

BIOINFORMATICS, MASTER OF SCIENCE

MS in Bioinformatics (<https://advanced.jhu.edu/academics/graduate/ms-bioinformatics/>)

Joint Offering with the Whiting School of Engineering

Johns Hopkins University offers an innovative graduate program that prepares professionals for success in bioinformatics. Drawing from the strengths of the Krieger School of Arts and Sciences and the Whiting School of Engineering, this program fully integrates the computer science, bioscience, and bioinformatics skills and knowledge needed to pursue a career in this dynamic field.

The 11-course degree program is thesis-optional and can be completed part-time or full-time and onsite, online, or through a combination of onsite and online courses.

Admissions Criteria for All Advanced Academic Programs (<https://e-catalogue.jhu.edu/arts-sciences/advanced-academic-programs/Admission/#admissionrequirements>)

PROGRAM-SPECIFIC REQUIREMENTS

In addition to the materials and credentials required for all programs, the Master of Science in Bioinformatics requires an undergraduate degree in the biological sciences or engineering with at least a 3.0 on a 4.0 scale.

- **Resume**
- **Statement of purpose:** Please provide a statement, up to one page in length, describing your personal background and/or a part of your life experience that has shaped you or your goals. Feel free to elaborate on personal challenges and opportunities that have influenced your decision to pursue a graduate degree at Johns Hopkins.
- **Program-specific prerequisite courses:**
 - One semester of organic chemistry
 - One semester of biochemistry
 - One semester of introduction to programming using Java, C++, C, or Python
 - One semester of data structures
 - One semester of probability and/or statistics
 - One semester of calculus

Program Requirements

Students in the MS in Bioinformatics program must complete 11 courses:

- Three required core courses
- Five customizable core courses
- One elective from biotechnology
- One elective from computer science
- One general elective

After completing the above courses, students may choose an independent study project (optional).

Code	Title	Credits
Core Courses - Required:		11
AS.410.602	Molecular Biology	
AS.410.610	Epigenetics, Gene Organization & Expression	
EN.705.601	Applied Machine Learning	
Core Courses - Customizable		9
		-11
AS.410.633	Introduction to Bioinformatics	
or EN.605.655	Biological Databases and Database Tools	
AS.410.634	Practical Computer Concepts for Bioinformatics	
or EN.605.644	Principles of Database Systems	
EN.605.620	Algorithms for Bioinformatics	
or EN.605.622	Foundations of Algorithms	
Select two of the following: ^{2, 3, 4}		6 - 8
AS.410.635	Bioinformatics: Tools for Genome Analysis	
AS.410.639	Protein Bioinformatics	
AS.410.640	Molecular Phylogenetic Techniques	
AS.410.666		
AS.410.671	Gene Expression Data Analysis and Visualization	
AS.410.709	Cancer Genomics	
AS.410.712	Advanced Practical Computer Concepts for Bioinformatics	
AS.410.713		
AS.410.733		
AS.410.734	Practical Introduction to Metagenomics	
AS.410.736	Genomic and Personalized Medicine	
EN.605.643	Linked Data and the Semantic Web	
EN.605.647	Neural Networks	
EN.605.651	Principles of Bioinformatics	
EN.605.653	Computational Genomics	
EN.605.656	Computational Drug Discovery, Dev	
EN.605.657	Statistics for Bioinformatics	
EN.605.716	Modeling and Simulation of Complex Systems	
EN.605.751	Algorithms for Structural Bioinformatics	
EN.605.755	Systems Biology	
Electives		
<i>Computer Science</i>		
Select one of the following: ^{1, 3}		3
EN.605.601	Foundations of Software Engineering	
EN.605.644	XML Design Paradigms	
EN.605.649	Principles and Methods in Machine Learning	
EN.605.662	Data Visualization	
EN.605.681	Principles of Enterprise Web Development	
EN.605.686	Mobile Application Development for the Android Platform	
EN.605.701	Software Systems Engineering	
EN.605.741	Large-Scale Database Systems	
EN.605.746	Advanced Machine Learning	
EN.605.747	Evolutionary and Swarm Intelligence	

EN.605.759 Independent Project in Bioinformatics

EN.605.788 Big Data Processing Using Hadoop

BiotechnologySelect one of the following: ^{1, 2} 4

AS.410.603 Advanced Cell Biology

AS.410.604 Cellular Signal Transduction

AS.410.612 Human Molecular Genetics

AS.410.613 Principles of Immunology

AS.410.616 Virology

AS.410.622 Molecular Basis of Pharmacology

AS.410.629 Genes & Disease

AS.410.630 Gene Therapy

AS.410.632 Emerging Infectious Diseases

AS.410.638 Cancer Biology

AS.410.641 Clinical & Molecular Diagnostics

AS.410.648 Clinical Trial Design and Conduct

AS.410.656 Recombinant DNA Laboratory

AS.410.752 High Throughput Screening & Automation Lab

AS.410.800 Independent Research in Biotechnology

General Elective 3 -

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Select from Biotechnology elective list or Computer Science elective list ^{1, 2, 3}¹ Students may select other electives with the approval of their adviser² See course listings page (https://e-catalogue.jhu.edu/course-descriptions/_biotechnology/) for the Center for Biotechnology Education³ See course listings page for Computer Science (https://e-catalogue.jhu.edu/course-descriptions/computer_science/)⁴ Students who take more than two may count the additional courses as electives

MS in Bioinformatics with Thesis Option

Students interested in pursuing the MS in Bioinformatics with the thesis option are required to take 12 courses. The thesis requires a two-semester research project. Students complete AS.410.800 Independent Research in Biotechnology first and AS.410.801 Biotechnology Thesis the following semester. Students interested in this option should consult with the program director or their academic adviser.

Learning Outcomes

Students in this program will:

- Critique current and classic research in molecular biology
- Search public databases in order to analyze data in a biological context
- Implement sequence alignment tools to elucidate the deeper context of biological data
- Develop bioinformatics tools to address biological problems
- Write computer programs to build databases within a biological context in multiple computer languages
- Design deployable computer algorithms

- Develop skills to meet individual career goals in computational biology and related fields.