COMPUTATIONAL BIOLOGY & BIOINFORMATICS MINOR (CASNR)

Description
This interdisciplinary minor prepares students to understand, use, and develop advanced computational methods and tools for processing, visualizing, and analyzing biological data and for modeling biological processes. Studies in computational biology and bioinformatics involve biosciences, computer science, engineering, mathematics, and statistics. Students will be prepared for careers in biomedical, biotechnology, agricultural, pharmaceutical, and engineering fields and for related graduate studies.

College Requirements

College Admission
Requirements for admission into the College of Agricultural Sciences and Natural Resources (CASNR) are consistent with general University admission requirements (one unit equals one high school year): 4 units of English, 4 units of mathematics, 3 units of natural sciences, 3 units of social sciences, and 2 units of world language. Students must also meet performance requirements: a 3.0 cumulative high school grade point average OR an ACT composite of 20 or higher, writing portion not required OR a score of 1040 or higher on the SAT Critical Reading and Math sections OR rank in the top one-half of graduating class; transfer students must have a 2.0 (on a 4.0 scale) cumulative grade point average and 2.0 on the most recent term of attendance. For students entering the PGA Golf Management degree program, a certified golf handicap of 12 or better (e.g., USGA handicap card) or written ability (MS Word file) equivalent to a 12 or better handicap by a PGA professional or high school golf coach is required. For more information, please visit http://pgm.unl.edu/requirements/.

Admission Deficiencies/Removal of Deficiencies
Students who are admitted to CASNR with core course deficiencies must remove these deficiencies within the first 30 credit hours at the University of Nebraska–Lincoln, or within the first calendar year at Nebraska, whichever takes longer, excluding foreign languages. Students have up to 60 credit hours to remove world language deficiencies. College-level coursework taken to remove deficiencies may be used to meet degree requirements in CASNR.

Deficiencies in the required entrance subjects can be removed by the completion of specified courses in the University or by correspondence.

The Office of Admissions, Alexander Building (south entrance), City Campus, provides information to new students on how deficiencies can be removed.

College Degree Requirements

Curriculum Requirements
The curriculum requirements of the College consist of three areas: ACE (Achievement-Centered Education), College of Agricultural Sciences and Natural Resources Core, and Degree Program requirements and electives. All three areas of the College Curriculum Requirements are incorporated within the description of the Major/Degree Program sections of the catalog. The individual major/degree program listings of classes ensures that a student will meet the minimum curriculum requirements of the College.

World Languages/Language Requirement
Two units of a world language are required. This requirement is usually met with two years of high school language.

Minimum Hours Required for Graduation
The College grants the bachelor's degree in programs associated with agricultural sciences, natural resources, and related programs. Students working toward a degree must earn at least 120 semester hours of credit. A minimum cumulative grade point average of C (2.0 on a 4.0 scale) must be maintained throughout the course of studies and is required for graduation. Some degree programs have a higher cumulative grade point average required for graduation. Please check the degree program on its graduation cumulative grade point average.

Grade Rules

Removal of C-, D, and F Grades
Only the most recent letter grade received in a given course will be used in computing a student's cumulative grade point average if the student has completed the course more than once and previously received a grade or grades below C in that course.

The previous grade (or grades) will not be used in the computation of the cumulative grade point average, but it will remain a part of the academic record and will appear on any transcript.

A student can remove from his/her cumulative average a course grade of C, D+, D, D-, or F if the student repeats the same course at the University of Nebraska and receives a grade other than P (pass), I (incomplete), N (no pass), W (withdrawn), or NR (no report). If a course is no longer being offered, it is not eligible for the revised grade point average computation process.

For complete procedures and regulations, see the Office of the University Registrar website at http://www.unl.edu/regrec/course-repeats/.

Pass/No Pass
Students in CASNR may take any course offered on a Pass/No Pass basis within the 24-hour limitation established by the Faculty Senate. However, a department may specify that the Pass/No Pass status of its courses be limited to non-majors or may choose to offer some courses for letter grades only.

GPA Requirements
A minimum cumulative grade point average of C (2.0 on a 4.0 scale) must be maintained throughout the course of studies and is required for graduation. Some degree programs have a higher cumulative grade point average required for graduation. Please check the degree program on its graduation cumulative grade point average.

Transfer Credit Rules
To be considered for admission, a transfer student, Nebraska resident or nonresident, 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 have completed less than 12 credit hours of college study must submit either ACT or SAT scores.

Ordinarily, credits earned at an accredited college are accepted by the University. The College, however, will evaluate all hours submitted on an application for transfer and reserves the right to accept or reject
Joint Academic Transfer Programs
The College of Agricultural Sciences and Natural Resources has agreements with many institutions to support joint academic programs. The transfer programs include dual degree programs and cooperative degree programs. Dual degree programs offer students the opportunity to receive a degree from a participating institution and also to complete requirements for a bachelor of science degree in CASNR. Cooperative programs result in a single degree from either the University of Nebraska–Lincoln or the cooperating institution.

Dual Degree Programs
A to B Programs
The A to B Program, a joint academic program offered by the CASNR and participating community colleges, allows students to complete the first two years of a degree program at the participating community college and continue their education and study in a degree program leading toward a bachelor of science degree.

The A to B Program provides a basic knowledge plus specialized coursework. Students transfer into CASNR with junior standing. Depending on the community college, students enrolled in the A to B Program may complete the requirements for an associate of science degree. Students transfer to the University of Nebraska–Lincoln, and work toward a bachelor of science degree.

Participating community colleges include:
- Central Community College
- Metropolitan Community College
- Mid-Plains Community College
- Nebraska College of Technical Agriculture
- Nebraska Indian Community College
- Northeast Community College
- Southeast Community College
- Western Nebraska Community College

3+2 Programs
Two specialized degree programs in animal science and veterinary science are offered jointly with an accredited college or school of veterinary medicine. These two programs permit CASNR animal science or veterinary science students to receive a bachelor of science degree from the University of Nebraska–Lincoln with a degree in animal science or veterinary science after successfully completing two years of the professional curriculum in veterinary medicine at an accredited veterinary school. Students who successfully complete the 3+2 Program, must provide transcripts and complete the Application for Degree form via MyRED. Students without MyRED access may apply for graduation in person at Husker Hub in the Canfield Administration Building, or by mail. Students should discuss these degree programs with their academic advisor.

Cooperative Degree Programs
Academic credit from the University and a cooperating institution are applied toward a four-year degree from either the University of Nebraska–Lincoln (University degree-granting program) or the cooperating institution (non University degree-granting program). All have approved programs of study.

UNL Degree-Granting Programs
A University of Nebraska–Lincoln degree-granting program is designed to provide students the opportunity to complete a two-year program of study at one of the four-year institutions listed below, transfer to CASNR, and complete the requirements for a bachelor of science degree.

Chadron State College. Chadron State College offers a 2+2 program leading to a grassland ecology and management degree program and a transfer program leading to a bachelor of science in agriculture in the teaching option.

Wayne State College. Wayne State College offers a 3+1 program leading to a bachelor of science in plant biology in the ecology and management option and a 3+1 program leading to a bachelor of science in Applied Science.

University of Nebraska at Kearney. Transfer programs are available for students pursuing degree programs leading to a bachelor of science degree.

University of Nebraska at Omaha. Transfer programs are available for students pursuing degree programs leading to a bachelor of science degree.

Non University of Nebraska–Lincoln Degree-Granting Programs
CASNR cooperates with other institutions to provide coursework that is applied towards a degree at the cooperating institution. Pre-professional programs offered by CASNR allow students to complete the first two or three years of a degree program at the University prior to transferring and completing a degree at the cooperating institution.

Chadron State College–Range Science. The 3+1 Program in range science allows Chadron State College students to pursue a range science degree through Chadron State College. Students complete three years of coursework at Chadron State College and one year of specialized range science coursework (32 credit hours) at CASNR.

Dordt College (Iowa)–Agricultural Education: Teaching Option. This program allows students to pursue an Agricultural Education Teaching Option degree leading toward a bachelor of science in agricultural education. Students at Dordt College will complete 90 credit hours in the Agricultural Education: Teaching Option Transfer Program.

Residency
Students must complete at least 30 of the total hours for their degree using University of Nebraska–Lincoln credits. At least 18 of the 30 credit hours must be in courses offered through CASNR (>299) including the appropriate ACE 10 degree requirement or an approved ACE 10 substitution offered through another Nebraska college and excluding independent study regardless of the number of hours transferred. Credit earned during education abroad may be used toward the residency requirement if students register through the University of
Nebraska–Lincoln and participate in prior-approved education abroad programs. University of Nebraska–Lincoln open enrollment and summer independent study courses count toward residence.

1 Includes courses taught by CASNR faculty through interdisciplinary prefixes (e.g., LIFE, MBIQ, ENVR, SOIL, EAEP, HRTM, ENSC) and CASNR crosslisted courses taught by non-CASNR faculty.

Online and Distance Education
There are many opportunities to earn college credit online through the University of Nebraska–Lincoln. Some of these credits may be applicable not only as elective credits but also toward the fulfillment of the College's education requirements. Credits earned online may count toward residency. However, certain offerings may not be counted toward scholarship requirements or academic recognition criteria.

For further information, contact:
Office of Online and Distance Education
University of Nebraska–Lincoln
305 Brace Labs
Lincoln, NE 68588-0109
402-472-4681
http://online.unl.edu/

Independent Study Rules
Students wishing to take part in independent studies must obtain permission; complete and sign a contract form; and furnish copies of the contract to the instructor, advisor, departmental office, and the Dean's Office. The contract should be completed before registration. Forms are available in 103 Agricultural Hall or online at the CASNR website.

Independent study projects include research, literature review or extension of coursework under supervision and evaluation of a departmental faculty member.

Students may only count 12 hours of independent study toward their degrees and no more than 6 hours can be counted during their last 36 hours earned, excluding senior thesis, internships, and courses taught under an independent study number.

Other College Degree Requirements
Capstone Course Requirement
A capstone course is required for each CASNR degree program. A capstone course is defined as a course in which students are required to integrate diverse bodies of knowledge to solve a problem or formulate a policy of societal importance.

ACE Requirements
All students must fulfill the Achievement Centered Education (ACE) requirements. Information about the ACE program may be viewed at ace.unl.edu (https://ace.unl.edu/).

The minimum requirements of CASNR reflect the common core of courses that apply to students pursuing degrees in the college. Students should work with an advisor to satisfy ACE outcomes 1, 2, 3, 4, 6, and 10 with the college requirements.

Catalog Rule
Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted to the University of Nebraska–Lincoln or when they were first admitted to a Joint Academic Transfer Program. 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 Agricultural Sciences and Natural Resources. Students must complete all degree requirements from a single catalog year. The catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Requirements for Minor Offered by Department
Eighteen (18) hours (not including prerequisites) of core courses and additional courses.

Prerequisite Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHEM 109A &amp; CHEM 109L</td>
<td>General Chemistry I and General Chemistry I Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>LIFE 120 &amp; LIFE 120L</td>
<td>Fundamentals of Biology I and Fundamentals of Biology I Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>MATH 106</td>
<td>Calculus I (or equivalent)</td>
<td>5</td>
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</table>

Core Courses

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CSCE 155T</td>
<td>Computer Science I: Informatics Focus</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 311</td>
<td>Data Structures and Algorithms for Informatics</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 337</td>
<td>Applications of Bioinformatics</td>
<td>4</td>
</tr>
<tr>
<td>STAT 218</td>
<td>Introduction to Statistics (^2)</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 380</td>
<td>Statistics and Applications</td>
<td>3</td>
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Credit Hours Subtotal: 13

Life Science Course

Select a course from either LS 1 or LS 2 choices, depending on your major.

LS 1 – For students in life science majors.
- BIOS 426 | Systems Biology |
- BIOS 427 | Practical Bioinformatics Laboratory |
- BIOS 456 / NRES 456 | Mathematical Models in Biology |
- BIOS 477 | Bioinformatics and Molecular Evolution |

LS 2
- BIOC 431 / BIOS 431 / CHEM 431 | Biochemistry I: Structure and Metabolism |
- BIOC 432 / BIOS 432 / CHEM 432 | Biochemistry II: Metabolism and Biological Information |
- BIOC 434 / AGRO 434 / BIOS 434 / CHEM 434 | Plant Biochemistry |
- BIOS 418 | Advanced Genetics |
- BIOS 420 / MBIO 420 | Molecular Genetics |
- BIOS 425 | Plant Biotechnology |
- BIOS 429 | Phylogenetic Biology |
- BIOS 472 | Evolution |

Credit Hours Subtotal: 3-4
<table>
<thead>
<tr>
<th>Computer Science/Math/Statistics/Engineering (CMSE) Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select a course from either CMSE 1 or CMSE 2 choices, depending on your major.</td>
</tr>
<tr>
<td><strong>CMSE 1 – For students in computer science, math, engineering, and related majors.</strong></td>
</tr>
<tr>
<td>CSCE 471 Computational Methods in Bioinformatics</td>
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<tr>
<td><strong>CMSE 2</strong></td>
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<td>BSEN 414 Medical Imaging Systems</td>
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<tr>
<td>CHME 473 Biochemical Engineering</td>
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<tr>
<td>CHME 474 Advanced Biochemical Engineering</td>
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<tr>
<td>CSCE 413 Database Systems</td>
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<td>CSCE 421 Foundations of Constraint Processing</td>
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<td>CSCE 423 Design and Analysis of Algorithms</td>
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<td>CSCE 435 Cluster and Grid Computing</td>
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<td>CSCE 456 Parallel Programming</td>
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<td>CSCE 472 Digital Image Processing</td>
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<td>CSCE 474 Introduction to Data Mining</td>
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<td>CSCE 476 Introduction to Artificial Intelligence</td>
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<td>CSCE 478 Introduction to Machine Learning</td>
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<td>CSCE 479 Introduction to Deep Learning</td>
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<td>ECEN 450 Bioinformatics</td>
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<td>MATH 439 Mathematical Biology</td>
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<td>MATH 452 Graph Theory</td>
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<tr>
<td>STAT 412 Advanced Statistical Design</td>
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<td>STAT 450 Introduction to Regression Analysis</td>
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</tbody>
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| Credit Hours Subtotal: | 3 |

Total Credit Hours: 19-20

1. These requirements can be replaced with equivalent courses upon approval except for BIOS 337, which cannot be replaced.
2. Students are strongly encouraged to take STAT 218 or STAT 380. However, ECEN 305 can be used to satisfy this requirement, subject to approval.
3. For life science major students, those courses listed as LS Elective 2 cannot be used for CBB requirements.
4. For students in computer science, mathematics, engineering, and related majors, those courses listed as CMSE Elective 2 cannot be used for CBB requirements.

**Grade Rules**

**C- and D Grades**

A grade of C or above is required for all courses in the minor.

**Pass/No Pass**

No course taken Pass/No Pass will be counted toward the minor.