**Microbiology (CAS)**

**Description**

Website: [http://microbiology.unl.edu](http://microbiology.unl.edu)

The microbiology major is an interdepartmental major that offers educational opportunities in various areas of microbiology leading to a bachelor of science degree in microbiology. The training offered is suitable for a professional career in microbiology, which may lead to employment in the food industry, clinical microbiology, biotechnology, and pharmaceuticals; or federal agencies such as the Food and Drug Administration, U.S. Department of Agriculture, U.S. Public Health Service, and Environmental Protection Agency. The program is also suitable as preparation for graduate studies leading to academic careers and professional careers in medicine, dentistry, veterinary medicine, pharmacy, and health-related fields. (Completion of the microbiology baccalaureate degree program does not automatically fulfill the admission requirements for application to a given professional program. Students considering applying to a professional program are strongly encouraged to work with their advisor to ensure that admission requirements are met during the completion of the microbiology degree.)

**Program Assessment.** To gauge the effectiveness of the program, majors within their senior year will be required to complete selected assessment activities. Results of participation in these assessment activities will in no way affect a student's GPA or graduation.

**College Admission**

The entrance requirements for the College of Arts and Sciences (CAS), including any of the majors or minors offered through the college, are the same as the University of Nebraska–Lincoln General Admission Requirements. In addition to these requirements, the College of Arts and Sciences strongly recommends a third and fourth year of one foreign language in high school. Four years of high school coursework in the same language will fulfill the College of Arts and Sciences language requirement. It will also allow students to continue language study at a more advanced level at the University of Nebraska–Lincoln and provide more opportunity to study abroad.

**Academic and Career Advising Center**

**Academic and Career Advising Center**

The Academic and Career Advising Center in 107 Oldfather Hall is the undergraduate hub for CAS students in all majors. Centrally located and easily accessed, students encounter friendly, knowledgeable people who are eager to help. Students visit the Advising Center in 107 Oldfather Hall to:

- Choose or change their major, minor, or degree program.
- Check in on policies, procedures, and deadlines.
- Get a college approval signature from the Dean’s representative, Sr. Director of Advising and Student Success.

While the assigned academic advisor should be the student's primary contact, there are daily walk-ins from 12-3 where a general academic advisor can answer a quick question. In addition, the CAS Career Coaches are located here. They help students explore majors and minors, gain experience, and develop a plan for life after graduation. Not sure where to go or who to ask? The Advising Center team can help.

**Assigned Academic Advisors**

Academic advisors are critical resources dedicated to students' academic, personal, and professional success. Every CAS student is assigned an academic advisor based on their primary major. Since most CAS students have more than just a single major, it is important to get to know the advisor for any minors or additional majors. Academic advisors work closely with the faculty to provide the best overall support and discipline-specific expertise.

Assigned advisors are listed in MyRED ([https://its.unl.edu/myunl/](https://its.unl.edu/myunl/)) and their offices may be located in or near the department of the major for which they advise or in the Academic and Career Advising Center. Students who have declared a pre-health or pre-law area of interest will also work with advisors in the Exploratory and Pre-Professional Advising Center (Explore Center) in 127 Love South, who are specially trained to guide students preparing to enter a professional school.

For complete and current information on advisors for majors, minors, or pre-professional areas, contact the Arts and Sciences Academic and Career Advising Center, 107 Oldfather Hall, 402-472-4190, [http://cas.unl.edu/advising](http://cas.unl.edu/advising/).

**Career Coaching**

The College believes that Academics + Experience = Opportunities and encourages students to complement their academic preparation with real-world experience, including internships, research, education abroad, service, and leadership. Arts and sciences students have access to a powerful network of faculty, staff, and advisors dedicated to providing information and support for their goals of meaningful employment or advanced education. Arts and sciences graduates have unlimited career possibilities and carry with them important career competencies—communication, critical thinking, creativity, context, and collaboration. They have the skills and adaptability that employers universally value. Graduates are not only prepared to effectively contribute professionally in the real world, but they have a solid foundation to excel in an increasingly global, technological, and interdisciplinary world.

Students should contact the career coaches in the Arts and Sciences Academic and Career Advising Center in 107 Oldfather, or their assigned advisor, for more information. The CAS career coaches help students explore career options, identify ways to build experience, and prepare to apply for internships, jobs, or graduate school, including help with resumes, applications, and interviewing.

**ACE Requirements**

Students must complete one course for each of the ACE Student Learning Outcomes below. Certified course choices are published in the degree audit, or visit the ACE website ([http://ace.unl.edu](http://ace.unl.edu)) for the most current list of certified courses.

**ACE Student Learning Outcomes**

ACE 1: Write texts, in various forms, with an identified purpose, that respond to specific audience needs, integrate research or existing knowledge, and use applicable documentation and appropriate conventions of format and structure.

ACE 2: Demonstrate competence in communication skills.

ACE 3: Use mathematical, computational, statistical, logical, or other formal reasoning to solve problems, draw inferences, justify conclusions, and determine reasonableness.
ACE 4: Use scientific methods and knowledge to pose questions, frame hypotheses, interpret data, and evaluate whether conclusions about the natural and physical world are reasonable.

ACE 5: Use knowledge, historical perspectives, analysis, interpretation, critical evaluation, and the standards of evidence appropriate to the humanities to address problems and issues.

ACE 6: Use knowledge, theories, and research perspectives such as statistical methods or observational accounts appropriate to the social sciences to understand and evaluate social systems or human behaviors.

ACE 7: Use knowledge, theories, or methods appropriate to the arts to understand their context and significance.

ACE 8: Use knowledge, theories, and analysis to explain ethical principles and their importance in society.

ACE 9: Exhibit global awareness or knowledge of human diversity through analysis of an issue.

ACE 10: Generate a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.

**College Degree Requirements**

**College Distribution Requirements – BA and BS**

The College of Arts and Sciences distribution requirements are common to both the bachelor of arts and bachelor of science degrees and are designed to ensure a range of courses. By engaging in study in several different areas within the College, students develop the ability to learn in a variety of ways and apply their knowledge from a variety of perspectives. All requirements are in addition to University ACE requirements, and no course can be used to fulfill both an ACE outcome and a College Distribution Requirement.

- A student may not use a single course to satisfy more than one College Distribution Requirement, with the exception of CDR Diversity. Courses used to meet CDR Diversity may also meet CDR Writing, CDR Humanities, or CDR Social Science.
- Independent study or reading courses and internships cannot be used to satisfy distribution requirements.
- Courses from interdisciplinary programs will be applied in the same area as courses from the home/cross-listed department.

**College Distribution Requirements**

**CDR: Written Communication**

Select from courses approved for ACE outcome 1.

**CDR: Natural, Physical, and Mathematical Sciences with Lab**

Select from biochemistry, biological sciences, chemistry, computer science, geology, meteorology, mathematics, and physics. Must include one lab in the natural or physical sciences. Lab courses may be selected from biochemistry, biological sciences, chemistry, geology, meteorology, and physics.

Some courses from geography and anthropology may also be used to satisfy the lab requirement above.

**CDR: Humanities**

Select from classics, English, history, modern languages and literatures, philosophy, and religious studies.

**CDR: Social Science**

Select from anthropology, communication studies, geography, political science, psychology, or sociology.

**CDR: Human Diversity in U.S. Communities**

Select from a set of approved courses as listed in the degree audit.

**CDR: Language**

Fulfilled by the completion of the 6-credit-hour second-year sequence in a single foreign language in one of the following departments: Classics and religious studies or modern languages and literatures. Instruction is currently available in Arabic, Chinese, Czech, French, German, Greek, Japanese, Latin, Russian, and Spanish.

A student who has completed the fourth-year level of one foreign language in high school is exempt from the languages requirement, but encouraged to continue on in their language study.

Credit Hours Subtotal: 13-32

1 See Degree Audit or a College of Arts and Sciences advisor for approved geography and anthropology courses that apply as natural science.

2 Language courses numbered 220 and below do not fulfill the CDR Humanities.

3 See Degree Audit or College of Arts and Sciences advisor for list of natural/physical science courses in anthropology, geography, and psychology that do not apply as social science.

**Language Requirement**

The University of Nebraska–Lincoln and the College of Arts and Sciences place great value on academic exposure and proficiency in a second language. The University of Nebraska–Lincoln entrance requirement of two years of the same foreign language or the College’s language distribution requirement (CDR: Language) will rarely be waived and only with relevant documentation. See the main College of Arts and Sciences page for more details.

**Scientific Base - BS Only**

The bachelor of science degree requires students to complete 60 hours in mathematical, physical, and natural sciences. Approved courses for scientific base credit come from the following College of Arts and Sciences disciplines: actuarial science, anthropology (selected courses), astronomy, biochemistry (excluding BIOC 101), biological sciences (excluding BIOS 100 or BIOS 203), chemistry (excluding CHEM 101), computer science (excluding CSCE 10), geography (selected courses), geology, life sciences, mathematics (excluding courses below MATH 104), meteorology, microbiology (excluding MBIO 101), and physics.

See your Degree Audit or your assigned academic advisor for a complete list, including individual classes that fall outside of the disciplines listed above. Up to 12 hours of scientific and technical courses offered by other colleges may be accepted toward this requirement with the approval of the College of Arts and Sciences. See your assigned academic advisor to start the approval process.

**Minimum Hours Required for Graduation**

A minimum of 120 semester hours of credit is required for graduation from the College of Arts and Sciences. A cumulative grade point average of at least 2.0 is required.
Grade Rules
Restrictions on C- and D Grades
The College will accept no more than 15 semester hours of C- and D grades from other domestic institutions except for UNO and UNK. All courses taken at UNO and UNK impact the UNL transcript. No transfer of C- and D grades can be applied toward requirements in a major or a minor. No University of Nebraska–Lincoln C- and D grades can be applied toward requirements in a major or a minor. International coursework (including education abroad) with a final grade equivalent to a C- or lower will not be validated by the College of Arts and Sciences departments to be degree applicable.

Pass/No Pass Privilege
The College of Arts and Sciences adheres to the University regulations for the Pass/No Pass (P/N) privilege with the following additional regulations:

• Pass/No Pass hours can count toward fulfillment of University ACE requirements and college distribution requirements up to the 24-hour maximum.
• Most arts and sciences departments and programs do not allow courses graded Pass/No Pass to apply to the major or minor. Students should refer to the department’s or program’s section of the catalog for clarification. By college rule, departments can allow up to 6 hours of Pass/No Pass in the major or minor.
• Departments may specify that certain courses of theirs can be taken only on a P/N basis.
• The college will permit no more than a total of 24 semester hours of P/N grades to be applied toward degree requirements. This total includes all Pass grades earned at the University of Nebraska–Lincoln and other U.S. schools. NOTE: This 24-hour limit is more restrictive than the University regulation.

Grading Appeals
A student who feels that he/she has been unfairly graded must ordinarily take the following sequential steps in a timely manner, usually by initiating the appeal in the semester following the awarding of the grade:

1. Talk with the instructor concerned. Most problems are resolved at this point.
2. Talk to the instructor’s department chairperson.
3. Take the case to the Grading Appeal Committee of the department concerned. The Committee should be contacted through the department chairperson.
4. Take the case to the College Grading Appeals Committee by contacting the Dean's Office, 1223 Oldfather Hall.

Course Level Requirements
Courses Numbered at the 300 or 400 Level
Thirty (30) of the 120 semester hours of credit must be in courses numbered at the 300 or 400 level. Of those 30 hours, 15 hours (1/2) must be completed in residence at the University of Nebraska--Lincoln.

Residency Requirement
Students must complete at least 30 of the 120 total hours for their degree at the University of Nebraska--Lincoln. Students must complete at least 1/2 of their major coursework, including 6 hours at the 300 or 400 level in their major and 15 of the 30 hours required at the 300 or 400 level, in residence. Credit earned during education abroad may be used toward the residency requirement only if students register through the University of Nebraska--Lincoln.

Catalog to Use
Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted to and enrolled as a degree-seeking student at the University of Nebraska–Lincoln. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at the University of Nebraska–Lincoln in the College of Arts and Sciences. Students must complete all degree requirements from a single catalog year. Beginning in 1990-1991, the catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Learning Outcomes
Graduates of microbiology will be able to:

1. Understand the physiology, biochemistry, and genetics of bacteria and other microorganisms, including cell structure, function, diversity, metabolism, and the genetics of metabolic regulation.
2. Be knowledgeable about the immune response and disease-causing microorganisms, including aspects of the innate and adaptive immune responses, as well as an introductory understanding of the molecular basis for pathogenesis.
3. Understand the role of microorganisms in plant and animal agriculture, foodborne disease and spoilage, as well as beneficial roles played by microorganisms.
4. Understand the taxonomic, ecological, evolutionary, and genetic relationships among microorganisms, including nutrient cycling, microbial diversity, and the biotechnological application of microorganisms to solve environmental problems.
5. Be proficient at the scientific method of investigation and hypothesis testing, including the development of theoretical and practical skills in the design and execution of experiments, as well as the development of oral and writing skills necessary for the effective communication of experimental results and/or scientific principles.

Major Requirements
Core Requirements

Required Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBIO 101</td>
<td>Introduction to the Microbiology Major</td>
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<tr>
<td>BIOS 312</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 314</td>
<td>Microbiology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>MBIO 420</td>
<td>Molecular Genetics</td>
<td>3</td>
</tr>
<tr>
<td>MBIO 440</td>
<td>Microbial Physiology</td>
<td>3</td>
</tr>
<tr>
<td>MBIO 443</td>
<td>Immunology</td>
<td>3</td>
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</tbody>
</table>

Credit Hours Subtotal: 14
Total Credit Hours: 14

Ancillary Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>BIOS 206</td>
<td>General Genetics</td>
<td>4</td>
</tr>
</tbody>
</table>
LIFE 120 & LIFE 120L  
Fundamentals of Biology I and Fundamentals of Biology I Laboratory  
4

LIFE 121 & LIFE 121L  
Fundamentals of Biology II and Fundamentals of Biology II Laboratory  
4

Credit Hours Subtotal: 12

Chemistry

General Chemistry

Select one sequence from the following: 8-11

CHEM 109A & CHEM 109L & CHEM 110A & CHEM 110L  
General Chemistry I and General Chemistry I Laboratory and General Chemistry II and General Chemistry II Laboratory

Or

CHEM 113A & CHEM 113L & CHEM 114 & CHEM 221  
Fundamental Chemistry I and Fundamental Chemistry I Laboratory and Fundamental Chemistry II and Elementary Quantitative Analysis

Organic Chemistry 4-8

If you plan to take BIOC 401 & BIOC 401L, select one sequence from the following:

CHEM 251 & CHEM 253 & CHEM 257 & CHEM 257L  
Organic Chemistry I and Organic Chemistry I Laboratory and Biological Organic Chemistry and Biological Organic Chemistry Laboratory

CHEM 261 & CHEM 263  
Organic Chemistry and Organic Chemistry Laboratory

If you plan to take BIOC 431, select one sequence from the following:

CHEM 251 & CHEM 253 & CHEM 252 & CHEM 252L  
Organic Chemistry I and Organic Chemistry I Laboratory and Organic Chemistry II and Organic Chemistry II Laboratory

CHEM 261 & CHEM 263 & CHEM 262 & CHEM 262L  
Organic Chemistry and Organic Chemistry Laboratory

Credit Hours Subtotal: 12-19

Biochemistry

Select one of the following: 3-4

BIOC 401 & BIOC 401L  
Elements of Biochemistry and Laboratory for Elements of Biochemistry

BIOC 432 / BIOS 432 / CHEM 432  
Biochemistry II: Metabolism and Biological Information

BIOC 433 / BIOS 433 / CHEM 433

BIOC 437 / BIOS 437  
Research Techniques in Biochemistry

BIOC 442 / STAT 442  
Computational Biology

BIOS 302  
Cell Biology

BIOS 303  
Molecular Biology

BIOS 313  
Molecular Microbiology Laboratory

BIOS 326  
Biology of Viruses

BIOS 402  
Cancer Biology

BIOS 407  
Biology of Cells and Organelles

BIOS 426  
Systems Biology

BIOS 444 / GEOL 444  
Earth and Environmental Microbiology

BIOS 460 / AGRO 460 / NRES 460 / SOIL 460  
Soil Microbial Ecology

BIOS 477  
Bioinformatics and Molecular Evolution

BIOS 487  
Field Parasitology

BIOS 491  
Special Topics in Biological Sciences

FDST 405 / BIOS 445  
Food Microbiology

FDST 406 / BIOS 446  
Food Microbiology Laboratory

FDST 415  
Molds and Mycotoxins in Food, Feed, and the Human Environment

FDST 455  
Microbiology of Fermented Foods

FDST 455L  
Microbiology of Fermented Foods Laboratory (offered even years only)

MBIO 421 / BIOS 421  
Microbial Diversity

PLPT 369 / BIOS 369  
Introductory Plant Pathology

PLPT 369L  
Introductory Plant Pathology Lab

Credit Hours Subtotal: 3-4

Mathematics and Statistics

MATH 106  
Calculus I 5

Select one of the following:

ECON 215  
Statistics

EDPS 459  
Statistical Methods

STAT 218  
Introduction to Statistics

STAT 380  
Statistics and Applications

Credit Hours Subtotal: 8

Total Credit Hours 45-53

1 BIOS 207 is also recommended for students specializing in Applied, Environmental, and Plant Microbiology or who are interested in epidemiology.

Specific Major Requirements

Advanced Microbiology Courses

Select at least 12 hours from the following advanced microbiology-related courses: 12

BIOC 432 / BIOS 432 / CHEM 432  
Biochemistry II: Metabolism and Biological Information

BIOC 433 / BIOS 433 / CHEM 433

BIOC 437 / BIOS 437  
Research Techniques in Biochemistry

BIOC 442 / STAT 442  
Computational Biology

BIOS 302  
Cell Biology

BIOS 303  
Molecular Biology

BIOS 313  
Molecular Microbiology Laboratory

BIOS 326  
Biology of Viruses

BIOS 402  
Cancer Biology

BIOS 407  
Biology of Cells and Organelles

BIOS 426  
Systems Biology

BIOS 444 / GEOL 444  
Earth and Environmental Microbiology

BIOS 460 / AGRO 460 / NRES 460 / SOIL 460  
Soil Microbial Ecology

BIOS 477  
Bioinformatics and Molecular Evolution

BIOS 487  
Field Parasitology

BIOS 491  
Special Topics in Biological Sciences

FDST 405 / BIOS 445  
Food Microbiology

FDST 406 / BIOS 446  
Food Microbiology Laboratory

FDST 415  
Molds and Mycotoxins in Food, Feed, and the Human Environment

FDST 455  
Microbiology of Fermented Foods

FDST 455L  
Microbiology of Fermented Foods Laboratory (offered even years only)

MBIO 421 / BIOS 421  
Microbial Diversity

PLPT 369 / BIOS 369  
Introductory Plant Pathology

PLPT 369L  
Introductory Plant Pathology Lab

Credit Hours Subtotal: 45-53

1 BIOS 207 is also recommended for students specializing in Applied, Environmental, and Plant Microbiology or who are interested in epidemiology.
VBMS 303  Principles and Prevention of Livestock Diseases
VBMS 408 / BIOS 408  Functional Histology
VBMS 424  Basic Molecular Infectious Diseases (offered odd years only)
VBMS 441 / BIOS 441  Pathogenic Microbiology

Credit Hours Subtotal: 12

Additional Major Requirements

Grade Rules
C- and D Grades
A grade of C or above is required for all courses in the major, including ancillary courses.

Pass/No Pass
With the exception of MBIO 101, no course taken Pass/No Pass will be counted toward the major, except for independent study, research, and seminars.

PLEASE NOTE
This document represents a sample 4-year plan for degree completion with this major. Actual course selection and sequence may vary and should be discussed individually with your college or department academic advisor. Advisors also can help you plan other experiences to enrich your undergraduate education such as internships, education abroad, undergraduate research, learning communities, and service learning and community-based learning.

Microbiology (B.S.)

Career Information
The following represents a sample of the internships, jobs and graduate school programs that current students and recent graduates have reported.

Transferable Skills
- Understand and utilize a variety of research methodologies
- Understand fundamental life processes
- Communicate results of scientific experiments to scientific and non-scientific audiences
- Design and implement research experiments
- Apply mathematical and scientific skills to solve real-world problems
- Comprehend and critically evaluate complex information
- Analyze and explain data
- Conduct and present research to large and small groups
- Read, understand, and critically review scientific information
- Understand and practice proper laboratory safety procedures
- Use quantitative analysis techniques
- Demonstrate ethical conduct in research activities
- Collaborate with a team to develop solutions
- Develop and defend evidence based arguments
- Develop basic techniques of statistical analysis

Jobs of Recent Graduates
- Research Assistant, University of Nebraska Medical Center - Omaha NE
- Lab Manager, University of Nebraska-Lincoln - Lincoln NE
- Laboratory Technician, POET Research Center, Inc - Scotland SD
- Plant Research Biologist, Midwest Research Inc. - York NE
- Contractor, Syngenta - Omaha NE
- Postdoctorate, Harvard University - Boston MA
- Science Writer, Li-COR Biosciences - Lincoln NE
- Chemist, Archer Daniels Midland - Lincoln NE
- Scientist I, Aerotek - Chicago IL
- Phlebotomist, BryanLGH - Lincoln NE

Internships
- R&D Summer Intern, Estee Lauder Companies - Melville NY
- Project Manager Assistant/Engineering Assistant, Li-COR Biosciences - Lincoln NE
- Construction Management Intern, Nemaha Landscape Construction - Lincoln NE
- Undergrad Student Research Intern, UNL Mid-America Transportation Center - Lincoln NE
- Certified Nursing Assistant, Delmar Gardens Retirement Home - CNA Program - O’Fallon MO
- Intern, Monsanto - Gothenburg NE
- Beckman Research Scholar, UNL College of Arts of Sciences Beckman Scholars - Lincoln NE
- Associate Management Intern, Cargill - Kansas City, MO
- Advanced Research Intern, Li-COR Biosciences - Lincoln NE
- Distinguished Life Sciences Scholar, College of Arts and Sciences - Lincoln NE

Graduate & Professional Schools
- Medicine, University of South Dakota Sanford School of Medicine - Vermillion SD
- Dentistry, University of Nebraska Medical College - Lincoln NE
- College of Medicine, University of Nebraska - Medical Center - Omaha NE
- Cancer Research Graduate Program, UNMC - Omaha NE
- Medical Anatomy, University of Nebraska Medical Center - Omaha NE
- Interdisciplinary Biology and Chemistry with a focus on chemistry, West Texas A&M University - Canyon TX
- Dental Program, UNMC College of Dentistry - Lincoln NE
- BS Biochemistry, University of Nebraska-Lincoln - Lincoln NE
- Biochemistry, University of Nebraska - Lincoln - Lincoln NE
- Masters of Arts in Business Administration, University of Nebraska-Lincoln - Lincoln NE