

BIOLOGY, BS

Banner Code: SC-BS-BIOL

Academic Advising

Exploratory Hall, Room 1200
Fairfax Campus

Website: biology.gmu.edu/academics/degree-programs/

The Biology, BS provides a sound liberal arts education with substantial experience in quantitative and analytical thought, along with preparation for related professions. The department provides the strong background necessary for not only for graduate study in the life sciences, but also enables students to develop careers in a wide variety of disciplines, including secondary school teaching, environmental management, microbiology, molecular biology, biotechnology, genetics, wildlife management, fisheries biology, and marine science. Furthermore, our curriculum prepares students for careers in the health sciences including medicine, dentistry, veterinary science, and related allied health disciplines.

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Undergraduate Admissions Policies section of this catalog.

To apply for this program, please complete the George Mason University Admissions Application (<https://www2.gmu.edu/admissions-aid/apply-now>).

Policies

Students must fulfill all Requirements for Bachelor's Degrees, including the Mason Core.

Important information and departmental policies are listed in the Department of Biology section of this catalog.

BIOL 308 Foundations of Ecology and Evolution meets the writing intensive requirement for this major.

For policies governing all undergraduate degrees, see AP.5 Undergraduate Policies.

Important Program Requirements

- Students may apply no more than 8 credits of BIOL 103 Introductory Biology I (Mason Core) or BIOL 104 Introductory Biology II (Mason Core) toward elective credit (or equivalent transfer credit at the 100 to 200-level) if taken before successful completion of BIOL 213 Cell Structure and Function (Mason Core).
- Biology majors must earn a minimum grade of 'C' in all biology core courses. A grade of 'C' or better must be earned in BIOL 213 Cell Structure and Function (Mason Core) in order to advance to other core requirements.
- Students may repeat BIOL 213 Cell Structure and Function (Mason Core) once, but a second time only with permission from the Department of Biology.

- Students may **not** count BIOL 124 Human Anatomy and Physiology and/or BIOL 125 Human Anatomy and Physiology toward any biology major requirement.
- Students who take BIOL 310 Biodiversity may **not** count BIOL 303 Animal Biology and/or BIOL 304 Plant Biology toward any biology major requirement.
- 44 credits must be in biology coursework.
- BIOL 493 Honors Research in Biology, BIOL 495 Directed Studies in Biology, and BIOL 497 Special Problems in Biology do not satisfy the requirements of the BS degree which state that students must complete at least two upper division courses that include a laboratory. The courses do, however, count as non-laboratory electives.

Several optional concentrations are available; details on each can be found in the Requirements tab.

Teacher Licensure

Students majoring in biology who wish to pursue a career teaching secondary school may consider applying for the Secondary Education – Biology (6-12) Undergraduate Certificate offered by the College of Education and Human Development as an option in seeking an initial Virginia teaching license. The certificate includes current endorsement and licensure coursework embedded within your major. Students apply to add this as a secondary program during their sophomore year and complete required content and education coursework leading to initial licensure in the state of Virginia within 120 credits.

Other routes to licensure include the Biology, BA or BS/Curriculum and Instruction, Accelerated MEd (Secondary Education Biology Concentration) or select traditional Master's programs. Please contact the Undergraduate Advisor in College of Education and Human Development for more information.

Requirements

Degree Requirements

Total credits: minimum 120

Students should refer to the Admissions & Policies tab for specific policies related to this program.

Students must complete their biology coursework and the supporting requirements which follow with a minimum GPA of 2.00.

All students must complete the biology core, chemistry, physics, mathematics, and computer science courses listed below. Students then elect to complete the BS degree either with a concentration or without a concentration.

Biology Core Courses

BIOL 213	Cell Structure and Function (Mason Core)	4
BIOL 214	Biostatistics for Biology Majors	4
BIOL 308	Foundations of Ecology and Evolution ¹	5
BIOL 310 & BIOL 330	Biodiversity and Biodiversity Lab and Recitation	5

BIOL 311	General Genetics	4
Total Credits		22

¹ Fulfills writing intensive requirement.

Chemistry

CHEM 211 & CHEM 213	General Chemistry I (Mason Core) and General Chemistry Laboratory I (Mason Core) (Natural Science course)	4
CHEM 212 & CHEM 214	General Chemistry II (Mason Core) and General Chemistry Laboratory II (Mason Core) (Natural Science course)	4
CHEM 313	Organic Chemistry I	3
CHEM 315	Organic Chemistry Lab I	2
Total Credits		13

Physics

Select from one from the following Mason Core: Natural Science sequences: 8

PHYS 243 & PHYS 244 & PHYS 245 & PHYS 246	College Physics (Mason Core) and College Physics Lab (Mason Core) and College Physics (Mason Core) and College Physics Lab (Mason Core)	8
PHYS 160 & PHYS 161 & PHYS 260 & PHYS 261	University Physics I (Mason Core) and University Physics I Laboratory (Mason Core) and University Physics II (Mason Core) and University Physics II Laboratory (Mason Core)	8
Total Credits		8

Mathematics

Select one from the following: 3-6

MATH 111 or MATH 113	Linear Mathematical Modeling (Mason Core) Analytic Geometry and Calculus I (Mason Core)	3-6
MATH 123 & MATH 124	Calculus with Algebra/Trigonometry, Part A and Calculus with Algebra/Trigonometry, Part B (Mason Core)	3-6
Total Credits		3-6

Computer Science

Select one from the following: 3

CDS 130	Computing for Scientists (Mason Core) ¹	3
Any course(s) that fulfills the Mason Core: Information Technology requirement		
Total Credits		3

¹ Recommended by the Department of Biology

BS without Concentration

Students who do not select an optional concentration must complete the biology core and shared courses shown above in addition to the curriculum requirements listed below.

Biology Electives

Complete 22 credits of additional biology courses ¹	22
Total Credits	22

¹ Of which, at least 14 credits must be upper division, and at least two of the upper division courses must include a laboratory.

Additional Science Courses

Students are encouraged to consult with a biology faculty advisor to determine which option (A, B, or C) best meets their career goals.

Select one from the following options: 3-8

Option A:		
CHEM 314 & CHEM 318	Organic Chemistry II and Organic Chemistry Lab II	
Option B:		
One 3 credit chemistry course at the 300 or 400-level (not CHEM 314)		
Option C:		
GEOL 101 & GEOL 102	Introductory Geology I (Mason Core) and Introductory Geology II (Mason Core) (Natural Science courses)	
Total Credits		3-8

Note:

Students expecting to enter a professional school are strongly encouraged to complete MATH 113 Analytic Geometry and Calculus I (Mason Core).

Concentration in Bioinformatics (BNF)

The highly interdisciplinary field of bioinformatics has emerged as a powerful modern science. There is a great demand for undergraduate and graduate-level trained individuals with a background in bioinformatics in industry as well as in academia.

Computer Science		3
CDS 130 is recommended to fulfill the Computer Science requirement in the shared core above.		
CDS 230	Modeling and Simulation I	
Bioinformatics		6
BINF 401	Bioinformatics and Computational Biology I	
BINF 402	Bioinformatics and Computational Biology II	
Biology		14-16
BIOL 312	Biostatistics for Bioinformatics	
BIOL 401	Phage Discovery	
BIOL 412	Phage Genomics	
Biology Lab Elective		
Select one from the following:		
BIOL 320	Comparative Chordate Anatomy	
BIOL 322 & BIOL 323	Developmental Biology and Lab for Developmental Biology	
BIOL 331	Invertebrate Zoology	
BIOL 332	Insect Biology	
BIOL 334	Vertebrate Paleontology	
BIOL 336	Invertebrate Paleontology	

BIOL 344	Plant Diversity and Evolution
BIOL 345	Plant Ecology
BIOL 350	Freshwater Ecosystems
BIOL 355	Ecological Engineering and Ecosystem Restoration
BIOL 379	RS: Ecological Sustainability (Mason Core)
BIOL 385 & BIOL 486	Biotechnology and Genetic Engineering and Molecular Biology and Biotechnology Laboratory
BIOL 405	Microbial Genetics
BIOL 406	Microbial Physiology and Metabolism
BIOL 407	Microbial Diversity
BIOL 430	Advanced Human Anatomy and Physiology I
BIOL 431	Advanced Human Anatomy and Physiology II
BIOL 452 & BIOL 453	Immunology and Immunology Laboratory
BIOL 454 & BIOL 455	Marine Mammal Biology and Conservation and Marine Mammal Biology and Conservation Field Course
BIOL 465	Histology
BIOL 468	Vertebrate Natural History
BIOL 472 & BIOL 473	Introductory Animal Behavior and Introductory Laboratory in Animal Behavior
BIOL 484 & BIOL 485	Eukaryotic Cell Biology and Eukaryotic Cell Biology Laboratory
BIOL 509 & BIOL 510	DNA Analysis of Biological Evidence and Forensic DNA Analysis Laboratory
BIOL 537	Ornithology
BIOL 538	Mammalogy
BIOL 539	Herpetology
BIOL 543 or BIOL 305 & BIOL 306	Tropical Ecosystems Biology of Microorganisms and Biology of Microorganisms Laboratory

Total Credits 23-25

Concentration in Biopsychology (BP)

The biopsychology concentration consists of a selection of courses designed to address the needs and interest of students who wish to study biology in more depth while simultaneously exploring psychology and neurobiology. This concentration will help prepare students for the MCAT section related to psychology and provide veterinary students with a background in animal learning/behavior.

Biopsychology Courses

BIOL 430	Advanced Human Anatomy and Physiology I	4
BIOL 431	Advanced Human Anatomy and Physiology II	4
PSYC 372	Physiological Psychology	3
PSYC 373	Physiological Psychology Laboratory	1

Additional Psychology/Neuroscience Course

Select 3-4 credits from the following: 3-4

PSYC 304	Principles of Learning
PSYC 376	Brain and Behavior
PSYC 406	Psychology of Communication (Mason Core)
NEUR 327	Cellular, Neurophysiological, and Pharmacological Neuroscience
NEUR 335	Molecular, Developmental, and Systems Neuroscience

Additional Biology Courses

Select 6-7 credits from the following: 6-7

BIOL 305	Biology of Microorganisms
BIOL 306	Biology of Microorganisms Laboratory
BIOL 314	Introduction to Research Design and Analysis
BIOL 322	Developmental Biology
BIOL 323	Lab for Developmental Biology
BIOL 472	Introductory Animal Behavior
BIOL 473	Introductory Laboratory in Animal Behavior
BIOL 483	General Biochemistry
BIOL 537	Ornithology
BIOL 538	Mammalogy

Additional Chemistry Courses

Select one from the following options: ¹ 3-5

Option A:

CHEM 314 & CHEM 318	Organic Chemistry II and Organic Chemistry Lab II
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Option B:

One chemistry course at the 300 or 400-level ²

Total Credits 24-28

¹ Students are encouraged to consult with a biology faculty advisor to determine which option best meets their career goals.

² CHEM 314 Organic Chemistry II alone does not fulfill this requirement.

Concentration in Biotechnology and Molecular Biology (BTMB)

The biotechnology and molecular biology concentration consists of a selection of courses that provide essential skills to students who seek employment in the field or wish to include an applied component in their undergraduate training in biology.

Biotechnology Courses

BIOL 305	Biology of Microorganisms	3
BIOL 306	Biology of Microorganisms Laboratory	1
BIOL 385	Biotechnology and Genetic Engineering	3
BIOL 483	General Biochemistry	4

Additional Biology Courses

Select 11 credits from the following, at least one of the courses must include a laboratory: 11

Laboratory Courses:

BIOL 402 & BIOL 403	Applied and Industrial Microbiology and Techniques in Applied and Industrial Microbiology	
BIOL 405	Microbial Genetics	
BIOL 406	Microbial Physiology and Metabolism	
BIOL 452 & BIOL 453	Immunology and Immunology Laboratory	
BIOL 486	Molecular Biology and Biotechnology Laboratory	
Non-laboratory Courses:		
BIOL 314	Introduction to Research Design and Analysis	
BIOL 382	Introduction to Virology	
BIOL 411	Advanced General Genetics	
BIOL 417	Selected Topics in Molecular and Cellular Biology ¹	
BIOL 418	Current Topics in Microbiology ¹	
BIOL 420	Vaccines	
BIOL 421	Genetics of Human Diseases	
BIOL 422	Stem Cell Biology and Regenerative Medicine	
BIOL 482	Introduction to Molecular Genetics	
BIOL 484	Eukaryotic Cell Biology	
BIOL 497	Special Problems in Biology ¹	
Additional Chemistry Courses		
CHEM 314	Organic Chemistry II	3
CHEM 318	Organic Chemistry Lab II	2
Total Credits		27

¹ Registration for BIOL 417 Selected Topics in Molecular and Cellular Biology, BIOL 418 Current Topics in Microbiology, or BIOL 497 Special Problems in Biology is subject to approval by the Director of Undergraduate Studies and the Chairman of the Department of Biology.

Concentration in Environmental and Conservation Biology (ESCB)

This concentration is offered to students seeking a biology degree that focuses on ecology and organismal biology and prepares them for graduate work or employment in environmental and conservation fields, such as natural resources management, fisheries, forestry, water quality management, aquatic and wetland ecology, and conservation biology. The concentration is staffed and supported by the Department of Environmental Science and Policy.

Environmental and Conservation Biology

BIOL 318	Conservation Biology	3
BIOL 377	Applied Ecology	3

Biology Electives

Select 16 credits from the following: ¹ 16

BIOL 309	Introduction to Oceanography	
BIOL 314	Introduction to Research Design and Analysis	
BIOL 326	Animal Physiology	
BIOL 331	Invertebrate Zoology	
BIOL 332	Insect Biology	

BIOL 344	Plant Diversity and Evolution	
BIOL 345	Plant Ecology	
BIOL 350	Freshwater Ecosystems	
BIOL 355	Ecological Engineering and Ecosystem Restoration	
BIOL 379	RS: Ecological Sustainability (Mason Core)	
BIOL 440	Field Biology	
BIOL 446	Ecological and Evolutionary Physiology	
BIOL 449	Marine Ecology	
BIOL 450	Marine Conservation	
BIOL 454	Marine Mammal Biology and Conservation	
BIOL 455	Marine Mammal Biology and Conservation Field Course	
BIOL 457	Reproductive Strategies	
BIOL 459	Fungi and Ecosystems	
BIOL 468	Vertebrate Natural History	
BIOL 472 & BIOL 473	Introductory Animal Behavior and Introductory Laboratory in Animal Behavior	
BIOL 480	The Diversity of Fishes	

Additional Science Courses

Select one from the following options: ² 3-8

Option A:

CHEM 314 & CHEM 318	Organic Chemistry II and Organic Chemistry Lab II	
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Option B:

One chemistry course at the 300 or 400-level ³

Option C:

GEOL 101 & GEOL 102	Introductory Geology I (Mason Core) and Introductory Geology II (Mason Core)	
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Total Credits 25-30

¹ Of which, two courses must be selected from the list above and must have either: 2 laboratory courses or 1 laboratory course and 1 field course (consult with an advisor for guidance).

² Students are encouraged to consult with a biology faculty advisor to determine which option best meets their career goals.

³ CHEM 314 Organic Chemistry II alone does not fulfill this requirement.

Concentration in Microbiology (MIB)

This concentration offers lecture and laboratory courses in microbiology to prepare students for employment or advanced study in microbial genetics, physiology, diversity, and related fields.

Microbiology Courses

BIOL 305	Biology of Microorganisms	3
BIOL 306	Biology of Microorganisms Laboratory	1
BIOL 405	Microbial Genetics	4
BIOL 407	Microbial Diversity	4

Biology Electives

Select 10 credits from the following: 10

BIOL 314	Introduction to Research Design and Analysis	
BIOL 382	Introduction to Virology	
BIOL 385	Biotechnology and Genetic Engineering	
BIOL 402	Applied and Industrial Microbiology	
BIOL 403	Techniques in Applied and Industrial Microbiology	
BIOL 404	Medical Microbiology	
BIOL 418	Current Topics in Microbiology	
BIOL 420	Vaccines	
BIOL 452	Immunology	
BIOL 453	Immunology Laboratory	
BIOL 459	Fungi and Ecosystems	
BIOL 483	General Biochemistry	

Additional Chemistry Courses

CHEM 314	Organic Chemistry II	3
CHEM 318	Organic Chemistry Lab II	2
Total Credits		27

Mason Core and Elective Credits

In order to meet a minimum of 120 credits, this degree requires additional credits (specific credit counts by concentration are shown below), which may be applied toward any remaining Mason Core requirements (outlined below), Requirements for Bachelor's Degrees, and electives. Students are strongly encouraged to consult with their advisors to ensure that they fulfill all requirements.

- Without concentration: 38-46 credits
- BNF concentration: 43-48 credits
- BP concentration: 40-47 credits
- BTMB concentration: 41-44 credits
- ESCB concentration: 38-46 credits
- MIB concentration: 41-44 credits

Mason Core

Note: Some Mason Core requirements may already be fulfilled by the major requirements listed above. Students are strongly encouraged to consult their advisors to ensure they fulfill all remaining Mason Core requirements.

Code	Title	Credits
Foundation Requirements		
	Written Communication	6
	Oral Communication	3
	Quantitative Reasoning	3
	Information Technology	3-7
Core Requirements		
	Arts	3
	Global Understanding	3
	Literature	3
	Natural Science	7
	Social and Behavioral Sciences	3
	Western Civilization/World History	3
Synthesis/Capstone Requirement ¹		

Synthesis/Capstone	3
Total Credits	40

¹ minimum 3 credits

Honors

Honors in the Major

Admissions

Minimum requirements for invitation:

- GPA in biology courses must be 3.33 or better
- GPA in supporting requirements (math and other science) must be 3.00 or better
- Grade of 'B' or better in BIOL 213 Cell Structure and Function (Mason Core)

Students should apply for admission to the Honors Program during their first or second year at the university. Contact the Department of Biology for information on applying.

Retention Requirements

Students in honors biology must maintain a biology GPA of 3.33 or better and a supporting GPA of 3.00 or better from the time they have accumulated 30 hours and thereafter. Students who fall below this standard will be given a one semester probationary period in which to bring their GPA back up to the minimum standard.

Requirements to Graduate with Biology Honors

Students are required to take 6 to 8 credits in honors courses in BIOL including three semesters of BIOL 494 Honors Seminar in Biology or two semesters of BIOL 494 Honors Seminar in Biology and one semester of BIOL 493 Honors Research in Biology. BIOL 498 Research Seminar may count towards one of the semester requirements of BIOL 494 Honors Seminar in Biology. The GPA requirements are as follows:

- Minimum 3.33 GPA in honors biology courses
- Minimum 3.33 GPA in biology requirements
- Minimum 3.00 GPA in supporting requirements
- Minimum 3.00 GPA overall

Accelerated Master's

Biology, BA or BS/Curriculum and Instruction, Accelerated MEd (Secondary Education Biology concentration)

Overview

Highly-qualified undergraduates may be admitted to the bachelor's/ accelerated master's program and obtain a BA or BS in Biology (degree without concentration) and an MEd in Curriculum and Instruction (concentration in secondary education biology) in an accelerated time-frame after satisfactory completion of 149 credits. See AP.6.7 Bachelor's/ Accelerated Master's Degree for policies related to this program.

This accelerated option is offered jointly by the Biology Undergraduate Program and the Graduate School of Education.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies.

Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies. For information specific to this accelerated master's program, see Application Requirements and Deadlines (<https://cehd.gmu.edu/bachelors-accelerated-masters-program>).

Accelerated Option Requirements

Students must complete the following courses in their senior year:

Senior			
Fall Semester	Credits	Spring Semester	Credits
EDCI 573	3	EDCI 673	3
EDUC 672	3	EDRD 619	3
	6		6
Total Credits 12			

While undergraduate students, accelerated master's students are able to apply two of the courses listed above to both the bachelor's and master's degrees. These courses are considered advanced standing for the MEd. A minimum grade of B must be earned to be eligible to count as advanced standing. The other two courses are taken as reserve graduate credit and do not apply to the undergraduate degree. Early in their final undergraduate semester, students must submit the Bachelor's/Accelerated Master's Transition Form to the CEHD Admissions Office and specify which of the four courses are to be designated as advanced standing and reserve graduate credit.

Biology, BS/Biology, Accelerated MS Overview

Qualified undergraduates may be admitted into an accelerated master's program and to obtain both a Biology, BS and a Biology, MS within an accelerated time frame. Students admitted to this program may take graduate courses after completing 90 undergraduate credits, and up to 6 credits of graduate work may be used in partial satisfaction of the requirements for the undergraduate degree. If students earn at least a 3.00 in these classes, they are granted advanced standing in the master's program and must then complete an additional 24 credits to receive the master's degree. All other master's degree requirements must be met, including a minimum of 18 credits taken for the master's after the bachelor's degree is complete.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate programs, see AP.6 Graduate Policies.

Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in the Graduate Admission Policies section of this catalog. Application information for this accelerated master's program

can be found on the School of Systems Biology's website (<http://ssb.gmu.edu/admissions>).

Successful applicants will have an overall undergraduate GPA of at least 3.20. Additionally, they will have completed the following courses with a GPA of 3.00 or higher:

Code	Title	Credits
BIOL 213	Cell Structure and Function (Mason Core)	4
BIOL 214	Biostatistics for Biology Majors	4
BIOL 308	Foundations of Ecology and Evolution	5
BIOL 310	Biodiversity	3
BIOL 311	General Genetics	4
CHEM 313	Organic Chemistry I	3
CHEM 315	Organic Chemistry Lab I	2

Three letters of recommendation, including one from a prospective thesis or project advisor, are required.

Accelerated Option Requirements

At the beginning of the student's final undergraduate semester, students must submit a bachelor's/accelerated master's transition form (available from the Office of the University Registrar (<http://registrar.gmu.edu>)) to the College of Science's Office of Academic and Student Affairs (<https://cos.gmu.edu/about/contact-us>). Students must begin their master's program in the semester immediately following conferral of the bachelor's degree.

Students must maintain an overall GPA of 3.00 or higher in graduate coursework and should consult with their faculty advisor to coordinate their academic goals.

After completing 120 credits and all requirements for the bachelor's degree and filing the Graduation Intent Form, students are awarded a bachelor's degree. Accelerated master's students must then submit scores on the GRE to have the provisional qualifier removed. Ordinarily, students should receive a minimum combined score of 303 on the verbal and quantitative portions of the general test.

Reserve Graduate Credit

While still in undergraduate status, a maximum of 6 additional graduate credits may be taken as reserve graduate credit and applied to the master's program. Reserve graduate credits do not apply to the undergraduate degree.