Bioinformatics and Computational Biology Undergraduate

Undergraduate study

Undergraduate study in BCBio is jointly administered by the Department of Computer Science, the Department of Genetics, Development, and Cell Biology, and the Department of Mathematics. The undergraduate B.S. degree is offered through the College of Liberal Arts and Sciences.

Bioinformatics and Computational Biology is an interdisciplinary science at the interfaces of the biological, informational and computational sciences. The science focuses on a variety of topics. These include gene identification, expression, and evolution; RNA, protein, and genome structure; and molecular and cellular systems and networks. The large group of participating faculty provides students with a multidimensional perspective on bioinformatics and computational biology and presents them with a broad range of possibilities to get involved in research.

This major will prepare students for careers at the interfaces of biological, informational and computational sciences. BCBio graduates with a B.S. seeking direct employment will find ready markets for their talents in agricultural and medical biotechnology industries, as well as in academia, national laboratories, and clinics. Although some students find employment directly after their baccalaureate training, many students will continue their education in one of the many excellent graduate programs in bioinformatics and computational biology that now exist.

Participation in this field requires that students achieve a high level of competence not only in biology, but also in mathematics, computer science, and statistics. As a result, the program includes required courses from many different disciplines. Graduates demonstrate an above-average ability to synthesize methods from these different disciplines to solve problems.

In addition to basic degree requirements listed in the Curriculum in Liberal Arts and Sciences (www.las.iastate.edu/academics/generaleducation/), BCBio majors must satisfy the following requirements:

A. Complementary Courses for the BCBio Major (34 cr)

One of the following:

- CHEM 177 and Laboratory in General Chemistry I
- CHEM 177L and General Chemistry II
- CHEM 201 & 201L Advanced General Chemistry and Laboratory in Advanced General Chemistry
- CHEM 331 General and Organic Chemistry I

- PHYS 221 Introduction to Classical Physics I
- STAT 330 Probability and Statistics for Computer Science
- STAT 341 Introduction to the Theory of Probability and Statistics I
- STAT 430 Empirical Methods for the Computational Sciences
- BIOL 211 Principles of Biology I
- BIOL 211L Principles of Biology Laboratory I
- BIOL 212 Principles of Biology II
- BIOL 212L Principles of Biology Laboratory II
- BIOL 314 Principles of Molecular Cell Biology

Total Credits: 34

B. Core Courses Within the BCBio Major (48 cr)

- GEN 313 Principles of Genetics
- GEN 313L Genetics Laboratory
- GEN 409 Molecular Genetics
- COM S 227 Introduction to Object-oriented Programming
- COM S 228 Introduction to Data Structures
- COM S 363 Introduction to Database Management Systems
- COM S 330 Discrete Computational Structures
- or CPR E 310 Theoretical Foundations of Computer Engineering

C. Core Courses Within the BCBio Major (48 cr)

- MATH 207 Matrices and Linear Algebra
- BCBIO 110 BCBIO Orientation
- BCBIO 211 Introduction to Bioinformatics and Computational Biology
- BCBIO 401 Fundamentals of Bioinformatics and Computational Biology I
- BCBIO 402 Fundamentals of Bioinformatics and Computational Biology II
- BCBIO 490 Independent Study

D. The communications and English proficiency requirements of the LAS college are met by:

- ENGL 150 Critical Thinking and Communication
- ENGL 250 Written, Oral, Visual, and Electronic Composition
- or ENGL 250H

Courses primarily for undergraduates:

BCBIO 110. BCBIO Orientation.
(1-0) Cr. 0.5. F.
First 8 weeks. Orientation to the area of bioinformatics and computational biology. For students considering a major in BCBIO. Specializations and career opportunities. Offered on a satisfactory-fail basis only.

BCBIO 211. Introduction to Bioinformatics and Computational Biology.
(3-0) Cr. 3. S.
Perl programming, molecular biology, biological databases, sequence alignment, homology search, identification of sequence patterns, construction of phylogenetic trees, gene function prediction, gene structure prediction, genomic annotation and comparative genomics.
BCBIO 401. Fundamentals of Bioinformatics and Computational Biology I. 
(3-0) Cr. 3. F. Prereq: BCBIO 211 and basic programming experience (e.g. COM S 207, COM S 208, COM S 227 or permission of instructor).
Application of computer science to molecular biology. String algorithms, sequence alignments, indexing data structures, homology search methods, pattern recognition, fragment assembly, genome annotation, construction of bioinformatics databases, and gathering and distribution of biological information with the Internet.

BCBIO 402. Fundamentals of Bioinformatics and Computational Biology II. 
(3-0) Cr. 3. S. Prereq: BCBIO 401

BCBIO 442. Bioinformatics and Computational Biology Techniques. 
(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.S. Prereq: BIOL 314 recommended
Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only. Nonmajor graduate credit.

BCBIO 442A. Bioinformatics and Computational Biology Techniques: Sequence Database Searching. 
(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.S. Prereq: BIOL 314 recommended
Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only. Nonmajor graduate credit.

BCBIO 442B. Bioinformatics and Computational Biology Techniques: Protein Structure Databases, Visualization, and Prediction. 
(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.S. Prereq: BIOL 314 recommended
Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only. Nonmajor graduate credit.

BCBIO 442C. Bioinformatics and Computational Biology Techniques: Phylogenetic Analysis. 
(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.S. Prereq: BIOL 314 recommended
Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only. Nonmajor graduate credit.

BCBIO 442D. Bioinformatics and Computational Biology Techniques: Microarray Analysis. 
(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.S. Prereq: BIOL 314 recommended
Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only. Nonmajor graduate credit.

BCBIO 444. Introduction to Bioinformatics. 
(Cross-listed with BCB, BIOL, COM S, CPR E, GEN). (4-0) Cr. 4. F. Prereq: MATH 165 or STAT 401 or equivalent
Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology. Nonmajor graduate credit.

BCBIO 490. Independent Study. 
Cr. 1-5. Repeatable, maximum of 9 credits. F.S.S.S. Prereq: BCBIO 211, junior or senior classification, permission of instructor
Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBIO 490 and 491 toward graduation.

BCBIO 491. Team Research Projects. 
Cr. 1-5. Repeatable, maximum of 9 credits. Prereq: BCBIO 211, junior or senior classification, permission of instructor
Research projects in bioinformatics and computational biology done by teams of students. Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBIO 490 and 491 toward graduation.