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.

College Requirements
College Admission
College Admission

The entrance requirements for the College of Arts and Sciences are the same as the University of Nebraska–Lincoln General Admission Requirements. Students who are admitted through the Admission by Review process may have certain conditions attached to their enrollment at Nebraska. 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. Four years of high school course work 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.

Transfer Students
To be considered for admission as a transfer student, Nebraska resident or nonresident, students must have an accumulated average of C (2.0 on a 4.0 scale) and a minimum C average in the last semester of attendance at another college. Transfer students who graduated from high school January 1997 and after must also meet the University of Nebraska–Lincoln General Admission Requirements. Those transfer students who graduated before January 1997 must have completed in high school, 3 years of English, 2 years of the same foreign language, 2 years of algebra, and 1 year of geometry. Transfer students who have completed less than 12 credit hours of college study must also submit either their ACT or SAT scores.

Ordinarily, hours earned at a similarly accredited college or university are applicable to the University of Nebraska–Lincoln degree. The College, however, will evaluate all hours submitted on an application for transfer, and reserves the right to accept or reject any of them, based upon its exclusion and restriction policies. Sixty (60) is the maximum number of hours the University will accept on transfer from a two-year college or international institution. Transfer credit in the major or minor must be approved by the departmental advisor on a Request for Substitution Form to meet specific course requirements, group requirements, or course level requirements in the major or minor. At least half of the hours in the major field must be completed at the University regardless of the number of hours transferred.

The College of Arts and Sciences will accept no more than 15 semester hours of C- and D grades from other schools. The C- and D grades cannot be applied toward requirements for a major or minor. This policy does not apply to the transfer of grades from UNO or UNK to the University of Nebraska–Lincoln. All D grades may be transferred from UNO or UNK, but they are not applicable to a major or minor.

Readmitted Students
University of Nebraska–Lincoln students who choose not to take courses for more than two consecutive terms, must reapply to the University of Nebraska–Lincoln. Students readmitted to the College of Arts and Sciences will follow the requirements stated in the catalog for the academic year of readmission and re-enrollment as a degree-seeking student in Arts and Sciences. In consultation with advisors, a student may choose to follow a catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at Nebraska 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.

Admission Deficiencies/Removal of Deficiencies
Students must remove entrance deficiencies in geometry and foreign language as soon as possible, and before graduating from the College of Arts and Sciences. For questions and more information, students should consult a college advisor in the Academic and Career Advising Center in 107 Oldfather Hall.

Removing Foreign Language Deficiencies
Students must complete the second semester of a first year language sequence to clear the deficiency and the second semester of the second year language sequence to complete the college graduation requirement in language.

Removing Geometry Deficiencies
A deficiency of one year of geometry can be removed by taking high school geometry courses through an approved independent study program, or by completing a geometry course from an accredited community college or a four-year institution. Neither of these options will count for college credit.

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 further the purposes of liberal education by encouraging study in several different areas within the College. All requirements are in addition to University ACE requirements. A student may not use a single course to satisfy more than one of the following five distribution requirements. A student cannot use a single course to satisfy both an ACE outcome and a College distribution requirement. A student cannot 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 or reading courses and internships cannot be used to satisfy distribution requirements. To see a complete list of excluded courses, run a degree audit through MyRED.

Courses from interdisciplinary programs will count in the same area as courses from the home/cross-listed department(s).

**College Distribution Requirements**

<table>
<thead>
<tr>
<th>CDR A - Written Communication</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td>Select from courses approved for ACE outcome 1.</td>
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</table>

<table>
<thead>
<tr>
<th>CDR B and BL - Natural, Physical, and Mathematical Sciences with Lab</th>
<th>4</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>CDR C - Humanities</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select from classics, English, history, modern languages and literatures, philosophy, and religious studies.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CDR D - Social Science</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select from: anthropology, communication studies, geography, political science, psychology, or sociology.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CDR E - Language</th>
<th>0-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>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, modern languages and literatures, or anthropology. Instruction is currently available in Arabic, Chinese, Czech, French, German, Greek, Japanese, Latin, Omaha, 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.</td>
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</table>

<table>
<thead>
<tr>
<th>CDR F - Additional Breadth</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
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</tbody>
</table>

Credit Hours Subtotal: 16-32

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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 or below apply only for the foreign language requirement.

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, anthropology (selected courses), astronomy, biochemistry (excluding BIOL 101), biological sciences (excluding 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, 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.

**Foreign Languages/Language Requirement**

**Languages Exemption Policy**

The University of Nebraska–Lincoln and the College of Arts and Sciences will exempt or waive students from the Nebraska entrance requirement of two years of the same foreign language or from the College’s language distribution requirement based on documentation only. The following are the options and procedures for documentation:

**High School Transcripts**

For the University entrance requirement, students must show an official high school transcript with two or more years of the same foreign language.

For the College of Arts and Sciences College Distribution Requirement E-Language, students must show an official high school transcript with four or more years of the same foreign language in high school, or show evidence of graduation from a non-English-speaking foreign high school. Students whose native language is not English must show English as a Second Language study on an official high school transcript. Four years of ESL at the high school level (9th, 10th, 11th and 12th grades) will be the basis for a waiver of the CDR E Language requirement.

**Proficiency Examination at UNL**

For the University entrance requirement, students who do not have transcript documentation can request to take a proficiency exam in the language. (This is not the same test as the Modern Languages Placement Exam.) However, the University will provide testing only in the languages it teaches. Currently, these languages are: Arabic, French, German, Spanish, Russian, Czech, Japanese, Chinese.

For the College of Arts and Sciences College Distribution Requirement E-Language, the Department of Modern Languages will oversee the test at the 202 level. If the student passes the test, the department will sign the College Request for Waiver form and indicate the level of proficiency. The form is then forwarded to the Arts and Sciences Advising Center for approval.

The Department of Modern Languages will oversee the test and provide written documentation to the Arts and Sciences Advising Center the level of proficiency passed.

**Distance Education**

For the University entrance requirement, students without transcript documentation who claim proficiency in a language not taught at the University of Nebraska–Lincoln, have the option of seeking out a distance education program in languages. If the student completes the equivalent of 102 from an approved distance education program, the student will meet the University’s entrance requirement. The student must have the course work approved before he/she takes/completes the course as equivalent to 102 by a College advisor. The student then completes the course and has the distance education program send the transcript to the Admissions Office.

For the College of Arts and Sciences College Distribution Requirement E-Language, the student can seek out a distance education program and complete the equivalent of the 202-level course. The student must submit
the request on the College Request for Substitution form and have the course work approved by a College advisor. The student then completes the course and has the distance education program send the transcript to the Admissions Office.

**Third Language Option**
If a student demonstrates knowledge of two foreign languages at the 102 level, the College of Arts and Sciences may consider waiving two semesters of the four semester College Distribution Requirement E-Languages requirement. If this waiver were granted, the student would then be required to complete 101 and 102 in another, 3rd foreign language at Nebraska.

**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 schools except for UNO and UNK. No transfer 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.

**Pass/No Pass Privilege**
University regulations for the Pass/No Pass (P/N) privilege state:

- The Pass/No Pass option is designed for your use by seeking to expand your intellectual horizons by taking courses in areas where you may have had minimal preparation.
- Neither the P nor the N grade contribute to your GPA.
- P is interpreted to mean C or above.
- A change to or from a Pass/No Pass may be made until mid-term (see academic calendar for specific dates per term).
- The Pass/No Pass or grade registration cannot conflict with the policy of the professor, department, college, or University governing the grading option.
- Changing to or from Pass/No Pass requires using the MyRED system to change the grading option or filing a Drop/Add form with the Office of the University Registrar, 107 Canfield Administration Building. After mid-term of the course, a student registered for Pass/No Pass cannot change to a grade registration unless the Pass/No Pass registration is in conflict with the policy of the professor, department, college, or University governing Pass/No Pass.
- The Pass/No Pass grading option cannot be used for the removal of C- or D or F grades.

Pass/No Pass privileges in the College of Arts and Sciences are extended to students according to the following additional regulations:

- 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 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 above 299**
Thirty of the 120 semester hours of credit must be in courses numbered above 299. Of the 30 hours above 299, 15 hours (1/2) must be completed in residence at UNL.

**Graduate Courses**
Seniors in the University who have obtained in advance the approval of the dean for Graduate Studies may receive up to 12 hours credit for graduate courses taken in addition to the courses necessary to complete their undergraduate work, provided that such credits are earned within the calendar year prior to receipt of the baccalaureate. For procedures, inquire at the Office of Graduate Studies.

Course work taken prior to receipt of the baccalaureate may not always be accepted for transfer to other institutions as graduate work.

**Residency**
**Residency Requirement and Open Enrollment and Summer Independent Study Courses**
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 course work including 6 hours above 299 in their major, and 15 of the 30 hours required above 299 in residence. Credit earned during education abroad may be used toward the residency requirement if students register through the University and participate in prior-approved education abroad programs. The University of Nebraska–Lincoln open enrollment and summer independent study courses count toward residence.

**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.
Key characteristics of ACE demonstrate the benefits of the program to students:

- Students receive a broad education with exposure to multiple disciplines, critical life skills and important reasoning, inquiry, and civic capacities.
- ACE is simple and transparent for students, faculty and advisors. Students complete the equivalent of 3 credit hours for each of the ten student learning outcomes.
- Students connect and integrate their ACE experiences with their selected major.
- Students can transfer all ACE certified courses across colleges within the institution to meet the ACE requirement and any course from outside the institution that is directly equivalent to a University of Nebraska–Lincoln ACE-certified course. Courses from outside institutions without direct equivalents may be considered with appropriate documentation for ACE credit (see academic advisor).

ACE allows faculty to assess and improve their effectiveness and facilitate students’ learning.

ACE Institutional Objectives and Student Learning Outcomes

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 Rule

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 Nebraska 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 may not be more than 10 years old at the time of graduation.

Learning Outcomes

Majors in 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.
BIOC 321 & BIOC 321L
Elements of Biochemistry and Laboratory for Elements of Biochemistry

BIOC 431 / BIOS 431 / CHEM 431
Structure and Metabolism

Credit Hours Subtotal: 3-4

Physics

Select one sequence of the following:

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 141 &amp; PHYS 142</td>
<td>Elementary General Physics I and Elementary General Physics II</td>
</tr>
<tr>
<td>PHYS 211 &amp; PHYS 221 &amp; PHYS 212 &amp; PHYS 222</td>
<td>General Physics I and General Physics Laboratory I and General Physics II and General Physics Laboratory II</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 10

Mathematics and Statistics

MATH 106
Calculus I

Select one of the following:

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Description</th>
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<tbody>
<tr>
<td>STAT 218</td>
<td>Introduction to Statistics</td>
</tr>
<tr>
<td>EDPS 459</td>
<td>Statistical Methods</td>
</tr>
<tr>
<td>ECON 215</td>
<td>Statistics</td>
</tr>
<tr>
<td>STAT 380 / MATH 380</td>
<td>Statistics and Applications</td>
</tr>
</tbody>
</table>

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.

Advanced Microbiology Courses

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

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BIOC 432 / BIOS 432 / CHEM 432</td>
<td>Metabolism and Biological Information</td>
</tr>
<tr>
<td>BIOC 433 / BIOS 433 / CHEM 433</td>
<td>Biochemistry Laboratory</td>
</tr>
<tr>
<td>BIOC 437 / BIOS 437</td>
<td>Research Techniques in Biochemistry</td>
</tr>
<tr>
<td>BIOC 442 / STAT 442</td>
<td>Computational Biology</td>
</tr>
<tr>
<td>BIOS 302</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>BIOS 303</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>BIOS 326</td>
<td>Biology of Viruses</td>
</tr>
<tr>
<td>BIOS 402</td>
<td>Cancer Biology</td>
</tr>
<tr>
<td>BIOS 407</td>
<td>Biology of Cells and Organelles</td>
</tr>
<tr>
<td>BIOS 426</td>
<td>Systems Biology</td>
</tr>
<tr>
<td>BIOS 444 / GEOL 444</td>
<td>Geomicrobiology</td>
</tr>
<tr>
<td>BIOS 460 / AGRO 460 / NRES 460 / SOIL 460</td>
<td>Soil Microbiology</td>
</tr>
</tbody>
</table>

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
• Pharmacy Technician, Cody’s U-Save Pharmacy - Auburn NE
• Assistant Professor, Bryan College of Health Sciences - Lincoln NE
• Contractor, Syngenta - Omaha NE
• Associate Analyst, Celerion - Lincoln NE
• Burn Technician, St. Elizabeth Regional Health Center - Lincoln NE
• Science Writer, LI-COR Biosciences - Lincoln NE
• Chemist, Archer Daniels Midland - Lincoln NE
• Scientist I, Aerotek - Chicago IL
• Plant Research Biologist, Midwest Research Inc. - York NE
• Laboratory Technician, POET Research Center, Inc - Scotland SD
• Process Engineer, Novozymes, Inc. - Blair NE
• Registered Nurse, Lincoln Orthopedic Surgery Center - 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, University of Nebraska-Lincoln 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, University of Nebraska-Lincoln 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
• Medical Doctor, University of Nebraska Medical Center - Omaha NE
• Doctor of Veterinary Medicine, University of Nebraska-Lincoln - Lincoln NE
• Cancer Research Graduate Program, University of Nebraska Medical Center - Omaha NE
• Doctor of Pharmacy, University of Nebraska Medical Center - Omaha NE
• Doctor of Dental Surgery, UNMC College of Dentistry - Lincoln NE
• Master’s Degree, Biochemistry, University of Nebraska-Lincoln - Lincoln NE
• Master’s Degree, Genetic Counseling, Northwestern University - Chicago IL
• Master’s Degree, Clinical Perfusion, University of Nebraska Medical Center - Omaha NE
• Ph.D., Molecular and Cell Biology, University of California-Berkeley - Berkeley CA
• Master’s Degree, Business Administration, University of Nebraska-Lincoln - Lincoln NE
• Juris Doctorate, Texas Wesleyan University School of Law - Fort Worth TX
• Master’s Degree, Medical Anatomy, University of Nebraska Medical Center - Omaha NE
• Doctor of Optometry, Southern College of Optometry - Memphis TN
• Master’s Degree, Sports Management, Indiana University - Bloomington IN