

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

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

MS without Concentration

Program in Biological Sciences

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

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| or BIOL 695 | Seminar in Molecular, Microbial, and Cellular Biology | |
| Research | | 1-6 |
| Select one from the following: | | |
| BIOL 798 | Master's Research Project | |
| BIOL 799 | Thesis (3-6 credits) | |
| Electives ¹ | | 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 | |
| Total Credits: | | 30 |

¹ 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)

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| Research Methodology | | 1-3 |
| BIOL 690 | Introduction to Graduate Studies in Biology | |
| or BIOS 702 | Research Methods | |
| Core Biology | | 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 | |
| Seminar | | 2 |
| BIOL 695 | Seminar in Molecular, Microbial, and Cellular Biology | |
| Research | | 1-6 |
| Select one from the following: | | |
| BIOL 798 | Master's Research Project | |
| BIOL 799 | Thesis (3-6 credits) | |

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| Electives | | 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 | | |
| Total Credits: | | 30 |

MS with Concentration in Molecular Biology (MOB)

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|---|---|-----|
| Research Methodology | | 1-3 |
| BIOL 690 | Introduction to Graduate Studies in Biology | |
| or BIOS 702 | Research Methods | |
| Core Biology | | 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 | |
| Bioinformatics | | 3 |
| Select one from the following: | | |
| BIOL 580 | Computer Applications for the Life Sciences | |
| BINF 630 | Bioinformatics Methods | |
| BINF 634 | Bioinformatics Programming | |
| Molecular Techniques | | 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. | | |
| Seminar | | 2 |
| BIOL 695 | Seminar in Molecular, Microbial, and Cellular Biology | |
| Research | | 1-6 |
| Select one from the following: | | |
| BIOL 798 | Master's Research Project | |
| BIOL 799 | Thesis (3-6 credits) | |
| Electives ¹ | | 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 | |

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| 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 |
| Total Credits: | 30 |

¹ 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)

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| Research Methodology | 1-3 |
| BIOL 690 | Introduction to Graduate Studies in Biology |
| or NEUR 702 | Research Methods |

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| Core Neuroscience | 12-13 |
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Select 12-13 credits from the following:

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| 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 |

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| Seminar | 2 |
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Select 2 credits from the following:

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

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

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| 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 |

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

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| Electives | 2-11 |
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Select 2-11 credits, suggested electives include but are not limited to the following:

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| 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 |

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| Total Credits: | 30 |
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MS with Concentration in Evolutionary Biology (EB)

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| Seminar | 3-4 |
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| BIOL 690 | Introduction to Graduate Studies in Biology |
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Select 2 credits from the following:

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| 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 |

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| Core Courses | 6-9 |
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Select at least two courses from the following:

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

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| Organismal Biology | 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:

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| 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 |

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| 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 | |
| Molecular Techniques | | 4-7 |
| EVPP 615 | Molecular Environmental Biology II | |
| EVPP 515 | Molecular Environmental Biology I ¹ | |
| Research | | 1-6 |
| Select one from the following: | | |
| BIOL 798 | Master's Research Project | |
| BIOL 799 | Thesis (3-6 credits) | |
| Electives | | 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 | |

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

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

MS with Concentration in Translational and Clinical Research (TCR)

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| Research Methodology | | 1-3 |
| BIOL 690 | Introduction to Graduate Studies in Biology | |
| or BIOS 702 | Research Methods | |
| Seminar | | 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) | |
| Advanced Eukaryotic Cell Biology | | 3 |
| BIOL 682 | Advanced Eukaryotic Cell Biology | |
| Bioinformatics/Biostatistics | | 3 |
| BINF 630 | Bioinformatics Methods | |
| or STAT 535 | Analysis of Experimental Data | |
| Human Genes, Cells and Tissues | | 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 | |
| Biochemistry | | 3-4 |
| Select 3-4 credits from the following: | | |
| BIOL 583 | General Biochemistry | |
| CHEM 563 | General Biochemistry I | |
| CHEM 660 | Protein Biochemistry | |
| Research | | 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 | |
| Electives | | 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 | |

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| 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.