

# BIOSCIENCES, PHD

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

**Alessandra Luchini, Program Director**

312 Colgan Hall  
Science and Technology Campus

Phone: 703-993-8400  
Email: [ssb@gmu.edu](mailto:ssb@gmu.edu)  
Website: [science.gmu.edu/academics/departments-units/systems-biology](https://science.gmu.edu/academics/departments-units/systems-biology)

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 (<https://catalog.gmu.edu/admissions/graduate-policies/>) section of this catalog. International students and students having earned international degrees should also refer to Admission of International Students (<https://catalog.gmu.edu/admissions/international-students/>) for additional requirements.

### Eligibility

Applicants should have obtained a minimum of 3.25 GPA in previous coursework with significant training in the biological sciences from an institution of higher education accredited by a Mason-recognized U.S. institutional accrediting agency or international equivalent.

### Application Requirements

To apply for this program, prospective students should submit the George Mason University Admissions Application (<https://www2.gmu.edu/admissions-aid/apply-now/>) and its required supplemental documentation, and:

- Three letters of recommendation from faculty members or individuals who have firsthand knowledge of the applicant's academic or professional capabilities.

- A goals statement consistent with the research interests of at least one faculty member in the program.
- 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 the missing prerequisites.

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

The GRE is not required for admission into this program.

## Policies

For policies governing all graduate programs, see AP.6 Graduate Policies (<https://catalog.gmu.edu/policies/academic/graduate-policies/>).

### Transferring Previous Graduate Credit into this Program

Previously earned and relevant graduate credits may be eligible for transfer into this program; details can be found in the Credit by Exam or Transfer (<https://catalog.gmu.edu/policies/academic/graduate-policies/>) section of this catalog.

## Requirements

### Degree Requirements

Total credits: 72

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

Students in this doctoral program are required to present two research papers at a meeting or conference anytime before graduation.

### Doctoral Coursework

#### Bioscience Core

Code	Title	Credits
BIOS 701	Systems Biology	3
or BIOL 682	Advanced Eukaryotic Cell Biology	
BIOS 702	Research Methods	3
BIOS 703	Laboratory Rotation (repeated twice)	6
BIOS 704	Topics in Biosciences (repeated three times)	3
BIOS 743	Genomics, Proteomics, and Bioinformatics	3
or BIOS 767	Molecular Evolution	
or BIOL 580	Computer Applications for the Life Sciences	

**Total Credits** **18**

## 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.

Code	Title	Credits
Select 6 credits from the following: <sup>1</sup>		6
BIOL 666	Human Genetics Concepts for Health Care	
BIOL 667	Signal Transduction in Cancer	
BIOL 689	Interdisciplinary Tools in the Biosciences	
BIOS 740	Laboratory Methods in Functional Genomics and Biotechnology	
BIOS 741	Genomics	
BIOS 742	Biotechnology	
<b>Total Credits</b>		<b>6</b>

<sup>1</sup> Students may take other courses as approved by their advisor.

## 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.

Code	Title	Credits
Select 6-7 credits from the following:		6-7
BIOL 553	Advanced Topics in Immunology	
BIOL 563	Virology	
BIOL 583	General Biochemistry	
BIOL 669	Pathogenic Microbiology	
BIOL 689	Interdisciplinary Tools in the Biosciences	
BIOL 715	Microbial Physiology	
<b>Total Credits</b>		<b>6-7</b>

<sup>1</sup> Students may take other courses as approved by their advisor.

## 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.

Code	Title	Credits
Select 6 credits from the following:		6
BIOL 502	Adaptation in Biosystems	
BIOL 574	Population Genetics	
BIOL 585	Eukaryotic Cell Biology Lecture/Laboratory	
BIOL 689	Interdisciplinary Tools in the Biosciences	
BIOS 716	Methods in Evolutionary Biology	
<b>Total Credits</b>		<b>6</b>

## Electives

Code	Title	Credits
Select 23-36 credits from the following lists associated with the chosen concentration:		23-36

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 667	Signal Transduction in Cancer
BIOL 685	Emerging Infectious Diseases
BIOL 689	Interdisciplinary Tools in the Biosciences
BIOL 718	Techniques in Microbial Pathogenesis
BIOS 710	Current Topics in Bioscience
BIOS 740	Laboratory Methods in Functional Genomics and Biotechnology
BIOS 741	Genomics
BIOS 742	Biotechnology
BIOS 744	Molecular Genetics
BIOS 898	Directed Studies in Biosciences
BIOS 899	Directed Research in Biosciences
BINF 633	Molecular Biotechnology
BINF 641	Biomolecular Modeling
BINF 705	Research Ethics

Biocomplexity and Evolutionary Biology Concentration <sup>1</sup>	
BIOL 506	Selected Topics in Microbiology
BIOL 507	Selected Topics in Ecology
BIOL 508	Selected Topics in Animal Biology
BIOL 518	Conservation Biology
BIOL 527	Conservation Medicine
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 638	Sensory Ecology	
BIOL 572	Human Genetics	
BIOL 573	Developmental Genetics	
BIOL 643	Microbial Ecology	
BIOL 648	Population Ecology	
BIOL 667	Signal Transduction in Cancer	
BIOL 689	Interdisciplinary Tools in the Biosciences	
BIOL 715	Microbial Physiology	
BIOS 741	Genomics	
BIOS 742	Biotechnology	
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	
<b>Total Credits</b>		<b>23-36</b>

## 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.

Code	Title	Credits
Select 12-24 credits from the following:		12-24
BIOS 998	Doctoral Dissertation Proposal	
BIOS 999	Doctoral Dissertation Research	
<b>Total Credits</b>		<b>12-24</b>

## 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.

<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.