BIOINFORMATICS, BACHELOR OF SCIENCE (B.S.) WITH A CONCENTRATION IN COMPUTATIONAL SCIENCES

This bioinformatics program consists of a core curriculum that provides the basics of biology, chemistry, computer science and statistics, as well as an introduction to the field of bioinformatics. The bachelor's program in bioinformatics requires breadth of training via VCU Life Sciences' general education requirements, specific training in the collateral course work and bioinformatics core, 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

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

Course	Title	Hours
General education (http://bulletin.vcu.edu/undergraduate/undergraduate-study/general-education-curriculum/)		
Select 12-13 credits from general education foundations and 17-18 credits from areas of inquiry. [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		
CMSC 256	Data Structures and Object Oriented Programming	4
CMSC 302	Introduction to Discrete Structures	3
CMSC 355	Fundamentals of Software Engineering	3
CMSC 401	Algorithm Analysis with Advanced Data Structures	3
Select concentration electives from list below.		11
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) [1]	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
BIOL 318	Evolution	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 540	Fundamentals of Molecular Genetics	3
BNFO/BIOL 541	Laboratory in Molecular Genetics	2
BNFO 591	Special Topics in Bioinformatics (variable) [1,2]	1-4
BNFO 593	Special Topics in Bioinformatics (variable) [1,2]	1-4
CHEM 301	Organic Chemistry	3
CMSC 409	Artificial Intelligence	3
CMSC 411	Computer Graphics	3
CMSC 416	Introduction to Natural Language Processing	3
CMSC 435	Introduction to Data Science	3
CMSC 508	Database Theory	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 8 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 310	Genetics	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	Inquiry and the Craft of Argument (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 300	Cellular and Molecular Biology	3
BNFO 411	Ethical Issues in Life Sciences	2
CMSC 256	Data Structures and Object Oriented Programming	4
CMSC 302	Introduction to Discrete Structures	3
Concentration elective		3
	Term Hours:	15
Spring semester		
CMSC 355	Fundamentals of Software Engineering	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		
CMSC 401	Algorithm Analysis with Advanced Data Structures	3
Concentration elective		4
Open electives		8
	Term Hours:	15
Spring semester		
BNFO 420	Applications in Bioinformatics	3
Open electives		12
	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.

Admission to the program

Applicants to this accelerated program must have junior or senior status in VCU's B.S. in Bioinformatics program. Minimum qualifications for admittance to the 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. Successful applicants would enter the accelerated program in the fall semester of their senior year and start the M.S. in the term after which they receive their bachelor's degree.

Undergraduate students must have departmental approval to participate in an accelerated program and must apply for admission to the master's program prior to beginning their final year of full-time undergraduate study. The entry term for the master's program will be the next available admission term following the last semester of undergraduate study. Admission to the master's program is provisional until the undergraduate degree has been conferred. Upon completion and conferral of the undergraduate degree, students are fully admitted to the master's program.

It is recommended that candidates submit applications for admission to the accelerated program immediately following completion of their junior year, but no later than July 1 of that year. Two reference letters (at least one from a bioinformatics faculty member) must accompany the application. 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 and before they have completed 90 credits toward the B.S. degree.

Once admitted into the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress (http://bulletin.vcu.edu/academic-regs/grad/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.

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 open electives, bioinformatics degree electives or concentration-specific requirements for the undergraduate degree. 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

- Bioinformatics (BNFO) (p. 4)
- 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. 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. Crosslisted as: LFSC 251.

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. Crosslisted as: LFSC 252.

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 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.

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 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 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. Crosslisted as: BNFO 251.

LFSC 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. Crosslisted as: BNFO 252.

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.