

# COMPUTATIONAL BIOLOGY & BIOINFORMATICS MINOR (ASC)

## 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

#### 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. 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.

#### 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 UNL 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 UNL 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 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 UNL. All D grades may be transferred from UNO or UNK, but they are not applicable to a major or minor.

#### Readmitted Students

UNL students who choose not to take courses for more than 2 consecutive terms, must reapply to UNL. 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 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.

#### 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).

Code	Title	Credit Hours
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#### College Distribution Requirements

CDR A - Written Communication		3
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Select from courses approved for ACE outcome 1.

<b>CDR B and BL - Natural, Physical, and Mathematical Sciences with Lab</b>	<b>4</b>
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.	
Some courses from geography and anthropology may also be used to satisfy the lab requirement above. <sup>1</sup>	
<b>CDR C - Humanities</b>	<b>3</b>
Select from classics, English, history, modern languages and literatures, philosophy, and religious studies. <sup>2</sup>	
<b>CDR D - Social Science</b>	<b>3</b>
Select from: anthropology, communication studies, geography, political science, psychology, or sociology. <sup>3</sup>	
<b>CDR E - Language</b>	<b>0-16</b>
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.	
<b>CDR F - Additional Breadth</b>	<b>3</b>
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

<sup>1</sup> See degree audit or a College of Arts and Sciences advisor for approved geography and anthropology courses that apply as natural science.

<sup>2</sup> Language courses numbered 210 or below apply only for the foreign language requirement.

<sup>3</sup> 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 BIOC 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

UNL and the College of Arts and Sciences will exempt or waive students from the UNL 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, UNL 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 UNL, 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 UNL 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 UNL.

## 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 UNL 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:**

- 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 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 UNL. 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 UNL and participate in prior-approved education abroad programs. UNL 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 UNL 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 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 & 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
MATH 106	Calculus I (or equivalent)	5
Credit Hours Subtotal:		17

### Core Courses <sup>1</sup>

CSCE 155T	Computer Science I: Informatics Focus	3
CSCE 311	Data Structures and Algorithms for Informatics	3
BIOS 237	Basic Applications of Bioinformatics	4
STAT 218	Introduction to Statistics <sup>2</sup>	3
	or STAT 380 / Statistics and Applications MATH 380	
Credit Hours Subtotal:		13

### Life Science Course <sup>3</sup>

Select a course from either LS 1 or LS 2 choices, depending on your major. 3-4

LS 1 - for students in life science majors.

BIOS 427	Practical Bioinformatics Laboratory	
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BIOS 428	Perl Programming for Biological Applications	
BIOS 456 / NRES 456	Mathematical Models in Biology	
BIOS 477	Bioinformatics and Molecular Evolution	
STAT 442 / BIOS 442	Computational Biology	
LS 2		
BIOS 431 / BIOS 431 / CHEM 431	Structure and Metabolism	
BIOS 432 / BIOS 432 / CHEM 432	Metabolism and Biological Information	
BIOC 434 / AGRO 434 / BIOS 434 / CHEM 434	Plant Biochemistry	
BIOS 420 / MBIO 420	Molecular Genetics	
BIOS 425	Plant Biotechnology	
BIOS 429	Phylogenetic Biology	
BIOS 472	Evolution	
Credit Hours Subtotal:		3-4
<b>Computer Science/Math/Statistics/Engineering (CMSE) Course <sup>4</sup></b>		
Select a course from either CMSE 1 or CMSE 2 choices, depending on your major.		3
<i>CMSE 1 - For students in computer science, math, engineering and related majors.</i>		
CSCE 471	Introduction to Bioinformatics	
<i>CMSE 2</i>		
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 Neural Networks	
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

- <sup>1</sup> *These requirements can be replaced with equivalent courses upon approval except for BIOS 237, which cannot be replaced.*
- <sup>2</sup> *Students are strongly encouraged to take STAT 218 or STAT 380. However, ECEN 305 can be used to satisfy this requirement, subject to approval.*
- <sup>3</sup> *For life science major students, those courses listed as LS Elective 2 cannot be used for CBB requirements.*
- <sup>4</sup> *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.