BIOLOGY, BACHELOR OF SCIENCE (B.S.)

The four-year curriculum in biology prepares students for graduate study in biology, for employment in laboratory or field programs in private industry or government agencies and for teaching in secondary schools. This curriculum also prepares students for admission into schools of medicine, dentistry and veterinary medicine, and into allied health programs.

Student learning outcomes

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

Knowledge base
Students will demonstrate knowledge of evolutionary processes and the functions and interactions of cells, organisms and species.

Communication skills
Students will demonstrate oral and written communication skills needed for professional careers in the field of biology.

Critical-thinking skills
Students will demonstrate critical thinking, problem-solving and analytical skills.

Method and inquiry
Students will demonstrate knowledge in the methods of inquiry and research in biology.

Transfer students

Transfer students intending to major in biology must satisfy all biology major course requirements and complete a minimum of 15 credits of VCU biology courses at the 300-, 400- or 500-level.

Extended Teacher Preparation Program

Biology majors interested in teaching careers in secondary education can enroll in the Extended Teacher Preparation Program, which simultaneously awards a bachelor's degree in biology and a master's degree in teaching. For more information about this program, jointly administered by the College of Humanities and Sciences and the School of Education, contact the School of Educations Student Services Center.

Honors in biology

Biology majors may graduate with honors in biology. To qualify, students must have overall and biology GPAs of at least 3.5 and must complete the following courses in this sequence: BIOL 392, at least four credits of BIOL 495 and BIOL 490. Grades of A or B must be earned in each of the listed courses. Students who qualify will have the notation "Honors in Biology" placed on their transcript. Students must meet all Department of Biology requirements for graduation. Students should consult with their academic advisers to create a program suitable to their particular needs and interests.

Special requirements

Degree requirements: The curriculum for a Bachelor of Science in Biology requires a minimum of 120 credits, with at least 40 of those credits in biology or other approved courses. A cumulative GPA of 2.0 for biology courses is required.

Laboratory requirement: Biology majors will take BIOZ 151 (https://bulletin.vcu.edu/search/?P=BIOZ%20151) and BIOZ 152 (https://bulletin.vcu.edu/search/?P=BIOZ%20152) and then select at least three additional approved laboratory experiences; up to two laboratory experiences can be selected from BIOL 451 (https://bulletin.vcu.edu/search/?P=BIOL%20451), BIOL 453 (https://bulletin.vcu.edu/search/?P=BIOL%20453), BIOL 492 (https://bulletin.vcu.edu/search/?P=BIOL%20492), BIOL 494, BIOL 495 (https://bulletin.vcu.edu/search/?P=BIOL%20495), BIOZ 391, BIOZ 395 (https://bulletin.vcu.edu/search/?P=BIOZ%20395), BIOZ 399 or BIOZ 493. Registration in BIOL 492 (https://bulletin.vcu.edu/search/?P=BIOL%20492), BIOL 494, BIOL 495 (https://bulletin.vcu.edu/search/?P=BIOL%20495), BIOZ 395 (https://bulletin.vcu.edu/search/?P=BIOZ%20395) or BIOZ 493 (https://bulletin.vcu.edu/search/?P=BIOZ%20493), must be for a minimum of two credit hours to count as a laboratory experience.

Transformative learning requirement: Students will take at least one REAL level 3 or 4 approved biology course.

Research and internship limits: A maximum total of six credits for all undergraduate research and internships in biology (BIOL 395 (https://bulletin.vcu.edu/search/?P=BIOL%20395), BIOL 451 (https://bulletin.vcu.edu/search/?P=BIOL%20451), BIOL 453 (https://bulletin.vcu.edu/search/?P=BIOL%20453), BIOL 492 (https://bulletin.vcu.edu/search/?P=BIOL%20492), BIOL 493 (https://bulletin.vcu.edu/search/?P=BIOL%20493), BIOL 494, BIOL 495 (https://bulletin.vcu.edu/search/?P=BIOL%20495), BIOZ 395 (https://bulletin.vcu.edu/search/?P=BIOZ%20395) and BIOZ 493 (https://bulletin.vcu.edu/search/?P=BIOZ%20493)) may be applied to the 40 credits of biology courses required for the major. Additional credits from these courses may be applied to upper-level and open elective credits toward the degree.

Preceptorship limits: A maximum of four combined credits from BIOL 496 (https://bulletin.vcu.edu/search/?P=BIOL%20496) and BIOL 499 (https://bulletin.vcu.edu/search/?P=BIOL%20499) may be applied to degree requirements. While BIOL 496 (https://bulletin.vcu.edu/search/?P=BIOL%20496) may be repeated for credit toward degree requirements when serving as a preceptorship for different courses, it may not be repeated with the same course for credit toward the degree.

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 Biology.

Course	Title	Hours
BIOL 151	Introduction to Biological Sciences I	3
BIOZ 151	Introduction to Biological Science Laboratory I	1
BIOL 152	Introduction to Biological Sciences II	3
BIOZ 152	Introduction to Biological Science Laboratory II	1
BIOL 200	Quantitative Biology	3
BIOL 300	Cellular and Molecular Biology	3
BIOL 310	Genetics	3
BIOL 317	Ecology	3
BIOL 318	Evolution	3

Degree requirements for Biology, Bachelor of Science (B.S.)

Course	Title	Hours
General education (https://bulletin.vcu.edu/undergraduate/undergraduate-study/general-education-curriculum/)		
Select 30 credits of general education courses in consultation with an adviser.		30
Major requirements		
• Major core requirements		
BIOL 152	Introduction to Biological Sciences II	3
BIOL 200	Quantitative Biology	3
BIOL 300	Cellular and Molecular Biology	3
BIOL 310	Genetics	3
BIOL 317	Ecology	3
BIOL 318	Evolution	3
BIOZ 151	Introduction to Biological Science Laboratory I [1]	1
BIOZ 152	Introduction to Biological Science Laboratory II [2]	1
• Additional major requirements		20
Biology transformative learning requirement		
Select at least one from all biology (BIOL and BIOZ) courses that are approved as REAL level 3 or 4 transformative learning experiences		
Major electives		
Select from all biology electives listed in the table below to satisfy the 40 biology credits required for the major. All majors must complete at minimum three additional upper-level biology lab courses. The laboratory experiences may be fulfilled by a separate laboratory section (BIOZ) or by laboratory hours included in a lecture-based (BIOL) course. Not all courses are offered each semester. BIOL courses at the 500 level are available to seniors and graduate students only.		
Ancillary requirements		
BIOL 151	Introduction to Biological Sciences I (satisfies general education BOK for natural science and AOI for scientific and logical reasoning)	3
CHEM 101 & CHEZ 101	General Chemistry I and General Chemistry Laboratory I (CHEM 101 satisfies general education BOK for natural science and AOI for scientific and logical reasoning)	4
CHEM 102 & CHEZ 102	General Chemistry II and General Chemistry Laboratory II	4
CHEM 301 & CHEZ 301	Organic Chemistry and Organic Chemistry Laboratory I	5
CHEM 302 & CHEZ 302	Organic Chemistry and Organic Chemistry Laboratory II	5
PHYS 201	General Physics I (satisfies general education AOI for scientific and logical reasoning)	4
PHYS 202	General Physics II	4
STAT 210	Basic Practice of Statistics	3
Quantitative requirement: Select from MATH or STAT options (four credits satisfy general education quantitative foundations) [3]		4-8
Open electives		
Select any course.		21-25
Total Hours		**120**

[1] BNFO 251 approved course substitute

[2] BNFO 252 approved course substitute

[3] Select one of the following options:

- Option A: MATH 151 and MATH 200
- Option B: MATH 200
- Option C: MATH 151 and STAT 314 or higher numbered statistics course

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

Biology Electives

Course	Title	Hours
BIOL 291	Topics in Biology	1-4
BIOL 303	Microbiology	3
BIOL 304	Biology Skills [1]	3
BIOL 307	Aquatic Ecology	3
BIOL 308	Vertebrate Histology [1]	4
BIOL 309	Entomology [1]	4
BIOL 312	Invertebrate Zoology	3
BIOL 313	Vertebrate Natural History	3
BIOL 314	Animal Reproduction	3
BIOL 320	Biology of the Seed Plant [1]	4
BIOL 321	Plant Development	3
BIOL 322	Plants, People and Culture	3
BIOL 324	Medicinal Botany	3
BIOL 325	Fungal Biology [1]	3
BIOL 330	Community Science: ____ [1]	3
BIOL 333	Evolution of the Angiosperms	3
BIOL 335	Global Change Biology	3
BIOL 340	Development and Stem Cells	3
BIOL 341/ANTH 301	Human Evolution [1]	4
BIOL 391	Topics in Biology (as approved)	1-4
BIOL 392	Introduction to Research	2
BIOL 395	Directed Study	1-2
BIOL 401	Applied and Environmental Microbiology	3
BIOL 402	Comparative Vertebrate Anatomy [1]	5
BIOL/ANTH 403	Primatology [1]	4
BIOL 411	Physiology	3
BIOL 413	Parasitology	3
BIOL 415	Mangrove Avian Field Ecology [1]	4

BIOL 416	Ornithology	3
BIOL 417	Mammalogy [1]	4
BIOL 420	Yeast and Fermentation [1]	3
BIOL 422	Forest Ecology [1]	4
BIOL 423	Plant Physiology	3
BIOL 425 Play course video for Field Botany	Field Botany [1]	3
BIOL 430	Invasion Biology	3
BIOL 431	Introduction to Marine Biology	3
BIOL 435	Herpetology	3
BIOL/FRSC 438	Forensic Molecular Biology	3
BIOL 440	Developmental Biology	3
BIOL 445	Neurobiology and Behavior [1]	4
BIOL 448	Neuroscience	3
BIOL 449	Stem Cells in Disease and Therapy	3
BIOL 450	Biology of Cancer I	3
BIOL 451	Biology of Cancer II [1]	4
BIOL 452	Biology of Drugs	3
BIOL 453	Cancer Biology Thesis [1]	4
BIOL 454	Biology of Aging and Diseases	3
BIOL 455	Immunology	3
BIOL 456	Virology	3
BIOL 459	Infectious Disease Ecology	3
BIOL 460	Human Evolutionary Genetics	3
BIOL 480	Animal-Plant Interactions	3
BIOL 489	Research Writing	1
BIOL 490	Presenting Research	1
BIOL 491	Topics in Biology	1-4
BIOL 492	Undergraduate Research [1]	1-4
BIOL 493	Biology Internship	1-3
BIOL 494	Research and Thesis I [1]	1-4
BIOL 495	Research and Thesis II [1]	1-4
BIOL 496	Biology Preceptorship: ____	2
BIOL 497	Ecological Service Learning	1
BIOL 498	Insects and Plants Service-learning	2
BIOL 499	Biology Lead Preceptorship	2
BIOL 502	Microbial Biotechnology	3
BIOL 503	Fish Biology [1]	4
BIOL 507	Aquatic Microbiology	4
BIOL 508	Barrier Island Ecology	3
BIOL 509	Microbial Ecology	3
BIOL 510	Conservation Biology	3
BIOL 514	Stream Ecology	4
BIOL 516	Population Genetics	3
BIOL 518	Plant Ecology	4
BIOL 519	Forest Ecology [1]	4
BIOL 520	Population Ecology	3
BIOL 521	Community Ecology	3
BIOL 522	Evolution and Speciation	3
BIOL 524	Endocrinology	3
BIOL 530/HGEN 501	Introduction to Human Genetics	3
BIOL 535	Wetlands Ecology [1]	4
BIOL/BNFO 540	Fundamentals of Molecular Genetics	3
BIOL 541	Laboratory in Molecular Genetics [1]	2
BIOL 545/LFSC 510	Biological Complexity	3
BIOL 548/LFSC 520	Bioinformatic Technologies	2
BIOL 550	Ecological Genetics	3
BIOL 560	Conservation Medicine	3
BIOL 565	Advances in Cell Signaling	3
BIOL 580	Eukaryotic Biotechnology	3
BIOL 591	Special Topics in Biology	1-4
BIOZ 303	Microbiology Laboratory	2
BIOZ 307	Aquatic Ecology Laboratory	1
BIOZ 310	Laboratory in Genetics	2
BIOZ 312	Invertebrate Zoology Laboratory	1
BIOZ 313	Vertebrate Natural History Laboratory	1
BIOZ 317	Ecology Laboratory	2
BIOZ 321	Plant Development Laboratory	2
BIOZ 324	Medicinal Botany Laboratory	1
BIOZ 367	Explorations in Cellular Organization	3
BIOZ 391	Topics in Biology Laboratory (as approved)	1-4
BIOZ 395	Directed Study Laboratory	1-2
BIOZ 399	Experiential and Applied Topics: ____	0-4
BIOZ 401	Applied and Environmental Microbiology Laboratory	2
BIOZ 405	Gross Anatomy Laboratory	2
BIOZ 416	Ornithology Laboratory	2
BIOZ 418	Integrative Physiology Laboratory	3
BIOZ/FRSZ 438	Forensic Molecular Biology Laboratory	2
BIOZ 491	Topics in Biology Laboratory	1-4
BIOZ 493	Biology Internship Laboratory	0-4
BNFO 301	Introduction to Bioinformatics	3
CHEM 403	Biochemistry I	3
ENVS 330	Environmental Pollution	3
LFSC 301	Integrative Life Sciences Research	3
MATH/BNFO 380	Introduction to Mathematical Biology	4
PHYS 381	Life in the Universe	3

[1]

This course includes laboratory hours and may be used to satisfy laboratory 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.

Recommended course sequence/plan of study

Freshman year

Fall semester		**Hours**
BIOL 151	Introduction to Biological Sciences I (satisfies general education BOK for natural science and AOI for scientific and logical reasoning)	3

BIOZ 151	Introduction to Biological Science Laboratory I	1
CHEM 101 & CHEZ 101	General Chemistry I and General Chemistry Laboratory I (CHEM 101 satisfies general education AOI for scientific and logical reasoning)	4
MATH 151	Precalculus Mathematics (satisfies general education quantitative foundations)	4
UNIV 101	Introduction to the University	1
UNIV 111 Play course video for Introduction to Focused Inquiry: Investigation and Communicatio	Introduction to Focused Inquiry: Investigation and Communication (satisfies general education UNIV foundations)	3
	Term Hours:	**16**
Spring semester		
BIOL 152 & BIOZ 152	Introduction to Biological Sciences II and Introduction to Biological Science Laboratory II	4
BIOL 200	Quantitative Biology	3
CHEM 102 & CHEZ 102	General Chemistry II and General Chemistry Laboratory II	4
UNIV 112 Play course video for Focused Inquiry II	Focused Inquiry II (satisfies general education UNIV foundations)	3
	Term Hours:	**14**
Sophomore year		
Fall semester		
BIOL 300	Cellular and Molecular Biology	3
CHEM 301 & CHEZ 301	Organic Chemistry and Organic Chemistry Laboratory I	5
STAT 210	Basic Practice of Statistics	3
UNIV 200	Advanced Focused Inquiry: Literacies, Research and Communication (satisfies general education UNIV foundations)	3
Open electives		1
	Term Hours:	**15**
Spring semester		
BIOL 310 or BIOL 317 or BIOL 318	Genetics or Ecology or Evolution	3
CHEM 302 & CHEZ 302	Organic Chemistry and Organic Chemistry Laboratory II	5
MATH 200 or STAT 314	Calculus with Analytic Geometry I or Applications of Statistics	4
General education course		3
	Term Hours:	**15**
Junior year		
Fall semester		
PHYS 201	General Physics I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	4
Select the two courses not previously taken from BIOL 310, BIOL 317 and BIOL 318.		6
Open elective		2
General education course		3
	Term Hours:	**15**
Spring semester		
PHYS 202	General Physics II	4
Biology elective		3
Biology laboratory elective		2
Open elective		3
General education course		3
	Term Hours:	**15**
Senior year		
Fall semester		
Biology electives		6
Biology laboratory elective		1
Open electives		8
	Term Hours:	**15**
Spring semester		
Biology electives		6
Biology laboratory elective		2
Open electives		7
	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 academically talented students to earn both the B.S. and M.S. in Biology 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 138 credits rather than the 150 credits necessary if the two degrees are pursued separately.

Students holding these degrees will be more broadly trained and will have significantly more experience and exposure to specific disciplines within biology. They will also receive a considerable amount of training in professional communication. Thus, they will be more competitive for private sector positions, professional programs and graduate studies at the doctoral level. In addition, the financial cost of the accelerated program provides a significant cost savings when compared to earning the B.S. followed by the M.S. in Biology.

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 including the biology core courses of BIOL 152, BIOL 200, BIOL 300, BIOL 310, BIOL 317 and BIOL 318; BIOZ 151 and BIOZ 152; CHEM 101, CHEM 102, CHEM 301 and CHEM 302; CHEZ 101, CHEZ 102, CHEZ 301 and CHEZ 302; an overall GPA of 3.0; and a biology major GPA of 3.0.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress (https://bulletin.vcu.eduabout:blank)" section of Bulletin, including maintaining a 3.0 GPA. Guidance to students in an accelerated program is provided by both the undergraduate biology adviser and the forensic science graduate program director.

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. 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.

Degree requirements

The Bachelor of Science in Biology 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 will satisfy biology major electives 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.

The graduate biology courses that may be taken as an undergraduate, once a student is admitted to the program, are:

Course	Title	Hours
BIOL 604	Research Integrity	1
BIOL 607	Science Communication: Fundamentals	2
BIOL 608	Science Communication: Research Proposals	2
BIOL 690	Biology Seminar	1
Graduate biology electives or other core courses		6
Total Hours		**12**

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		
PHYS 201	General Physics I	4-5
or PHYS 207	University Physics I	
Select the two courses not previously taken from BIOL 310, BIOL 317 and BIOL 318		6
Foreign language 101		3
General education course		3
Term Hours:		16-17
Spring semester		
PHYS 202	General Physics II	4-5
or PHYS 208	University Physics II	
Biology elective		3
Biology lab elective		1-2
Foreign language 102		3
General education course		3
Term Hours:		14-16
Senior year		
Fall semester		
BIOL 604	Research Integrity	1
BIOL 607	Science Communication: Fundamentals	2
Biology lab elective		1-2
Graduate biology elective or other core course		3
Open electives		9
Term Hours:		16-17
Spring semester		
Select one of the following (capstone):		0-3
BIOL 475	Biology Capstone Seminar: ____	
BIOL 477	Biology Capstone Experience	
BIOZ 476	Molecular Capstone Laboratory	
BIOL 608	Science Communication: Research Proposals	2
BIOL 690	Biology Seminar	1
Biology lab elective		1-2
Graduate biology elective or other core course		3
Open electives		7
Term Hours:		14-18
Fifth year		
Fall semester		
BIOL 606	Quantitative Ecology	3
or BIOS 543	Graduate Research Methods I	
or STAT 543	Statistical Methods I	
BIOL 631	Biology Integration: From Molecules to Organisms	3
BIOL 693	Current Topics in Biology	1
BIOL 698	Thesis	2
or BIOL 692	Independent Study	
Term Hours:		9
Spring semester		
BIOL 632	Biology Integration: From Organisms to Landscapes	3
BIOL 690	Biology Seminar	1

BIOL 693	Current Topics in Biology	1
BIOL 698	Thesis	1
or BIOL 692	Independent Study	
Graduate biology elective or additional credits of thesis (BIOL 698)		3
Term Hours:		9

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows academically talented students to earn both the B.S. in Biology and M.S. in Forensic Science with a concentration in forensic biology in a minimum of five and a half 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 150 credits rather than the 162 credits necessary if the two degrees are pursued separately.

Students holding these degrees will have foundational work in biology, followed by advanced training in forensic science through a combination of laboratory and classroom work and will gain important professional development skills. The goal of the accelerated program is to significantly enhance the student's qualifications to pursue a career in the forensic science field. Alternatively, students who distinguish themselves may be able to pursue advanced study in doctoral or professional programs on an accelerated timetable.

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 60 undergraduate credit hours including CHEM 301, CHEZ 301, CHEM 302, CHEZ 302, CHEM 403 and BIOL 310; an overall GPA of 3.3; and a GPA of 3.0 in biology course work. Two reference letters (at least one from a biology or forensic science faculty member) must accompany the Accelerated Program Declaration Form.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress (https://bulletin.vcu.eduabout:blank)" section of Bulletin, including maintaining a 3.0 GPA. Guidance to students in an accelerated program is provided by both the undergraduate biology adviser and the forensic science graduate program director.

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. 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.

Degree requirements

The Bachelor of Science in Biology 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 satisfy required major electives 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.

The graduate forensic science courses that may be taken as an undergraduate, once a student is admitted to the program, are:

Course	Title	Hours
BIOL 540	Fundamentals of Molecular Genetics (satisfies undergraduate biology elective)	3
BIOS 543	Graduate Research Methods I (satisfies elective (upper-level))	3
or STAT 543	Statistical Methods I	
FRSC 673 & FRSZ 673	Forensic Microscopy and Forensic Microscopy Laboratory (satisfies undergraduate biology elective and biology laboratory elective)	3
FRSC 675 & FRSZ 675	Forensic Serology and DNA Analysis and Forensic Serology and DNA Analysis Laboratory (satisfies undergraduate biology elective and biology laboratory elective)	3
Total Hours		**12**

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 317	Ecology	3
or BIOL 318	Evolution	
CHEM 403	Biochemistry I	3
PHYS 201	General Physics I	4-5
or PHYS 207	University Physics I	
Foreign language 101		3
General education course		3
Term Hours:		16-17
Spring semester		
BIOL 317	Ecology	3
or BIOL 318	Evolution	
PHYS 202	General Physics II	4-5
or PHYS 208	University Physics II	

Biology elective		3
Foreign language 102		3
Open elective		2
Term Hours:		15-16
Senior year		
Fall semester		
FRSC 673 & FRSZ 673	Forensic Microscopy and Forensic Microscopy Laboratory	3
FRSC 675 & FRSZ 675	Forensic Serology and DNA Analysis and Forensic Serology and DNA Analysis Laboratory	3
Biology elective		3
Open electives		5
Term Hours:		14
Spring semester		
BIOS 543	Graduate Research Methods I	3
or STAT 543	Statistical Methods I	
BIOL 540	Fundamentals of Molecular Genetics	3
BIOZ 476	Molecular Capstone Laboratory	2
General education course		3
Open elective		3
Term Hours:		14
Fifth year		
Fall semester		
FRSC 565	Scientific Crime Scene Investigation	3
FRSC 570	Forensic Science Seminar	1
FRSC 670	Forensic Evidence and Criminal Procedure	3
FRSC 671	Instrumentation in Forensic Chemistry	2
Term Hours:		9
Spring semester		
BIOL 516	Population Genetics	3
FRSC 570	Forensic Science Seminar	1
FRSC 676	Advanced Forensic DNA Analysis	3
FRSC 677	Professional Practices and Expert Testimony	3
FRSC 793	Directed Research in Forensic Science	1
Term Hours:		11
Sixth year		
Fall semester		
FRSC 570	Forensic Science Seminar	1
FRSC 660	Toolmark Examinations	3
or FRSC 661	Analysis of Pattern Evidence	
or FRSC 662	Firearm Identification	
FRSC 686	Emerging Molecular Applications for Forensic Biology	3
FRSC 793	Directed Research in Forensic Science	2
FRSC elective		1
Term Hours:		10

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows qualified students to earn both the B.S. in Biology and M.S. in Health and Movement Science with a concentration in exercise science 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 degrees. Thus, the two degrees may be earned with a minimum of 144 credits rather than the 156 credits necessary if the two degrees are pursued separately.

Students holding these degrees will have completed advanced course work focused on biology and the application of health and movement science principles to exercise science, preparing graduates for a wide range of career options that promote physical well-being in healthy children and adults, athletes, and clinical populations. These career opportunities exist in health and fitness centers, sports programs, clinical settings, academic institutions, rehabilitation facilities and public health agencies, where graduates can pursue employment in community, corporate and university exercise programs, cardiac rehabilitation, or advanced study and research in the field of exercise physiology.

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 84 undergraduate credit hours including an overall minimum GPA of 3.0; and a GPA of 3.0 in ancillary requirements and biology core course work. Students who do not meet the minimum GPA requirements may submit GRE scores to receive further consideration. Students who are interested in the accelerated program should consult with the graduate program director of the M.S. program before they have completed 84 credits. Successful applicants would enter the program in the fall 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 minimum 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate adviser for the biology program and the faculty adviser to the 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 fall 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. Three reference letters (at least two from biology faculty members) are required.

Degree requirements

The Bachelor of Science in Biology 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 will substitute for required major electives 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.

The graduate health and movement science courses that may be taken as an undergraduate, once a student is admitted to the program, are listed below. Students will take four courses (12 credits) from the list.

Course	Title	Hours
HEMS 600	Introduction to Research Design in Health and Movement Sciences	3
HEMS 601	Movement Physiology	3
HEMS 604	Nutrition for Health and Physical Activity	3
HEMS 610	Laboratory Techniques in Rehabilitation Science [1]	3
HEMS 675	Clinical Exercise Physiology	3

[1] HEMS 610 is also approved to fulfill a biology laboratory elective.

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		
PHYS 201	General Physics I	4-5
or PHYS 207	University Physics I	
Foreign language 101		3
General education course		3
Select two courses not taken from BIOL 310, BIOL 317 and BIOL 318		6
Term Hours:		16-17
Spring semester		
PHYS 202	General Physics II	4-5
or PHYS 208	University Physics II	
Biology elective		3
Biology laboratory elective		1-2
Foreign language 102		3
General education course		3
Term Hours:		14-16
Senior year		
Fall semester		
HEMS 600	Introduction to Research Design in Health and Movement Sciences	3
or HEMS 601	Movement Physiology	
HEMS 604	Nutrition for Health and Physical Activity	3
or HEMS 610	Laboratory Techniques in Rehabilitation Science	
or HEMS 675	Clinical Exercise Physiology	
Biology laboratory electives		1-2
Open electives		9
Term Hours:		16-17
Spring semester		
HEMS 601	Movement Physiology	3
or HEMS 600	Introduction to Research Design in Health and Movement Sciences	
HEMS 604	Nutrition for Health and Physical Activity	3
or HEMS 610	Laboratory Techniques in Rehabilitation Science	
or HEMS 675	Clinical Exercise Physiology	
Biology capstone: BIOL 475, BIOZ 476 or BIOL 477		0-3
Biology laboratory elective		1-2
Open electives		7
Term Hours:		14-18
Fifth year		
Fall semester		
BIOS 543	Graduate Research Methods I	3
or STAT 543	Statistical Methods I	
HEMS 604	Nutrition for Health and Physical Activity	3
or HEMS 605	Psychology of Physical Activity	
or HEMS 610	Laboratory Techniques in Rehabilitation Science	
or HEMS 675	Clinical Exercise Physiology	
HEMS 692	Independent Study	3
General elective		3
Term Hours:		12
Spring semester		
HEMS 604	Nutrition for Health and Physical Activity	3
or HEMS 605	Psychology of Physical Activity	
or HEMS 610	Laboratory Techniques in Rehabilitation Science	
or HEMS 675	Clinical Exercise Physiology	
HEMS 692	Independent Study	3
or HEMS 695	Externship	
or HEMS 797	Directed Research Study	
General elective		3
Specified elective		3
Term Hours:		12

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows academically talented students to earn both the B.S. in Biology and M.S. in Medical Laboratory Sciences with a categorical concentration in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. This accelerated program provides specialized study, including a clinical practicum, and will allow students to pursue the

categorical concentration of the master's program in one of the following areas: hematology, microbiology or immunohematology. Students in the program may count up to 10 hours of graduate courses toward both the B.S. and M.S. degrees. Thus, the two degrees may be earned with a minimum of 144 credits rather than the 154 credits necessary if the two degrees are pursued separately.

Students holding these degrees will have a head start for career advancement in medical laboratory sciences. The M.S. degree provides students with advanced theoretical and technical education and prepares them to assume roles as laboratory supervisors, educators and researchers. VCU will provide students with a superior, yet flexible, course of advanced study in medical laboratory sciences.

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 requires completion of 90 undergraduate credit hours including the biology core courses of BIOL 152, BIOL 200, BIOL 300, BIOL 310, BIOL 317 and BIOL 318; BIOZ 151 and BIOZ 152; CHEM 101, CHEM 102, CHEM 301 and CHEM 302; CHEZ 101, CHEZ 102, CHEZ 301 and CHEZ 302; an overall GPA of 3.0; a biology major GPA of 3.0; eight to 10 credit hours of discipline-specific undergraduate course work in medical laboratory sciences based on the student's choice of specialty (see curriculum requirements for the M.S. degree program in medical laboratory sciences, categorical concentration in the Graduate Bulletin for a list of the undergraduate discipline-specific courses, also included in the plan of study below). The credits for the discipline-specific undergraduate courses in medical laboratory sciences will substitute for required major electives in the undergraduate degree.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress (https://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 adviser for the biology program and the faculty adviser to the 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. 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.

Degree requirements

The Bachelor of Science in Biology 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 10 graduate credits may be taken prior to completion of the baccalaureate degree selected from the list below in consultation with an advisor. These graduate credits will substitute for required major electives 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.

The graduate courses that may be taken as an undergraduate, once a student is admitted to the program, and may be counted toward both B.S. and M.S. degrees are:

Course	Title	Hours
CLLS 500	Concepts and Techniques in Clinical Laboratory Science [1]	3
CLLS 595	Clinical Practicum	3
CLLS 661	Research Methodology in Medical Laboratory Sciences	3
CLLS 690	Clinical Laboratory Sciences Seminar	1
HGEN 501	Introduction to Human Genetics [2]	3

[1] CLLS 500 is approved to fulfill a biology laboratory elective.

[2] HGEN 501 is a discipline-specific course option for the hematology and immunohematology specialties; it is not a shared course option for the microbiology specialty.

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 first year, prior to admission to the accelerated program in the second year. Each of the specialty areas of the categorical concentrations is outlined below.

Hematology specialty

Course	Title	Hours
Junior year		
Fall semester		
CLLS 301	Hematology (satisfies biology laboratory elective)	3.5
CLLS 304	Urine and Body Fluid Analysis (satisfies biology laboratory elective)	2
PHYS 201	General Physics I	4-5
or PHYS 207	University Physics I	
Foreign language 101		3
Select one course not yet taken from:		3
BIOL 310	Genetics	
or BIOL 317	Ecology	
or BIOL 318	Evolution	
Term Hours:		15.5-16.5
Spring semester		

CLLS 302	Abnormal Hematology (satisfies biology laboratory elective)	4
PHYS 202	General Physics II	4-5
or PHYS 208	University Physics II	
Foreign language 102		3
Select one course not yet taken from:		3
BIOL 310	Genetics	
or BIOL 317	Ecology	
or BIOL 318	Evolution	
Term Hours:		14-15
Senior year		
Fall semester		
CLLS 500	Concepts and Techniques in Clinical Laboratory Science (shared graduate requirement; satisfies biology laboratory elective)	3
HGEN 501	Introduction to Human Genetics (shared graduate requirement; satisfies biology laboratory elective)	3
General education course		3
Open electives		5.5
Term Hours:		14.5
Spring semester		
BIOL 475	Biology Capstone Seminar: ____ (select one for capstone)	0-3
or BIOL 477	Biology Capstone Experience	
or BIOZ 476	Molecular Capstone Laboratory	
CLLS 661	Research Methodology in Medical Laboratory Sciences (shared graduate credit; satisfies biology elective)	3
CLLS 690	Clinical Laboratory Sciences Seminar (shared graduate requirement; satisfies biology elective)	1
Biology elective		1
General education course		3
Open electives		7
Term Hours:		15-18
Fifth year		
Summer semester		
CLLS 595	Clinical Practicum	3
Term Hours:		3
Fall semester		
ALHP 594	Health Education Practicum	2
BIOS 543	Graduate Research Methods I	3
or STAT 543	Statistical Methods I	
CLLS 690	Clinical Laboratory Sciences Seminar	1
CLLS 790	Research in Clinical Laboratory Sciences	1
HADM 602	Health System Organization, Financing and Performance	3
Term Hours:		10
Spring semester		
ALHP 594	Health Education Practicum	2
CLLS 580	Principles of Education/Management	3
CLLS 629	Advanced Concepts in Hematology (specialty course)	2
CLLS 690	Clinical Laboratory Sciences Seminar	1
CLLS 790	Research in Clinical Laboratory Sciences	3
Term Hours:		11

Immunohematology specialty[1]

Course	Title	Hours
Junior year		
Fall semester		
CLLS 310	Clinical Immunology (satisfies biology laboratory elective)	4.5
PHYS 201	General Physics I	4-5
or PHYS 207	University Physics I	
Foreign language 101		3
Select two courses not yet taken from:		6
BIOL 310	Genetics	
or BIOL 317	Ecology	
or BIOL 318	Evolution	
Term Hours:		17.5-18.5
Spring semester		
CLLS 306	Immunohematology (satisfies biology laboratory elective)	4.5
PHYS 202	General Physics II	4-5
or PHYS 208	University Physics II	
Foreign language 102		3
General education course		3
Term Hours:		14.5-15.5
Senior year		
Fall semester		
CLLS 500	Concepts and Techniques in Clinical Laboratory Science (shared graduate requirement; satisfies biology laboratory elective)	3
HGEN 501	Introduction to Human Genetics (shared graduate requirement; satisfies biology elective)	3
General education course		3
Open electives		6
Term Hours:		15
Spring semester		
BIOL 475	Biology Capstone Seminar: ____ (select one for capstone)	0-3
or BIOL 477	Biology Capstone Experience	
or BIOZ 476	Molecular Capstone Laboratory	
CLLS 661	Research Methodology in Medical Laboratory Sciences (shared graduate credit; satisfies biology elective)	3
CLLS 690	Clinical Laboratory Sciences Seminar (shared graduate requirement; satisfies biology elective)	1
Biology elective		1
Open electives		7

Term Hours:		12-15
Fifth year		
Summer semester		
CLLS 595	Clinical Practicum	3
Term Hours:		3
Fall semester		
ALHP 594	Health Education Practicum	2
BIOS 543	Graduate Research Methods I	3
or STAT 543	Statistical Methods I	
CLLS 690	Clinical Laboratory Sciences Seminar	1
CLLS 790	Research in Clinical Laboratory Sciences	1
HADM 602	Health System Organization, Financing and Performance	3
Term Hours:		10
Spring semester		
ALHP 594	Health Education Practicum	2
CLLS 580	Principles of Education/Management	3
CLLS 627	Advanced Concepts in Immunology and Immunohematology (specialty course)	3
CLLS 690	Clinical Laboratory Sciences Seminar	1
CLLS 790	Research in Clinical Laboratory Sciences	3
Term Hours:		12

[1]

This specialty requires one additional credit of graduate work.

Microbiology specialty

Course	Title	Hours
Junior year		
Fall semester		
CLLS 307	Introduction to Pathogenic Microbiology (satisfies biology elective)	3
PHYS 201	General Physics I	4-5
or PHYS 207	University Physics I	
Foreign language 101		3
Select two courses not yet taken from:		6
BIOL 310	Genetics	
or BIOL 317	Ecology	
or BIOL 318	Evolution	
Term Hours:		16-17
Spring semester		
CLLS 308	Pathogenic Bacteriology (satisfies biology laboratory elective)	5
PHYS 202	General Physics II	4-5
or PHYS 208	University Physics II	
Foreign language 102		3
General education course		3
Term Hours:		15-16
Senior year		
Fall semester		
CLLS 500	Concepts and Techniques in Clinical Laboratory Science (shared graduate requirement; satisfies biology laboratory elective)	3
General education course		3
Open electives		7
Term Hours:		13
Spring semester		
BIOL 475	Biology Capstone Seminar: ____ (select one for capstone)	0-3
or BIOL 477	Biology Capstone Experience	
or BIOZ 476	Molecular Capstone Laboratory	
CLLS 661	Research Methodology in Medical Laboratory Sciences (shared graduate credit; satisfies biology elective)	3
CLLS 690	Clinical Laboratory Sciences Seminar (shared graduate requirement; satisfies biology elective)	1
Biology laboratory elective		2
Open electives		6
Term Hours:		12-15
Summer semester		
CLLS 595	Clinical Practicum (shared graduate credit; satisfies biology elective)	3
Term Hours:		3
Fifth year		
Fall semester		
ALHP 594	Health Education Practicum	2
BIOS 543	Graduate Research Methods I	3
or STAT 543	Statistical Methods I	
CLLS 608	Laboratory Diagnosis of Infectious Diseases (specialty course)	3
CLLS 690	Clinical Laboratory Sciences Seminar	1
CLLS 790	Research in Clinical Laboratory Sciences	1
HADM 602	Health System Organization, Financing and Performance	3
Term Hours:		13
Spring semester		
ALHP 594	Health Education Practicum	2
CLLS 580	Principles of Education/Management	3
CLLS 628	Advanced Concepts in Microbiology (specialty course)	2
CLLS 690	Clinical Laboratory Sciences Seminar	1
CLLS 790	Research in Clinical Laboratory Sciences	3
Term Hours:		11