

Bioinformatics and Computational Biology

PROGRAM CHAIR

Stephen J. Freeland
Bioinformatics, molecular evolution

PROFESSORS

Thomas Cronin
Vision science

Philip Farabaugh
Molecular genetics

Lasse Lindahl
Molecular biology, gene expression

Phyllis Robinson
Neurobiology

Suzanne Rosenberg
Immunology, cancer biology

Phillip Sokolove
Neurobiology, biological rhythms, science education

G. Rickey Welch
Nutrition, biochemistry, science history

Richard E. Wolf, Jr.
Molecular biology, gene regulation

ASSOCIATE PROFESSORS

Charles J. Bieberich
Molecular biology of development

Daphne Blumberg
Developmental biology

Mauricio Bustos
Plant molecular biology

Nessly Craig
Molecular biology of mammalian cells

David M. Eisenmann
Developmental biology, genetics, molecular biology

Jeffery W. Leips
Life history evolution

Patricia McGraw
Molecular biology, lipid membrane transport

Stephen Miller
Plant molecular biology

Kevin E. Omland
Avian evolution, molecular phylogeny

Michael O'Neill
Genetic regulation

Harold V. Schreier
Microbiology, gene regulation

ASSISTANT PROFESSORS

Rachel Brewster
Developmental biology, neuroscience, genetics, molecular and cell biology

Ivan Erill
Computational biology, gene expression, genome annotation

Maricel Kann
Protein structure and function, gene expression, biological data mining

Weinhong Lin
Cellular neurobiology, olfaction

Hua Lu
Plant-pathogen interaction, developmental biology

Tamra Mendelson
Speciation, sexual selection, systematics

SENIOR RESEARCH SCIENTIST

Janice Zengel
Molecular biology, gene expression

SENIOR LECTURERS

Esther Fleischmann
Bryan MacKay
James W. Sandoz
Julia B. Wolf

LECTURERS/ INSTRUCTORS

Steven Caruso
Lark Claassen
Reagan Lake

CHEMICAL AND BIOCHEMICAL ENGINEERING

Govind Rao
Professor and Director, Center for Advanced Sensor Technology
Mammalian cell culture, metabolic engineering, oxygen toxicity, biosensing

Douglas D. Frey
Associate Professor
Separation and transport processes, protein purification

Mark Marten
Associate Professor
Bioprocess engineering, fermentation, metabolic engineering

Mariajose Castellanos
Assistant Professor
Biological networks, molecular systems biology, models of pathogenesis

CHEMISTRY AND BIOCHEMISTRY

Bradley R. Arnold
Associate Professor
Time-resolved polarized spectroscopy

C. Allen Bush
Professor
Biophysical chemistry of complex carbohydrates

Daniele Fabris
Associate Professor
Bioanalytical chemistry, mass spectrometry of nucleic acid adducts, protein-nucleic acid interactions.

Richard L. Karpel
Professor
Protein-nucleic acid interactions

Michael F. Summers
Professor
Nuclear magnetic resonance, bioinorganic chemistry

COMPUTER SCIENCE AND ELECTRICAL ENGINEERING

Hillol Kargupta
Associate Professor
Distributed and mobile data mining, computation of gene expression, genetic algorithms

INFORMATION SYSTEMS

Anthony F. Norcio
Professor
Human-computer interfaces, healthcare informatics

Carolyn Seaman
Associate Professor
Software engineering for bioinformatics

MATHEMATICS AND STATISTICS

Johnathan Bell
Professor
Mathematical biology

Kathleen Hoffman
Associate Professor
Applications of calculus within mathematical biology

Florian Potra
Associate Professor
Applications of numerical methods to bioinformatics

Courses in this program are listed under BIOL, MATH, CHEM, PHYS and CMSC.
The program Web site is at www.umbc.edu/biosci/undergrad/bioinformatics.php.

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This program offers a combination of courses in the areas of biology, chemistry, physics, computer science and mathematics. Graduates will acquire the necessary skills for data analysis of complex databases, extraction of essential information from genomic sequence information, modeling of biological and ecological systems, as well as the design and development of software and algorithms to support these activities. Students also have the opportunity to engage in independent research in the lab, the field, the library or off-campus, working one-on-one with a faculty mentor. The curriculum consists of 86-89 credits in the modern biological and related sciences (computer science, chemistry, information systems, mathematics and physics). This program is appropriate for any student desiring a focused, in-depth grounding in all the essential elements of bioinformatics and computational biology.

Career and Academic Paths

An undergraduate degree in bioinformatics and computational biology from UMBC provides students with an excellent background for employment in industry, academics, government or for graduate studies in the areas of bioinformatics, biology, computational biology or molecular biology.

For specific requirements, students should consult the Graduate Catalog of the institution they are interested in attending.

Academic Advising

Bioinformatics and computational biology majors who have not yet completed their gateway requirements will be advised by the undergraduate academic advisor for life sciences (see the description of degree requirements for details regarding the gateway). Subsequently, they will be assigned to one of the full-time faculty for advising. Students

are required to see their advisors at least once each semester. Academic progress is monitored through graduation.

Bachelor of Science (B.S.)

The Department of Biological Sciences is currently conducting a review of its undergraduate programs. Students should be aware that this may result in changes to the bioinformatics and computational biology curriculum. These changes may go into effect as early as Fall 2009.

Students are encouraged to consult the Biological Sciences Department's publications (including the departmental Web site, www.umbc.edu/biosci) in order to obtain up-to-date information on major requirements and course offerings.

Gateway Requirements

Students who wish to obtain a B.S. degree in Bioinformatics and Computational Biology must meet the following gateway requirements:

- A grade point average (GPA) of 3.0 in the following courses, with no grade lower than a "C."

BIOL 100
BIOL 302
CHEM 101
CHEM 102
CMSC 201
MATH 151

If any of the gateway courses are repeated, both the original grade and the first repeat grade will be used in calculating the gateway GPA. Any subsequent repeats after the first two attempts will not be considered in the gateway GPA.

- A minimum of three of the above courses must be taken at UMBC.
- Students who do not meet the above requirements may petition the BINP

Steering Committee and request a waiver or substitution of the gateway requirements.

The complete curriculum consists of 87-92 credits distributed as follows:

A. Biology [21]

BIOL 100
Concepts of Biology

BIOL 100L
Concepts of
Biology Laboratory

BIOL 302
Molecular and
General Genetics

BIOL 303
Cell Biology

BIOL 302L
Molecular AND General
Genetics Laboratory

OR

BIOL 303L
Cell Biology Laboratory

BIOL 430
Biological Chemistry

BIOL 495 Seminar in
Bioinformatics

B. Chemistry [16]

CHEM 101
Principles of Chemistry I

CHEM 102
Principles of Chemistry II

CHEM 102L
Introductory Chemistry
Laboratory I

CHEM 351
Organic Chemistry I

CHEM 352
Organic Chemistry II

C. Computer Science [18]

CMSC 201
Computer Science I
for Majors

CMSC 202
Computer Science II
for Majors

CMSC 203
Discrete Structures

CMSC 341
Data Structures

CMSC 461
Database-Management
Systems

D. Mathematics and Statistics [15]

MATH 151
Calculus I

MATH 152
Calculus II

MATH 221
Linear Algebra

STAT 355
Introduction to Probability
and Statistics for
Scientists and Engineers

E. Physics [8]

PHYS 121
Introductory Physics I

PHYS 122
Introductory Physics II

F. Required Electives [9-12]

A total of three additional courses are required, to be selected from the two lists below; two courses are to be selected from **List A** and one course from **List B**.

List A (two courses from the choices below)

- A three-credit biology core course (BIOL 301, BIOL 304, BIOL 305 or BIOL 442 — only one of these may be applied to satisfy the major requirements for bioinformatics and computational biology)

- Any BIOL 4XX elective approved for the biology major

- Any CHEM 4XX elective approved for the biochemistry major (except those on List B — see below)

d. CHEM 301
OR
CHEM 303

e. CHEM 438

Note: Students must successfully complete both CHEM 437 and CHEM 438. CHEM 437 can be used as a substitute for BIOL 430 and CHEM 438 will count as a **List A** elective. CHEM 437 by itself will not be accepted as fulfilling any of the major requirements for the bioinformatics major. BIOL 428 can be used to fulfill either a List A or a List B (but not both) elective.

List B: An approved list of BIOL, CHEM, CMSC, IS and MATH courses. See the program coordinator or the biological sciences department for a current list of courses.

Evaluation of student performance is separate for lecture and laboratory courses. A student planning to complete the B.S. major in bioinformatics in four years should begin a first course in chemistry and mathematics during the first semester of the freshman year.

A majority of the required biology courses must be completed in residence at UMBC. In fulfilling major requirements in bioinformatics, a student must obtain a grade of "C" or higher in all required courses.

Prerequisites and corequisites for all BIOL courses will be enforced. Prerequisites in all biology courses must be satisfied with a grade of "C" or better.

The department will adhere to university policies that limit to two the number of times a student may register for the same course.

New freshmen who have Advanced Placement (AP) credit in biology may be exempted from taking BIOL 100 and 100L (see Appendix).

CHEM 351L and 352L are recommended for health professional students and students anticipating graduate studies.

Note: A maximum of six credits may be taken from the combination of BIOL 499 and 499H and CHEM 399 and 499 (or independent study from other related departments).

Honors Program

Bioinformatics and computational biology majors who have completed the following requirements will be eligible to enter the Biological Sciences Departmental Honors Program. The following courses, or acceptable transfer equivalents thereof, will have been completed with a cumulative GPA of 3.5: BIOL 100, 100L, 302, 303, 302L or 303L; CHEM 101, 102, 102L, 351; MATH 151 and STAT 355. Additionally, the student must maintain a minimum GPA of 3.5 in the major and 3.25 overall.

This program, in addition to the regular requirements for the major, includes the following nine credits of coursework:

BIOL 499H
Honors Independent Research
(Two semesters for a minimum total of six credits)

BIOL 497H
Honors Capstone
One semester

Eligible students should apply to the Biological Sciences Departmental Honors Committee. Forms are available in the biological sciences office.

Special Opportunities

Talented upper-class undergraduates committed to performing quality independent research are encouraged to apply for a variety of research opportunities offered by UMBC's outstanding faculty. Under the guidance of faculty mentors, student research assistants work on their own lab research projects and help their mentors with important research. These unique,

intensive experiences allow students to sharpen their critical thinking skills, learn how to write and read scientific papers, and expand their scientific understanding of computational biology concepts.

Tutorial Center

Bioinformatics students are invited to use the facilities of the Biological Sciences Tutorial Center, located in room 011 of the Biological Sciences Building. The center has 12 computer workstations for student use and two workstations for faculty. The center is open for students to study in groups and to access course Web pages and other information on the Web. Tutors are available for the biology core courses (Concepts of Biology, Ecology and Evolution, Molecular and General Genetics, Cell Biology, Plant Biology and Animal Physiology).

Student Organizations

Biology Council of Majors (BIO/COM)

All bioinformatics majors are welcome to join the Biology Council of Majors (BIO/COM). This very active student organization strives to "promote the achievement of the professional ambitions of its members and to serve as a means of social contact among them."

There are also on-campus clubs for students pursuing various health-related professions.