

# BIOLOGY, MS

**Banner Code:** SC-MS-BIOL

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This program provides advanced training for college graduates or professionals seeking careers in the biomedical research, biotechnology, neuroscience or biodefense, as well as evolutionary and animal biology, animal biology and biology teaching. Master's level concentrations are available in microbiology and infectious disease, molecular biology, neuroscience, evolutionary biology, and translational and clinical research. Alternatively, students may choose the program in general biological sciences, which allows flexibility to build a degree program tailored to a specific research or career interest.

## Admissions & Policies

### Admissions

University-wide admissions policies can be found in the Graduate 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>).

While each applicant's qualifications are reviewed as a whole, the following are provided: Applicants to the program must have a bachelor's degree in biology or its equivalent. Additionally, all MS concentrations require a GPA of 3.00 in biology coursework or in the last 60 credits of undergraduate study. Students must also submit three letters of recommendation and scores on the GRE general exam. Exam scores should be in the 45th percentile or above. Admission is contingent on acceptance by a faculty research advisor.

### Microbiology and Infectious Disease (MID) Concentration

Students who choose the Microbiology and Infectious Disease Concentration (MID) must have a lecture and lab course in microbiology and a lecture course in biochemistry.

### Translational and Clinical Research (TCR) Concentration

Students who choose the Translational and Clinical Research Concentration may submit MCAT scores in place of GRE general exam scores.

### Evolutionary Biology (EB) Concentration

Students who choose the Evolutionary Biology Concentration must also submit a personal statement/statement of interest consistent with at least one faculty member's research program. GRE score should be approximately 303.

## Policies

For policies governing all graduate programs, see AP.6 Graduate Policies.

## Requirements

### Degree Requirements

Total credits: 30

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

### Program of Study

The faculty advisor and the student work together to develop a program of study that best fits the student's background and interests. The student must submit a program of study to the program director for approval within the first 12 credits of coursework. By the end of the second semester of coursework, students will form a graduate committee made up of three faculty members. At least two committee members must be faculty in the School of Systems Biology.

### Concentration Options

Candidates for the Biology, MS focus their study in one of five approved concentrations below, or by completing coursework for the program in biological sciences in an area of study chosen in consultation with the student's advisor and program director.

### Research Options

Students have the option to complete a 3-6 credit master's thesis (BIOL 799 Thesis) or a 1-3 credit research project (BIOL 798 Master's Research Project). In accordance with AP.6 Graduate Policies, the same quality of work is expected of students regardless of which option they choose.

- **Thesis:** In general, the MS thesis is most appropriate for students planning or considering a research career. Students pursuing the thesis option must write a formal thesis that meets the requirements of the school and must defend their thesis and present their results in a public seminar.
- **Research Project:** The MS project is most appropriate for students who have scheduling commitments, such as a full-time job, that may preclude performing a complete series of laboratory experiments. Students pursuing the project option must successfully complete written and oral comprehensive exams.

#### Select a Master's Thesis or Research Project

BIOL 799	Thesis	3-6
BIOL 798	Master's Research Project	1-3

### MS without Concentration

#### Program in Biological Sciences

<b>Research Methodology</b>		1-3
BIOL 690	Introduction to Graduate Studies in Biology	
or BIOS 702	Research Methods	
<b>Seminar</b>		2
BIOL 692	Seminar in Biology	

or BIOL 695	Seminar in Molecular, Microbial, and Cellular Biology	
<b>Research</b>		1-6
Select one from the following:		
BIOL 798	Master's Research Project	
BIOL 799	Thesis (3-6 credits)	
<b>Electives</b> <sup>1</sup>		19-26
Select 19–26 credits of electives in BIOL, BIOS, or related areas as approved by the student's advisor and the program director.		
BIOL 553	Advanced Topics in Immunology	
BIOL 568	Advanced Topics in Molecular Genetics	
BIOL 575	Selected Topics in Genetics	
BIOL 579	Molecular Evolution and Conservation Genetics	
BIOL 583	General Biochemistry	
BIOL 585	Eukaryotic Cell Biology Laboratory	
BIOL 682	Advanced Eukaryotic Cell Biology	
BIOL 793	Research in Biology	
BIOS 740	Laboratory Methods in Functional Genomics and Biotechnology	
BIOS 741	Genomics	
BIOS 742	Biotechnology	
BIOS 743	Genomics, Proteomics, and Bioinformatics	
BIOS 744	Molecular Genetics	
BIOS 767	Molecular Evolution	
<b>Total Credits:</b>		30

<sup>1</sup> These courses are provided as suggestions only; this is not intended to be a comprehensive list of elective options. Note that two courses covering substantially similar topics may not both be counted in the student's program of study. Students should consult their faculty research advisor or the graduate program coordinator when preparing a program of study.

## MS with Concentration in Microbiology and Infectious Disease (MID)

<b>Research Methodology</b>		1-3
BIOL 690	Introduction to Graduate Studies in Biology	
or BIOS 702	Research Methods	
<b>Core Biology</b>		12
Select four courses from the following:		
BIOL 553	Advanced Topics in Immunology	
BIOL 563	Virology	
BIOL 669	Pathogenic Microbiology	
BIOL 715	Microbial Physiology	
BIOL 718	Techniques in Microbial Pathogenesis	
<b>Seminar</b>		2
BIOL 695	Seminar in Molecular, Microbial, and Cellular Biology	
<b>Research</b>		1-6
Select one from the following:		
BIOL 798	Master's Research Project	
BIOL 799	Thesis (3-6 credits)	

<b>Electives</b>		7-14
Select 7-14 credits from the following:		
BIOL 564	Techniques in Virology	
BIOL 553	Advanced Topics in Immunology	
BIOL 682	Advanced Eukaryotic Cell Biology	
BIOS 743	Genomics, Proteomics, and Bioinformatics	
BIOS 710	Current Topics in Bioscience	
Or relevant graduate level coursework selected in consultation with the advisor		
<b>Total Credits:</b>		30

## MS with Concentration in Molecular Biology (MOB)

<b>Research Methodology</b>		1-3
BIOL 690	Introduction to Graduate Studies in Biology	
or BIOS 702	Research Methods	
<b>Core Biology</b>		13
BIOL 568	Advanced Topics in Molecular Genetics	
or BIOS 744	Molecular Genetics	
BIOL 583	General Biochemistry	
BIOL 682	Advanced Eukaryotic Cell Biology	
BIOL 579	Molecular Evolution and Conservation Genetics	
or BIOS 767	Molecular Evolution	
<b>Bioinformatics</b>		3
Select one from the following:		
BIOL 580	Computer Applications for the Life Sciences	
BINF 630	Bioinformatics Methods	
BINF 634	Bioinformatics Programming	
<b>Molecular Techniques</b>		2-4
Select 2-4 credits from the following:		
BIOL 585	Eukaryotic Cell Biology Laboratory	
BIOL 678	Cell-Based Assays	
BIOS 740	Laboratory Methods in Functional Genomics and Biotechnology	
Special topics courses, such as BIOL 575 or BIOL 691, may also be approved for this requirement by the program director, but only in semesters in which they are primarily a laboratory course of at least two credits with substantial content of techniques in molecular biology.		
<b>Seminar</b>		2
BIOL 695	Seminar in Molecular, Microbial, and Cellular Biology	
<b>Research</b>		1-6
Select one from the following:		
BIOL 798	Master's Research Project	
BIOL 799	Thesis (3-6 credits)	
<b>Electives</b> <sup>1</sup>		0-8
Select 0-8 credits of electives in BIOL, BIOS, or related areas as approved by the student's advisor and the program director.		
BIOL 553	Advanced Topics in Immunology	

BIOL 568	Advanced Topics in Molecular Genetics
BIOL 575	Selected Topics in Genetics
BIOL 579	Molecular Evolution and Conservation Genetics
BIOL 583	General Biochemistry
BIOL 585	Eukaryotic Cell Biology Laboratory
BIOL 682	Advanced Eukaryotic Cell Biology
BIOL 793	Research in Biology
BIOS 740	Laboratory Methods in Functional Genomics and Biotechnology
BIOS 741	Genomics
BIOS 742	Biotechnology
BIOS 743	Genomics, Proteomics, and Bioinformatics
BIOS 744	Molecular Genetics
BIOS 767	Molecular Evolution
<b>Total Credits:</b>	30

<sup>1</sup> These courses are provided as suggestions only; this is not intended to be a comprehensive list of elective options. Note that two courses covering substantially similar topics may not both be counted in the student's program of study. Students should consult their faculty research advisor or the graduate program coordinator when preparing a program of study.

## MS with Concentration in Neuroscience (NEUR)

<b>Research Methodology</b>	1-3
BIOL 690	Introduction to Graduate Studies in Biology
or NEUR 702	Research Methods

<b>Core Neuroscience</b>	12-13
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Select 12-13 credits from the following:

NEUR 600	Chemistry and the Brain
NEUR 601	Developmental Neuroscience
NEUR 602	Cellular Neuroscience
NEUR 603	Mammalian Neuroanatomy
NEUR 604	Ethics in Scientific Research
or BINF 705	Research Ethics
NEUR 701	Neurophysiology Laboratory

<b>Seminar</b>	2
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Select 2 credits from the following:

BIOL 695	Seminar in Molecular, Microbial, and Cellular Biology
BIOS 704	Topics in Biosciences
NEUR 709	Neuroscience Seminars

<b>Statistics</b>	3-4
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Select 3-4 credits from the following:

ECE 528	Introduction to Random Processes in Electrical and Computer Engineering
PSYC 611	Advanced Statistics
STAT 535	Analysis of Experimental Data
STAT 544	Applied Probability
STAT 554	Applied Statistics I

<b>Research</b>	1-6
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Select one from the following:	
BIOL 798	Master's Research Project
BIOL 799	Thesis (3-6 credits)

<b>Electives</b>	2-11
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Select 2-11 credits, suggested electives include but are not limited to the following:

BIOL 566	Cancer Genomics
BIOL 568	Advanced Topics in Molecular Genetics
BIOL 583	General Biochemistry
BIOL 666	Human Genetics Concepts for Health Care
BIOL 682	Advanced Eukaryotic Cell Biology
BINF 630	Bioinformatics Methods
BINF 705	Research Ethics
BIOS 741	Genomics
BIOS 742	Biotechnology
BIOS 743	Genomics, Proteomics, and Bioinformatics
BIOS 744	Molecular Genetics
NEUR 689	Topics in Neuroscience

<b>Total Credits:</b>	30
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## MS with Concentration in Evolutionary Biology (EB)

<b>Seminar</b>	3-4
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BIOL 690	Introduction to Graduate Studies in Biology
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Select 2 credits from the following:

BIOL 692	Seminar in Biology
or BIOL 695	Seminar in Molecular, Microbial, and Cellular Biology
BIOL 692	Seminar in Biology
& BIOL 695	and Seminar in Molecular, Microbial, and Cellular Biology

<b>Core Courses</b>	6-9
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Select at least two courses from the following:

BIOL 574	Population Genetics
BIOL 579	Molecular Evolution and Conservation Genetics
BIOL 648	Population Ecology

<b>Organismal Biology</b>	6-8
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Select 6-8 credits from the following suggestions in consultation with an advisor and/or committee and the program director:

BIOL 501	Microbial Diversity: An Organismal Approach
BIOL 507	Selected Topics in Ecology
BIOL 508	Selected Topics in Animal Biology
BIOL 518	Conservation Biology
BIOL 532	Animal Behavior
BIOL 533	Selected Topics in Plant Biology
BIOL 537	Ornithology
BIOL 538	Mammalogy
BIOL 539	Herpetology
BIOL 543	Tropical Ecosystems
BIOL 559	Fungi and Ecosystems

BIOL 566	Cancer Genomics	
BIOL 572	Human Genetics	
BIOL 581	Estuarine and Coastal Ecology	
BIOL 582	Estuarine and Coastal Ecology Laboratory	
BIOL 643	Microbial Ecology	
EVPP 536	The Diversity of Fishes	
<b>Molecular Techniques</b>		4-7
EVPP 615	Molecular Environmental Biology II	
EVPP 515	Molecular Environmental Biology I <sup>1</sup>	
<b>Research</b>		1-6
Select one from the following:		
BIOL 798	Master's Research Project	
BIOL 799	Thesis (3-6 credits)	
<b>Electives</b>		0-10
Select 0-10 credits of suggested courses from the following, but other courses are allowed if approved by an advisor and/or committee and the program director		
BIOL 508	Selected Topics in Animal Biology	
BIOL 518	Conservation Biology	
BIOL 537	Ornithology	
BIOL 538	Mammalogy	
BIOL 539	Herpetology	
BIOL 543	Tropical Ecosystems	
BIOL 553	Advanced Topics in Immunology	
BIOL 568	Advanced Topics in Molecular Genetics	
BIOL 575	Selected Topics in Genetics	
BIOL 572	Human Genetics	
BIOL 579	Molecular Evolution and Conservation Genetics	
BIOL 581 & BIOL 582	Estuarine and Coastal Ecology and Estuarine and Coastal Ecology Laboratory	
BIOL 583	General Biochemistry	
BIOL 585	Eukaryotic Cell Biology Laboratory	
BIOL 666	Human Genetics Concepts for Health Care	
BIOL 682	Advanced Eukaryotic Cell Biology	
BIOL 793	Research in Biology	
BIOS 701	Systems Biology	
BIOS 740	Laboratory Methods in Functional Genomics and Biotechnology	
BIOS 741	Genomics	
BIOS 742	Biotechnology	
BIOS 743	Genomics, Proteomics, and Bioinformatics	
BIOS 744	Molecular Genetics	
BIOS 762	Phylogenetic Analysis	
BIOS 765	Molecular Systematics	
BIOS 767	Molecular Evolution	
EVPP 536	The Diversity of Fishes	
EVPP 550	Waterscape Ecology and Management	
EVPP 551	Fungi and Ecosystems	
EVPP 555	Lab in Waterscape Ecology	

EVPP 643	Microbial Ecology	
EVPP 651	Multivariate Data Analysis for Ecology and Environmental Science	
EVPP 681	Introduction to Bioinformatics	
<b>Total Credits:</b>		30

<sup>1</sup> Only required if not previously completed; this course is a prerequisite to EVPP 615.

## MS with Concentration in Translational and Clinical Research (TCR)

<b>Research Methodology</b>		1-3
BIOL 690	Introduction to Graduate Studies in Biology	
or BIOS 702	Research Methods	
<b>Seminar</b>		2
Select 2 credits from the following:		
BIOL 695	Seminar in Molecular, Microbial, and Cellular Biology	
BINF 704	Colloquium in Bioinformatics	
BIOL 508	Selected Topics in Animal Biology (when the topic is research and development related to biotechnology)	
<b>Advanced Eukaryotic Cell Biology</b>		3
BIOL 682	Advanced Eukaryotic Cell Biology	
<b>Bioinformatics/Biostatistics</b>		3
BINF 630	Bioinformatics Methods	
or STAT 535	Analysis of Experimental Data	
<b>Human Genes, Cells and Tissues</b>		3
Select 3 credits from the following:		
BIOL 666	Human Genetics Concepts for Health Care	
BIOL 572	Human Genetics	
BIOS 743	Genomics, Proteomics, and Bioinformatics	
<b>Biochemistry</b>		3-4
Select 3-4 credits from the following:		
BIOL 583	General Biochemistry	
CHEM 563	General Biochemistry I	
CHEM 660	Protein Biochemistry	
<b>Research</b>		1-6
Select one from the following:		
BIOL 798	Master's Research Project	
or CHEM 798	Research Project	
BIOL 799	Thesis (3-6 credits)	
or CHEM 799	Master's Thesis	
<b>Electives</b>		6-14
Select 6-14 credits from the following:		
BIOL 553	Advanced Topics in Immunology	
BIOL 562	Personalized Medicine	
BIOL 563	Virology	
BIOL 566	Cancer Genomics	
BIOL 568	Advanced Topics in Molecular Genetics	
BIOL 669	Pathogenic Microbiology	

BIOL 715	Microbial Physiology
BIOS 741	Genomics
BIOS 742	Biotechnology
BIOS 743	Genomics, Proteomics, and Bioinformatics
BIOS 744	Molecular Genetics
CHEM 567	The Chemistry of Enzyme-Catalyzed Reactions
CHEM 579	Special Topics
CHEM 624	Principles of Chemical Separation
CHEM 660	Protein Biochemistry
CHEM 661	Antibiotic Chemistry and Resistance
CHEM 662	Modern Methods of Drug Discovery
CHEM 665	Protein-Protein Interactions: Methods and Applications
CHEM 796	Directed Reading and Research

**Total Credits:** 30

#### Curriculum Notes

- For students concurrently enrolled in the Advanced Biomedical Sciences Graduate Certificate, contact your advisor for details regarding:
  - BMED course credit that may be counted towards this concentration
  - Meeting requirements for graduate certificates and requirements for master's degrees

## Accelerated Master's

### 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.