COMPUTATIONAL BIOLOGY & BIOINFORMATICS MINOR (CAS)

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.

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 Hall 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.

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 preprofessional 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>Requirement</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CDR A - Written Communication</td>
<td>3</td>
</tr>
<tr>
<td>Select from courses approved for ACE outcome 1.</td>
<td></td>
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<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>
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<tr>
<td>Some courses from geography and anthropology may also be used to satisfy the lab requirement above. 1</td>
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<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. 2</td>
<td></td>
</tr>
<tr>
<td>CDR D - Social Science</td>
<td>3</td>
</tr>
<tr>
<td>Select from anthropology, communication studies, geography, political science, psychology, or sociology. 3</td>
<td></td>
</tr>
<tr>
<td>CDR E - Language</td>
<td>0-16</td>
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</tbody>
</table>

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.

1 Some courses from geography and anthropology may also be used to satisfy the lab requirement above.
2 Select from classics, English, history, modern languages and literatures, philosophy, and religious studies.
3 Select from anthropology, communication studies, geography, political science, psychology, or sociology.
A student who has completed the fourth-year level of one foreign language in high school is exempt from the language 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.

<table>
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<tr>
<th>Credit Hours Subtotal:</th>
<th>16-32</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>See Degree Audit or a College of Arts and Sciences advisor for approved geography and anthropology courses that apply as natural science.</td>
</tr>
<tr>
<td>2</td>
<td>Language courses numbered 210 and below do not fulfill the CDR C.</td>
</tr>
<tr>
<td>3</td>
<td>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.</td>
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</tbody>
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**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 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, 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.

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

Prerequisite Courses
CHEM 109 General Chemistry I (or equivalent) 4
LIFE 120 Fundamentals of Biology I and Fundamentals of Biology I laboratory 4
MATH 106 Calculus I (or equivalent) 5
Credit Hours Subtotal: 13

Core Courses
CSCE 155T Computer Science I: Informatics Focus 3
CSCE 311 Data Structures and Algorithms for Informatics 3
BIOS 337 Applications of Bioinformatics 4
or STAT 218 Introduction to Statistics 2 3
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 Structure and Metabolism
BIOC 432 / BIOS 432 / CHEM 432 Metabolism and Biological Information
BIOS 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

Computer Science/Math/Statistics/Engineering (CMSE) Course 4
Select a course from either CMSE 1 or CMSE 2 choices, depending on your major.
CMSE 1 - For students in computer science, math, engineering and related majors.

CSCE 471 Computational Methods in Bioinformatics

CMSE 2
BSEN 414 Medical Imaging Systems
CHME 473 Biochemical Engineering
CHME 474 Advanced Biochemical Engineering
CSCE 410 Information Retrieval Systems
CSCE 413 Database Systems
CSCE 421 Foundations of Constraint Processing
CSCE 423 Design and Analysis of Algorithms
CSCE 435 Cluster and Grid Computing
CSCE 456 Parallel Programming
CSCE 472 Digital Image Processing
CSCE 474 Introduction to Data Mining
CSCE 476 Introduction to Artificial Intelligence
CSCE 478 Introduction to Machine Learning
CSCE 479 Introduction to Deep Learning
ECEN 450 Bioinformatics
MATH 439 Mathematical Models in Biology
MATH 452 Graph Theory
STAT 412 Introduction to Experimental Design
STAT 450 Introduction to Regression Analysis
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.