

# BIOSCIENCES, PHD

**Banner Code:** SC-PHD-BIOS

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This program is a research-oriented field of study that prepares students for significant contributions in academic or industrial settings. It is broken down into three concentrations: Cell and Molecular Biology, Microbiology and Infectious Disease, and Biocomplexity and Evolutionary Biology.

The academic component is a three-tiered structure. The first tier provides a set of core courses designed to advance research skills across all disciplines. The second tier comprises additional core courses and elective courses. The first two tiers are designed to be completed in approximately two years, including the comprehensive qualifying exam. Only on completion of these requirements, the qualifying exam, and a successful dissertation proposal can the students advance to candidacy status. The third tier focuses on research and culminates in a dissertation.

## 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>).

### Application Requirements

The following are required of applicants to this program:

- Minimum 3.25 GPA in previous coursework with significant training in the biological sciences.
- Three letters of recommendation from faculty members or individuals who have firsthand knowledge of the applicant's academic or professional capabilities.
- Statement of purpose consistent with the research interests of at least one faculty member in the program.
- Scores on GRE general exam (required) and biology or biochemistry subject exam (recommended) taken within the past five years prior to date of application submission. The GRE exam is waived if applicants hold a master's Degree from a fully-accredited U.S. university at the time of their application.
- A TOEFL score of 575 on the paper-based exam or 230 on the computer-based exam is required of international students.

An interview may also be required. Applications should be submitted by January 1st for fall admission. Under unusual circumstances, applications may be considered for spring admission if they are received

by October 1st. Applications will be considered until positions are filled. Students are encouraged to meet application deadlines to be considered for scholarships and stipends.

Strong candidates who lack several prerequisites may be admitted to provisional status. Removal from provisional status and continuation in the program is contingent on earning a GPA of 3.25 in the program's fundamental courses, plus completion of missing prerequisites.

Students who have not taken a course in basic biochemistry will be required to complete one prior to BIOS 701 Systems Biology.

### Policies

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

### Reduction of Credits

For students entering the doctoral program with a master's degree in a related field from a regionally accredited institution, the number of required credits may be reduced up to 30 credits, subject to approval of the program faculty and the college's associate dean for student affairs.

### Transfer of Credit

Graduate credits taken previously and not used toward another degree may be transferred, subject to the approval of the advisor, the program director, and the associate dean. See AP.6.5 Credit by Exam, Reduction or Transfer for more information.

## Requirements

### Degree Requirements

Total credits: 72

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

Students in the doctoral program are required to present two research papers at a meeting or conference any time before graduation.

### Doctoral Coursework

#### Bioscience Core

BIOL 682	Advanced Eukaryotic Cell Biology	3
Six credits or two instances of		6
BIOS 703	Laboratory Rotation	
Three credits of		3
BIOS 704	Topics in Biosciences	
Total Credits		12

### Concentration in Cell and Molecular Biology (CMB)

This concentration prepares students for significant contributions in an academic or industrial research career. Coursework covers microarray analysis of gene expression, proteome analysis, sequencing and analysis of gene polymorphisms, gene and genome evolution, molecular studies of disease mechanisms, mechanisms of toxicology and mutagenesis, developmental neuroscience, and biotechnological applications.

Select 12 credits from the following:

12

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	
Total Credits		12

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

Students in this concentration will be prepared for employment in academia, government, or industry. By stressing mechanisms of pathogenicity, physiology, metabolism, and genomic and proteomic analysis of pathogens, students will have a firm foundation for future research in infectious disease. Students will also be introduced to advanced laboratory practices, such as animal research methodologies and biocontainment laboratory work.

Select 12 credits from the following:		12
BIOL 553	Advanced Topics in Immunology	
BIOL 563	Virology	
BIOL 669	Pathogenic Microbiology	
BIOL 715	Microbial Physiology	
BIOL 718	Techniques in Microbial Pathogenesis	
Total Credits		12

### Concentration in Biocomplexity and Evolutionary Biology (BEB)

This concentration prepares students for careers in academia, government or industry. Through this concentration students will learn laboratory and quantitative skills that will enable them to investigate evolutionary relationships among organisms at the population, species or ecosystem level. Students will be encouraged to explore a wide range of coursework in order to develop a broad background in evolutionary biology and a deep knowledge of relevant methodologies necessary to keep abreast in this rapidly changing field.

The science of evolutionary biology is fundamentally concerned with documenting not only genetic change, but also the processes that cause it. Evolutionary biology includes paleobiology, population genetics, evolutionary ecology and phylogenetics. Biocomplexity is the study of living organisms, including their unique structural, chemical and genetic properties, their distribution and abundance in nature, and their evolutionary relationships to all other organisms. Given the fact that most of the earth's biodiversity is unknown, collecting, cataloging and studying organisms have always been and will continue to be one of the most challenging aspects of biology.

Select 12 credits from the following:		12
BIOL 574	Population Genetics	
BIOL 585	Eukaryotic Cell Biology Laboratory	
BIOS 716	Methods in Evolutionary Biology	
BIOS 767	Molecular Evolution	
Total Credits		12

### Electives

Select 24-36 credits from the following lists associated with the chosen concentration: 24-36

#### Cell and Molecular Biology & Microbiology and Infectious Disease Concentrations

BIOL 564	Techniques in Virology
BIOL 568	Advanced Topics in Molecular Genetics
BIOL 579	Molecular Evolution and Conservation Genetics
BIOL 580	Computer Applications for the Life Sciences
BIOL 685	Emerging Infectious Diseases
BIOS 701	Systems Biology
BIOS 702	Research Methods
BIOS 710	Current Topics in Bioscience
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 760	Seminar in Molecular Systematics
BIOS 898	Directed Studies in Biosciences
BIOS 899	Directed Research in Biosciences
BINF 633	Molecular Biotechnology
BINF 636	Microarray Methodology and Analysis
BINF 705	Research Ethics
<b>Biocomplexity and Evolutionary Biology Concentration <sup>1</sup></b>	
BIOL 506	Selected Topics in Microbiology
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 561	Comparative Animal Physiology
BIOL 566	Cancer Genomics
BIOL 572	Human Genetics
BIOL 573	Developmental Genetics
BIOL 643	Microbial Ecology
BIOL 715	Microbial Physiology
BIOS 741	Genomics
BIOS 742	Biotechnology
BIOS 743	Genomics, Proteomics, and Bioinformatics
BIOS 744	Molecular Genetics
BIOS 898	Directed Studies in Biosciences
BIOS 899	Directed Research in Biosciences

EVPP 536	The Diversity of Fishes
GEOL 501	Selected Topics in Modern Geology (may be repeated once)
GEOL 534	Vertebrate Paleontology
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Total Credits	24-36

<sup>1</sup> Students may take other courses related to their research topic if approved by their committee. Courses in Geographic Information Systems or Statistics are encouraged.

## Dissertation Committee

Upon admission to the program, each student is assigned an advisor from the bioscience faculty. The advisor may be changed by mutual consent of student and advisor, or petition to the program director and associate dean. With their advisor, students adopt an individual program that focuses on a specific area of research.

By the end of the fourth semester of coursework, students assemble a dissertation committee of four graduate faculty members with representation from at least two academic departments. The faculty advisor and the program director approve the program of study.

## Qualifying Examination

On nearing completion of course requirements, students take a qualifying exam with a written and an oral component. At the discretion of the committee, the written qualifying exam may be retaken once if the student's performance was deemed below satisfaction.

## Advancement to Candidacy

Upon successful completion of the qualifying exam, the majority of all coursework, and an accepted dissertation proposal, students will be recommended for advancement to candidacy by the committee and the program director.

The semester after advancement to candidacy, students are eligible to enroll in dissertation research (BIOS 999 Doctoral Dissertation Research). Students must review their progress on the dissertation with their graduate committee on a regular basis until graduation.

## Dissertation Research

No more than 24 combined credits from BIOS 998 Doctoral Dissertation Proposal and BIOS 999 Doctoral Dissertation Research may be applied toward satisfying doctoral degree requirements. Students register for a minimum of 3 credits of BIOS 999 Doctoral Dissertation Research in the first semester of advancement.

Select 12-24 credits from the following:	12-24
BIOS 998	Doctoral Dissertation Proposal
BIOS 999	Doctoral Dissertation Research
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Total Credits	12-24

## Doctoral Dissertation

After advancing to doctoral candidacy, students work with their dissertation committee to develop their dissertation proposal into a completed doctoral dissertation. The dissertation research should represent a significant contribution that is publishable in a refereed scientific journal. When the dissertation is complete, students will present their results to their graduate committee and defend their dissertation in a public forum.