	3

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.

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 FOUR-YEAR PLAN

This Sample Four-Year Plan is a tool to assist students and their advisor(s). Students should use it—along with their DARS report, the Degree Planner, and Course Search & Enroll tools—to make their own four-year plan based on their placement scores, credit for transferred courses and approved examinations, and individual interests. As students become involved in athletics, honors, research, student organizations, study abroad, volunteer experiences, and/or work, they might adjust the order of their courses to accommodate these experiences. Students will likely revise their own four-year plan several times during college.

SAMPLE MICROBIOLOGY FOUR-YEAR PLAN

Freshman

Fall	Credits	Spring	Credits
CHEM 103 ¹		4 CHEM 104	5
MATH 221 ²		5 BIOLOGY/BOTANY/ ZOOLOGY 151 ³	5

Communication A		3 Foreign Language (if needed)	4
Foreign Language (if needed)		4 Literature Breadth	3
		16	17

Sophomore

Fall	Credits	Spring	Credits
CHEM 343		3 CHEM 345	3
BIOLOGY/BOTANY/ ZOOLOGY 152		5 CHEM 344	2
Directed Study / Research ⁴		2 MICROBIO 303	3
Ethnic Studies/Social Science		3 MICROBIO 305	1
Literature Breadth		3 Directed Study / Research	2
		Social Science Breadth	3
		16	14

Junior

Fall	Credits	Spring	Credits
PHYSICS 103 ⁶		4 PHYSICS 104	4
BIOCHEM 501 ⁵		3 MICROBIO 450	3
MICROBIO 304		2 MICROBIO 526	3
MICROBIO 470		3 STAT 371	3
Directed Study / Research		2 Directed Study / Research	2
		14	15

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
		14	14

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 should use Starfish to schedule an appointment with an advisor in the Biochemistry & Microbiology Undergraduate Advising Hub (<http://biochemmicrobio.wisc.edu/>).

Prospective / future UW-Madison students should send an email to the Biochemistry & Microbiology Undergraduate Advising Hub (biochemmicrobio-advisor@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

Ané, Currie, Donohue, Forest, Gourse, Johnson, Kaspar (chair), McMahon (Civil and Environmental Engineering), Thomas, Wang, Wassarman, Yu

ASSOCIATE PROFESSORS

Amador-Noguez, Burton, Rey, Suen

ASSISTANT PROFESSORS

Anantharaman, Coon