Microbiology (CAS)

Description
Website: 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 application to a professional program are strongly encouraged to work with their advisor to ensure that admission requirements are met during 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.

Admission
College Admission
The entrance requirements for the College of Arts and Sciences are the same as the UNL General Admission Requirements. Students who are admitted through the Admission by Review process may have certain conditions attached to their enrollment at UNL. These conditions are explained under “Removal of Deficiencies.”

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 UNL, and provide more opportunity to study abroad.

Advising
Academic and Career Advising
The Academic and Career Advising Center in 107 Oldfather is a centrally located and easily accessed resource for students in all majors in the College of Arts and Sciences. The professional academic advisors and career coaches offer 1-1 meetings on a walk-in and appointment basis weekdays. Advisors will provide assistance choosing majors and minors, understanding degree requirements and academic policies, completing paperwork, meeting deadlines, adding/dropping courses, and planning for graduation. In addition, career coaches can help students identify career options related to their interests and connect them with experiences like internships, research, and more that will prepare them for those career options. These specially trained advisors and coaches also serve as first point of contact in the College for all incoming freshmen and transfer students during New Student Enrollment.

Students in the College who have declared a major will be assigned an academic advisor who is their first point of contact for a variety of questions. Academic advisors help students be successful in adjusting to UNL overall as well as making progress toward degree completion. The assigned advisor may be located within the department of their primary major, or in the Advising Center. Students can identify their assigned advisor in MyRED on the academics tab. In addition, faculty advisors are experts in their discipline, including advanced coursework and requirements, opportunities for research, student organizations, and considering graduate school in the discipline. 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 Library 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.

College Degree Requirements

College Distribution Requirements

Bachelor of Arts or Bachelor of Science (16 hours + Language)
The College of Arts and Sciences distribution requirements are designed to ensure a breadth of courses within the liberal arts degree. 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.

- A student may not use a single course to satisfy 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.
- A student may not use a course from their primary major to satisfy the Breadth Requirement (F), but may apply an ancillary requirement of the primary major or a course from their second major toward this requirement.
- Independent study, directed readings, or internship courses cannot be used to satisfy a College Distribution Requirement.
- Cross-listed courses from interdisciplinary programs will be applied in the same area as courses from the home/cross-listed department.

College Distribution Requirements

<table>
<thead>
<tr>
<th>CDR A - Written Communication</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select from courses approved for ACE outcome 1.</td>
<td></td>
</tr>
<tr>
<td>CDR B and BL - Natural, Physical, and Mathematical Sciences with Lab</td>
<td>4</td>
</tr>
<tr>
<td>Select from biochemistry, biological sciences, chemistry, computer science, geology, meteorology, mathematics, physics and statistics. Must include one lab in the natural or physical sciences. Lab courses may be selected from biochemistry, biological sciences, chemistry, geology, meteorology and physics.</td>
<td></td>
</tr>
<tr>
<td>Some courses from geography and anthropology may also be used to satisfy the lab requirement above.</td>
<td></td>
</tr>
<tr>
<td>CDR C - Humanities</td>
<td>3</td>
</tr>
<tr>
<td>Select from classics, English, history, modern languages and literatures, philosophy, and religious studies.</td>
<td></td>
</tr>
<tr>
<td>CDR D - Social Science</td>
<td>3</td>
</tr>
<tr>
<td>Select from courses approved for ACE outcome 2.</td>
<td></td>
</tr>
</tbody>
</table>
A minimum of 120 semester hours of credit is required for graduation.

Minimum Hours Required for Graduation

Credits: 0-16

CDR E - 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.

CDR F - Additional Breadth

Select from natural, physical and mathematical sciences (Area B), humanities (Area C), or social sciences (Area D). Cannot be a course from the primary major.

Credit Hours Subtotal: 16-32

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 210 and below do not fulfill the CDR C.

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.

Scientific Base

Bachelor of Science Only (60 hours)
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, astronomy, biochemistry (excluding BIOL 101), biological sciences (excluding BIOS 100 or BIOS 203), chemistry (excluding CHEM 101), computer science (excluding CSCE 10), geology (selected courses), geology, life sciences, mathematics (excluding courses below MATH 104), meteorology, microbiology, physics and statistics.

See your degree audit or a College of Arts and Sciences 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 approval of a college advisor.

Language Requirement

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

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 total 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 UNL 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 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 UNL 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 UNL.

Residency Requirement

Students must complete at least 30 of the 120 total hours for their degree at UNL. 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 UNL.
ACE Requirements

Consistent with the mission and values of the University, ACE is based on a shared set of four institutional objectives and ten student learning outcomes. The ACE program was approved by faculty in all eight undergraduate colleges and endorsed by the Faculty Senate, the student government, and the Academic Planning Committee in January 2008 for implementation in the fall 2009. ACE aligns with current national initiatives in general education.

To meet the ACE Program requirement, a student will complete a minimum of 3 credit hours for each of the ten ACE Student Learning Outcomes (a total of 30 ACE credit hours). See the ACE website at: http://ace.unl.edu for the most current information and the most recently certified courses.

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 UNL. 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 UNL 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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 312</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 313</td>
<td>Molecular Microbiology Laboratory</td>
<td>1-2</td>
</tr>
<tr>
<td>or BIOS 314</td>
<td>Microbiology Laboratory</td>
<td></td>
</tr>
<tr>
<td>MBIO 420 /</td>
<td>Molecular Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 420</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MBIO 440 /</td>
<td>Microbial Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 440</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MBIO 443 / BIOS 443 Immunology 3

Total Credit Hours 13-14

Specific Major Requirements

Biological Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIFE 120</td>
<td>Fundamentals of Biology I &amp; LIFE 120L</td>
<td>2</td>
</tr>
<tr>
<td>LIFE 121</td>
<td>Fundamentals of Biology II &amp; LIFE 121L</td>
<td>2</td>
</tr>
<tr>
<td>BIOS 206</td>
<td>General Genetics</td>
<td>4</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 12

Chemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHEM 109</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 110</td>
<td>and General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Fundamental Chemistry I &amp; CHEM 114</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Fundamental Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
<td></td>
</tr>
</tbody>
</table>

Organic Chemistry

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 251</td>
<td>Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 253</td>
<td>and Organic Chemistry I Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 255</td>
<td>Biological Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 257</td>
<td>and Biological Organic Chemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 261</td>
<td>Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 263</td>
<td>and Organic Chemistry Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 251</td>
<td>Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 253</td>
<td>and Organic Chemistry I Laboratory</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 252</td>
<td>and Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 261</td>
<td>Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 263</td>
<td>and Organic Chemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 262</td>
<td>and Organic Chemistry</td>
<td></td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 12-19

Biochemistry

Select one of the following: 3-4

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC 401</td>
<td>Elements of Biochemistry &amp; BIOC 401L</td>
<td></td>
</tr>
<tr>
<td>&amp; BIOC 401L</td>
<td>and Laboratory for Elements of Biochemistry</td>
<td></td>
</tr>
<tr>
<td>BIOC 431</td>
<td>Structure and Metabolism</td>
<td></td>
</tr>
<tr>
<td>&amp; BIOC 431</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 431</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 3-4

Physics

Select one sequence from the following: 10

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 141</td>
<td>Elementary General Physics I</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 142</td>
<td>and Elementary General Physics II</td>
<td></td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics I</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 221</td>
<td>and General Physics Laboratory I</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 212</td>
<td>and General Physics II</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 222</td>
<td>and General Physics Laboratory II</td>
<td></td>
</tr>
</tbody>
</table>
Credit Hours Subtotal: 10

Mathematics and Statistics

MATH 106  Calculus I  5

Select one of the following: 3

STAT 218  Introduction to Statistics
EDPS 459  Statistical Methods
ECON 215  Statistics
STAT 380  Statistics and Applications

Total Credit Hours 12

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.

Advanced Microbiology Courses

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

- BIOC 432 / BIOS 432 / CHEM 432  Metabolism and Biological Information
- BIOC 433 / BIOS 433 / CHEM 433  Biochemistry Laboratory
- BIOC 437 / BIOS 437  Research Techniques in Biochemistry
- BIOC 442 / STAT 442  Computational Biology
- BIOS 302  Cell Biology
- BIOS 303  Molecular Biology
- BIOS 326  Biology of Viruses
- BIOS 402  Cancer Biology
- BIOS 407  Biology of Cells and Organelles
- BIOS 426  Systems Biology
- BIOS 444 / GEOL 444  Geomicrobiology
- BIOS 460 / AGRO 460 / NRES 460 / SOIL 460  Soil Microbiology
- BIOS 477  Bioinformatics and Molecular Evolution
- BIOS 487  Field Parasitology
- BIOS 497  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
- 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

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.

Pass/No Pass
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 - Biochemistry, University of Nebraska - Lincoln NE
• Masters of Arts in Business Administration, University of Nebraska - Lincoln NE