

CENTER FOR BIOLOGICAL DATA SCIENCE

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Director

cbds.vcu.edu (<https://cbds.vcu.edu/>)

The Center for Biological Data Science is a multidisciplinary focus of research and scholarly activity within VCU Life Sciences. The mission of the center is to teach and advance interdisciplinary quantitative and computational data science for the life sciences, to provide experiential education in bioinformatics, and to promote collaborative and reproducible research.

- Bioinformatics, Bachelor of Science (B.S.) with a concentration in biological/genomic sciences (<http://bulletin.vcu.edu/undergraduate/vcu-life-sciences/center-study-biological-complexity/bioinformatics-bs-concentration-biological-genomic/>)
- Bioinformatics, Bachelor of Science (B.S.) with a concentration in computational sciences (<http://bulletin.vcu.edu/undergraduate/vcu-life-sciences/center-study-biological-complexity/bioinformatics-bs-concentration-computational/>)
- Bioinformatics, Bachelor of Science (B.S.) with a concentration in quantitative/statistical sciences (<http://bulletin.vcu.edu/undergraduate/vcu-life-sciences/center-study-biological-complexity/bioinformatics-bs-concentration-quantitative-statistical/>)
- Bioinformatics (BNFO) (p. 1)
- Life sciences (LFSC) (p. 3)

Bioinformatics

BNFO 101. Introduction to Scientific Computing. 1 Hour.

Semester course; 1 lecture hour. 1 credit. Enrollment is restricted to bioinformatics majors. This course will introduce students to basic principles and skills for using a computer to solve scientific problems. It is hands-on course and does not assume any special prior knowledge or skill with computers. Students completing the course will become familiar with and develop skills and practical knowledge of how to use common computer-based command-line tools and systems critical for effective scientific computing.

BNFO 125. Disease and Human Ancestry. 3 Hours.

Semester course; 3 lecture hours. 3 credits. This course introduces the role that disease has played in human existence. A key part of this understanding comes from new DNA sequencing and genomic data analysis tools that provide information about our ancestry and origin, as well as about the ancestry and history of disease organisms that have co-evolved with us. The vast amount of new data has opened controversial doors to social and ethical implications, such as questions of race and discrimination, and teach us how to fight emerging disease at local and global levels. This course will discuss these topics through case examples of different diseases from parasites (e.g., malaria), bacteria (e.g., bubonic plague, tuberculosis and syphilis) and viruses (e.g., smallpox, influenza and AIDS).

BNFO 191. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of nine credits, with the provision that no more than nine combined credits of BNFO 191 and BNFO 193 can apply toward graduation. An introductory, detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program.

BNFO 193. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of nine credits, with the provision that no more than nine combined credits of BNFO 191 and BNFO 193 can apply toward graduation. An introductory, detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program. Graded as pass/fail.

BNFO 201. Computing Skills and Concepts for Bioinformatics. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: MATH 151 or 200 with a minimum grade of C, or satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. An introduction to computation in bioinformatics, including basics of data representation, and computer organization, as well as programming in Python or other appropriate scripting language. Bioinformatics applications in the literature will be discussed. Guest speakers will share bioinformatics career experiences and opportunities.

BNFO 251. Phage Discovery I. 2 Hours.

Semester course; 4 laboratory hours. 2 credits. Corequisite: BIOL 151 or 152. An exploratory laboratory where students will purify phage from soil, visualize phage using electron microscopy and isolate genomic material for nucleic acid sequencing. Registration by override only.

BNFO 252. Phage Discovery II. 2 Hours.

Semester course; 4 laboratory hours. 2 credits. Corequisite: BIOL 151 or 152. An exploratory laboratory where students will learn about the genomes of viruses infecting bacteria. Students will be given the genome sequence of a novel virus, which will be the basis for a series of computer-based analyses to understand the biology of the virus and to compare it with other viruses that infect the same host. Registration by override only.

BNFO 291. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of nine credits, with the provision that no more than nine combined credits of BNFO 291 and BNFO 293 can apply toward graduation. An introductory, detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program.

BNFO 292. Independent Study. 1-2 Hours.

Semester course; variable hours. 1-2 credits. May be repeated for a maximum total of 6 credits. Prerequisite: permission of instructor. A course designed to provide an opportunity for independent readings of the bioinformatics literature under supervision of a staff member.

BNFO 293. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of nine credits, with the provision that no more than nine combined credits of BNFO 291 and BNFO 293 can apply toward graduation. An introductory, detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program. Graded as pass/fail.

BNFO 300. Molecular Biology Through Discovery. 3 Hours.

Semester course; 3 lecture hours. 3 credits. The course aims to expand students' "ignorance," a prerequisite for success in science, by confronting them with the interface between the known and the unknown, stressing the process by which the boundary is traversed. It will do so using as the raw material the study of molecular biology, an essential groundwork for bioinformatics.

BNFO 301. Introduction to Bioinformatics. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: BNFO 201 or permission of instructor. The course will present a practical and theoretical introduction to the tools and techniques needed to obtain and interpret a variety of genome-related data types. The course will include several bioinformatic methods underlying nucleotide and protein sequence alignment, statistical methods for data visualization in R, the types of experimental results commonly encountered in bioinformatics data analysis and the public databases where these data can be accessed.

BNFO 315. Effective Communication in the Sciences. 3 Hours.

Semester course; 3 lecture hours. 3 credits. How do we tell our science as a story? This course will explore ways to share science with fellow scientists and the public, including best practices for presenting data, simplifying complex ideas for presentations and sharing science in an accurate and ethical way in different media. Students will experience a hands-on approach to scientific writing and storytelling and hear from guest speakers from varying backgrounds in scientific communication. Communicating about science is an important part of being published, securing funding and building awareness around interests and this course is a first step to honing those skills.

BNFO 380. Introduction to Mathematical Biology. 4 Hours.

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Prerequisites: MATH 200 and BIOL 151, both with a minimum grade of C, or permission of instructor. An introduction to mathematical biology. Various mathematical modeling tools will be covered and implemented in a range of biological areas. Additionally, the collaborative research process will be presented and discussed. Crosslisted as: MATH 380.

BNFO 391. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of nine credits, with the provision that no more than nine combined credits of BNFO 391 and BNFO 393 can apply toward graduation. A detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program.

BNFO 393. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of nine credits, with the provision that no more than nine combined credits of BNFO 391 and BNFO 393 can apply toward graduation. An introductory, detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program. Graded as pass/fail.

BNFO 411. Ethical Issues in Life Sciences. 2 Hours.

Semester course; 2 lecture hours. 2 credits. This course will introduce fundamentals in ethical conduct with a focus on interdisciplinary application to the life sciences, with attention paid to the design, collection, analysis and dissemination of bioinformatic datasets. Graded as pass/fail.

BNFO 420. Applications in Bioinformatics. 3 Hours.

Semester course; 2 lecture and 2 laboratory hours. 3 credits. Prerequisites: CMSC 245 or 255 and BNFO 301. Capstone course. Students will integrate biological, computational and quantitative skills to complete bioinformatics projects in a professional team-problem-solving context. Course includes explicit instruction in the conduct of research as well as a review of applicable strategies, methods and technologies. Written and oral presentation is emphasized, with systematic feedback and practice opportunities provided.

BNFO 440. Computational Methods in Bioinformatics. 3 Hours.

Semester course; 2 lecture and 2 laboratory hours. 3 credits. Prerequisites: CMSC 255 and 256; BNFO 301, or permission of instructor. An introduction to mathematical and computational methods in bioinformatics analysis. Topics include but are not limited to operating systems, interfaces, languages, SQL, search algorithms, string manipulation, gene sequencing, simulation and modeling, and pattern recognition. Students will be exposed to Maple, Matlab, SPSS, E-cell, BioPerl, Epigram and C as part of the requirements of this course.

BNFO 451. Genomic Medicine. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: BIOL 300. Genomic medicine is a clinical approach to diagnose and treat patients based on testing that includes an individual's genomic information. This course will provide an introduction to this emerging field and its potential to improve the diagnosis, prevention and treatment of disease. Topics will include key genomic technologies and the computational approaches used to probe genomic data as applied to real clinical examples. The ethical, legal and societal issues in genomic medicine will be explored. This course is geared toward students with a general biology background.

BNFO 491. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of 12 credits, with the provision that no more than 12 combined credits of BNFO 491 and BNFO 493 can apply toward graduation. A detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program.

BNFO 492. Independent Study. 1-4 Hours.

Semester course; variable hours. A minimum of three hours of supervised activity per week per credit is required. 1-4 credits. May be repeated for a maximum total of 6 credits. Prerequisite: BIOL 218. Projects should include data collection and analysis, learning bioinformatics-related research techniques, and mastering experimental procedures, all under the direct supervision of a faculty member. A final report must be submitted at the completion of the project. Graded as pass/fail.

BNFO 493. Special Topics in Bioinformatics. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for a maximum total of 12 credits, with the provision that no more than 12 combined credits of BNFO 491 and BNFO 493 can apply toward graduation. A detailed study of a selected topic in bioinformatics unavailable as an existing course. If multiple topics are offered, students may elect to take more than one. Adviser's approval is required for counting each special topics course toward meeting specific requirements of the B.S. program. Graded as pass/fail.

BNFO 496. Undergraduate Teaching Assistantship in Bioinformatics. 1-2 Hours.

Semester course; 1-2 field experience hours. 1-2 credits. May be repeated for a maximum total of two credits. Enrollment requires permission of instructor and a minimum grade of B in the course the student will TA. Student will work with course instructor to implement course objectives. Typical duties involve media preparation, answering questions, providing feedback on course assignments and peer mentoring. Provides exposure to the practice, possibilities, rewards and responsibilities of the act of teaching. Graded as pass/fail.

BNFO 497. Research and Thesis. 1-4 Hours.

Semester course; variable hours. A minimum of three hours of supervised activity per week per credit is required. 1-4 credits. May be repeated for a maximum total of 6 credits. Prerequisites: BIOL 218, junior or senior status. Projects should include data collection and analysis, learning bioinformatics-related research techniques, and mastering experimental procedures, all under the direct supervision of a faculty member. A written thesis of substantial quality is required at the completion of the research.

Life Sciences

LFSC 101. Academic and Career Options in Life Sciences. 1 Hour.

Semester course; 1 lecture hour. 1 credit. Students interested in the life sciences at VCU are faced with an enormous variety of academic options from bioinformatics and biomedical engineering to exercise science and nursing. Students outside of these programs have post-graduate opportunities in the life sciences, such as health care administration and government policy. This course will introduce students to an overview of all of the academic programs in life sciences available at VCU and their associated potential career options. Graded as pass/fail.

LFSC 191. Special Topics in Integrative Life Sciences. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for credit with different topics. A 100-level study of a selected topic in integrative life sciences. Students will find specific topics and prerequisites for each special topics course listed in the Schedule of Classes. If multiple topics are offered, students may elect to take more than one.

LFSC 301. Integrative Life Sciences Research. 3 Hours.

Semester course; 2 lecture and 1 recitation hours. 3 credits. Pre- or corequisite: UNIV 200 or HONR 200. Students will leave this course knowing enough about science and the process of science to feel confident in critically evaluating scientific information and/or embarking on their own process of discovery with a faculty mentor. They will gain an appreciation of the interdisciplinary and complex nature of life sciences and will hone their critical thinking about how science interacts with and informs society.

LFSC 307. Community Solutions: Multiple Perspectives. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: PSYC 101. Explores possibilities for addressing social concerns of the Richmond community by understanding the complex nature of social issues as essential to their successful amelioration via perspectives of life and social sciences. Toward this end, expertise from the social sciences, the life sciences and the community are integrated. Includes a service-learning experience (a 20-hour volunteer requirement). Crosslisted as: PSYC 307.

LFSC 391. Special Topics in Integrative Life Sciences. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for credit with different topics. A 300-level study of a selected topic in integrative life sciences. Students will find specific topics and prerequisites for each special topics course listed in the Schedule of Classes. If multiple topics are offered, students may elect to take more than one.

LFSC 401. Faith and Life Sciences. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: UNIV 200 or HONR 200. Open to students of any school or program. Explores the complex relationships between faith traditions and the life sciences. Topics include epistemology, impact of life sciences on ideas of fate and responsibility, limits of science and technology, and scientific and religious perspectives on human origins, consciousness, aggression, forgiveness, health, illness and death. Crosslisted as: RELS 401.

LFSC 491. Special Topics in Integrative Life Sciences. 1-4 Hours.

Semester course; 1-4 lecture hours. 1-4 credits. May be repeated for credit with different topics. A 400-level study of a selected topic in integrative life sciences. Students will find specific topics and prerequisites for each special topics course listed in the Schedule of Classes. If multiple topics are offered, students may elect to take more than one.