BIOINFORMATICS, BACHELOR OF SCIENCE (B.S.) WITH A CONCENTRATION IN BIOLOGICAL/GENOMIC SCIENCES

This bioinformatics program consists of a core curriculum that provides immersion in the field of bioinformatics as well as foundational courses in biology, chemistry, computer science and statistics. The bachelor's program in bioinformatics requires breadth of training via the VCU ConnectED general education requirements, a bioinformatics core with ancillary scientific course work and focused training in the areas of biological/genomic sciences, computational sciences or quantitative/statistical sciences through the concentration-specific courses.

Students wishing to pursue the bioinformatics major must apply for admission into the program. High school seniors as well as students transferring to VCU should follow the regular VCU admissions process and deadlines, being sure to indicate clearly in their application that they wish to apply to the bioinformatics program. Continuing VCU students wishing to apply to the program may contact the bioinformatics academic adviser at (804) 828-0825.

Transfer students and continuing VCU students with at least 15 college credits should present a suggested college GPA of 3.0 including relevant course work in science, math or computer science.

Learning outcomes

Upon completing this program, students will know and know how to do the following:

- Present scientific results, both orally and in writing, in a way that makes clear to an appropriate target audience the distinction between what is known (and how) and what is merely suspected between an observation and a conclusion in a way that tells a compelling story
- Will have demonstrated fundamental knowledge of the basic concepts of biology (particularly molecular biology), the physical sciences, mathematics, statistics and computational science and the ability to apply that knowledge within the context of bioinformatics
- Will have demonstrated an ability to identify and analyze bioinformatics problems and strategies to solve said problems
- Will possess an appropriate level of technical knowledge and ability necessary to address a scientific problem by exploiting biological software and datasets and creating simple bioinformatics tools
- Will have demonstrated an ability to identify and access relevant scientific literature and draw from it in a meaningful and critical manner

Special requirements

A minimum grade of C in the following courses is required for enrollment in all courses for which they are prerequisites and to successfully complete the B.S. in Bioinformatics with a concentration in biological/genomic sciences:

Course	Title	Hours
BIOL 151	Introduction to Biological Sciences I	3
BIOL 152	Introduction to Biological Sciences II	3
BIOL 300	Cellular and Molecular Biology	3
BNFO 101	Introduction to Scientific Computing	1
BNFO 201	Computing Skills and Concepts for Bioinformatics	3
BNFO 251	Phage Discovery I	2
BNFO 252	Phage Discovery II	2
BNFO 301	Introduction to Bioinformatics	3
BNFO 411	Ethical Issues in Life Sciences	2
BNFO 420	Applications in Bioinformatics	3
CHEM 101	General Chemistry I	3
CHEM 102	General Chemistry II	3
CHEM 301	Organic Chemistry	3
CHEM 302	Organic Chemistry	3
CHEZ 101	General Chemistry Laboratory I	1
MATH 200	Calculus with Analytic Geometry I	4

Degree requirements for Bioinformatics, Bachelor of Science (B.S.) with a concentration in biological/genomic sciences

Course	Title	Hours
General education (http://bulletin.vcu.edu/undergraduate/undergraduate-study/general-education-curriculum/)		
Select 30 credits of general education courses in consultation with an adviser. [1]		30
Major requirements		
• Major core requirements		
BIOL 152	Introduction to Biological Sciences II	3
BIOL 300	Cellular and Molecular Biology	3
BIOL 310	Genetics	3
BNFO 101	Introduction to Scientific Computing	1
BNFO 201	Computing Skills and Concepts for Bioinformatics	3
BNFO 251	Phage Discovery I	2
BNFO 252	Phage Discovery II	2
BNFO 301	Introduction to Bioinformatics	3
BNFO 411	Ethical Issues in Life Sciences	2
BNFO 420	Applications in Bioinformatics	3
CHEM 102	General Chemistry II	3
CHEZ 102	General Chemistry Laboratory II	1
CMSC 255	Introduction to Programming	4
STAT 321	Introduction to Statistical Computing	3
• Concentration requirements		
BNFO/BIOL 540	Fundamentals of Molecular Genetics	3
BNFO/BIOL 541	Laboratory in Molecular Genetics	2
or BIOZ 476	Molecular Capstone Laboratory	
CHEM 301	Organic Chemistry	3
CHEM 302	Organic Chemistry	3
CHEM 403	Biochemistry I	3
Select concentration electives from list below.		10

Ancillary requirements [1]		
BIOL 151	Introduction to Biological Sciences I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	3
CHEM 101	General Chemistry I (satisfies general education AOI for scientific and logical reasoning)	3
CHEZ 101	General Chemistry Laboratory I (satisfies general education AOI for scientific and logical reasoning)	1
MATH 200	Calculus with Analytic Geometry I	4
PHYS 207	University Physics I (either course satisfies general education AOI for scientific and logical reasoning)	4-5
or PHYS 201	General Physics I	
STAT 212	Concepts of Statistics (satisfies general education quantitative foundations)	3
Open electives		
Select any course.		23-24
Total Hours		**120**

[1]

The ancillary courses fulfill 12 of the required 30 credits of general education, including fulfillment of the quantitative foundations requirement, the natural sciences breadth of knowledge requirement and the maximum allowable nine credits of scientific and logical reasoning area of inquiry.

The minimum number of credit hours required for this degree is 120.

Concentration electives

Course	Title	Hours
BIOZ 310	Laboratory in Genetics	2
BIOL 317	Ecology	3
BIOZ 317	Ecology Laboratory	2
BIOL 318	Evolution	3
BIOL 455	Immunology	3
BIOZ 476	Molecular Capstone Laboratory (if BIOL 541/BNFO 541 was already taken as concentration-required course)	2
BIOL 550	Ecological Genetics	3
BNFO 391	Special Topics in Bioinformatics (variable) [1,2]	1-4
BNFO 393	Special Topics in Bioinformatics (variable) [1,2]	1-4
BNFO 491	Special Topics in Bioinformatics (variable) [1,2]	1-4
BNFO 492	Independent Study (variable) [1]	1-4
BNFO 493	Special Topics in Bioinformatics (variable) [1,2]	1-4
BNFO 496	Undergraduate Teaching Assistantship in Bioinformatics (variable) [1]	1-2
BNFO 497	Research and Thesis (variable) [1]	1-4
BNFO/BIOL 541	Laboratory in Molecular Genetics (if BIOZ 476 was already taken as concentration-required course)	2
BNFO 591	Special Topics in Bioinformatics (variable) [1,2]	1-4
BNFO 593	Special Topics in Bioinformatics (variable) [1,2]	1-4
CHEZ 301	Organic Chemistry Laboratory I	2
CHEZ 302	Organic Chemistry Laboratory II	2
CMSC 256	Data Structures and Object Oriented Programming	4
CMSC 302	Introduction to Discrete Structures	3
MICR 515	Principles of Molecular Microbiology	3
STAT 314	Applications of Statistics	4
STAT 421	Applied Statistical Computing Using R	3

[1]

May be taken only with adviser's permission

[2]

No more than eight combined credits of BNFO 391, BNFO 393, BNFO 491, BNFO 493, BNFO 591 and BNFO 593 may apply toward concentration elective requirements.

What follows is a sample plan that meets the prescribed requirements within a four-year course of study at VCU. Please contact your adviser before beginning course work toward a degree.

Freshman year		
Fall semester		**Hours**
BIOL 151	Introduction to Biological Sciences I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	3
BNFO 251	Phage Discovery I	2
CHEM 101	General Chemistry I (satisfies general education AOI for scientific and logical reasoning)	3
CHEZ 101	General Chemistry Laboratory I (satisfies general education AOI for scientific and logical reasoning)	1
UNIV 111 Play course video for Focused Inquiry I	Focused Inquiry I (satisfies general education UNIV foundations)	3
General education course		3
	Term Hours:	**15**
Spring semester		
BIOL 152	Introduction to Biological Sciences II	3
BNFO 101	Introduction to Scientific Computing	1
BNFO 252	Phage Discovery II	2
CHEM 102	General Chemistry II	3

UNIV 112 Play course video for Focused Inquiry II	Focused Inquiry II (satisfies general education UNIV foundations)	3
General education course		3
	Term Hours:	**15**
Sophomore year		
Fall semester		
BIOL 300	Cellular and Molecular Biology	3
BNFO 201	Computing Skills and Concepts for Bioinformatics	3
CHEZ 102	General Chemistry Laboratory II	1
STAT 212	Concepts of Statistics (satisfies general education quantitative foundations)	3
UNIV 200	Advanced Focused Inquiry: Literacies, Research and Communication (satisfies general education UNIV foundations)	3
General education course		3
	Term Hours:	**16**
Spring semester		
BNFO 301	Introduction to Bioinformatics	3
CMSC 255	Introduction to Programming	4
MATH 200	Calculus with Analytic Geometry I	4
Open electives		3
	Term Hours:	**14**
Junior year		
Fall semester		
BIOL 310	Genetics	3
BNFO 411	Ethical Issues in Life Sciences	2
CHEM 301	Organic Chemistry	3
Concentration elective		3
Open electives		4
	Term Hours:	**15**
Spring semester		
CHEM 302	Organic Chemistry	3
PHYS 207	University Physics I (satisfies general education AOI for scientific and logical reasoning)	5
STAT 321	Introduction to Statistical Computing	3
Concentration electives		4
	Term Hours:	**15**
Senior year		
Fall semester		
BNFO 540	Fundamentals of Molecular Genetics	3
BNFO 541	Laboratory in Molecular Genetics	2
CHEM 403	Biochemistry I	3
Open electives		7
	Term Hours:	**15**
Spring semester		
BNFO 420	Applications in Bioinformatics	3
Concentration elective		3
Open electives		9
	Term Hours:	**15**
	Total Hours:	**120**

The minimum number of credit hours required for this degree is 120.

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows qualified students to earn both the B.S. and M.S. in Bioinformatics in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students in the program may count up to 12 hours of graduate courses toward both the B.S. and M.S. degrees. Thus, the two degrees may be earned with a minimum of 142 credits rather than the 154 credits necessary if the two degrees are pursued separately.

Students holding these degrees will have a head start for pursuing careers in industry or continuing in an academic setting. The M.S. degree provides two tracks: (1) a thesis track with formal research experience and (2) a nonthesis (professional science master's) track combining business skills with an externship experience. This degree can lead to expanded job opportunities, greater potential for job advancement and higher starting salaries.

Entrance to the accelerated program

Interested undergraduate students should consult with their adviser as early as possible to receive specific information about the accelerated program, determine academic eligibility and submit (no later than two semesters prior to graduating with a baccalaureate degree, that is, before the end of the spring semester of their junior year) an Accelerated Program Declaration Form to be approved by the graduate program director. Limited spaces may be available in the accelerated program. Academically qualified students may not receive approval if capacity has been reached.

Minimum qualifications for entrance to this accelerated program include completion of 90 undergraduate credit hours; an overall GPA of 3.0; and a GPA of 3.0 in bioinformatics degree course work. Applicants should have completed a substantial amount of course work toward the B.S. degree and maintained a strong academic record. Students who are interested in the accelerated program should consult with the program director to the M.S. in Bioinformatics program during their junior year after they have completed 75 credits and before they have completed 90 credits toward the B.S. degree. Applicants to this accelerated program must have junior or senior status in VCU's B.S. in Bioinformatics program. Successful applicants would enter the accelerated program in the first semester of their senior year.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "**Satisfactory academic progress**" section of the Graduate Bulletin, including maintaining a 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate bioinformatics adviser and the program director of the bioinformatics graduate program.

Admission to the graduate program

Entrance to the accelerated program enables the student to take the approved shared courses that will apply to the undergraduate and graduate degrees. However, entry into an accelerated program via an approved Accelerated Program Declaration Form does not constitute application or admission into the graduate program. Admission to

the graduate program requires a separate step that occurs through a formal application to the master's program, which is submitted through Graduate Admissions no later than a semester prior to graduation with the baccalaureate degree, that is, before the end of the first semester of the senior year. In order to continue pursuing the master's degree after the baccalaureate degree is conferred, accelerated students must follow the admission to graduate study requirements outlined in the VCU Bulletin. Two reference letters (at least one from a bioinformatics faculty member) must accompany the application.

Degree requirements

The Bachelor of Science in Bioinformatics degree will be awarded upon completion of a minimum of 120 credits and the satisfactory completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

A maximum of 12 graduate credits may be taken prior to completion of the baccalaureate degree. These graduate credits may substitute for bioinformatics requirements for the undergraduate degree, and are planned in consultation with the undergraduate academic adviser and the graduate program director. These courses are shared credits with the graduate program, meaning that they will be applied to both undergraduate and graduate degree requirements. For best alignment of these credits, students must plan ahead.

Examples of bioinformatics degree courses that may be taken as an undergraduate, once a student is admitted to the program, are:

Course	Title	Hours
BIOS 543	Graduate Research Methods I	3
BNFO 540	Fundamentals of Molecular Genetics	3
BNFO 541	Laboratory in Molecular Genetics	2
BNFO 592	Independent Study	1-9
BNFO 620	Bioinformatics Practicum	3
BNFO 621	Business and Entrepreneurship Essentials for Life Scientists	3
BNFO 653	Advanced Molecular Genetics: Bioinformatics	3
BNFO 692	Independent Study	1-9
CMSC 508	Database Theory	3

Recommended course sequence/plan of study

What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the junior year prior to admission to the accelerated program in the senior year.

Course	Title	Hours
Junior year		
Fall semester		
BIOL 300	Cellular and Molecular Biology	3
BNFO 411	Ethical Issues in Life Sciences	2
Required B.S. course work		10
Term Hours:		15
Spring semester		
BNFO 541	Laboratory in Molecular Genetics	2
PHYS 207	University Physics I	5
STAT 321	Introduction to Statistical Computing	3
Required B.S. course work		5
Term Hours:		15
Senior year		
Fall semester		
BNFO 540	Fundamentals of Molecular Genetics	3
CMSC 256	Data Structures and Object Oriented Programming	4
Required B.S. course work		8
Term Hours:		15
Spring semester		
Required B.S. course work		5
BNFO 601	Integrated Bioinformatics	4
BNFO 620	Bioinformatics Practicum	3
BNFO 621	Business and Entrepreneurship Essentials for Life Scientists	3
Term Hours:		15
Fifth year		
Fall semester		
BNFO 531	Quantitative Methods in Bioinformatics	3
BNFO 690	Seminars in Bioinformatics	1
OVPR 601	Scientific Integrity	1
Graduate electives (500 and 600 level) [1]		5
Term Hours:		11
Spring semester		
BNFO 653	Advanced Molecular Genetics: Bioinformatics	3
BNFO 700	Externship in Bioinformatics	2
Graduate electives (500 and 600 level) [1]		6
Term Hours:		11

[1] For example: 500-level (or higher) BIOL, BIOC, BIOS, BNFO, CMSC, ENVS, HGEN, LFSC, STAT courses

Students interested in the accelerated B.S. and M.S. program can contact the individuals listed below who will explain the program and coordinate the curriculum.

Undergraduate adviser
Lian Currie
lcurrie@vcu.edu
Grace E. Harris Hall, Room 3116a

Graduate program director
Allison Johnson
aajohnson@vcu.edu
Grace E. Harris Hall, Room 3115

- Bioinformatics (BNFO) (p. 5)
- Life sciences (LFSC) (p. 6)

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.