Computational Biology, B.S.

Bachelor of Science in Computational Biology

Overview

Students in the B.S. program in Computational Biology are expected to acquire the following skills upon graduation:

- Understand the fundamentals of single and multi-variable calculus, as used to construct models of biological systems.
- Construct their own logical mathematical proofs and later apply these proof techniques to theorems in algorithms and theoretical computer science.
- Obtain a firm grounding in probability and statistics necessary for interpretation of biomedical research results.
- Apply the fundamentals of modern chemistry and physics to biological molecules.
- Learn the principles of organization of biological systems on the cellular and molecular level.
- Interpret the connection of the principles of inheritance to the molecular level.
- Understand the relationship between macro and micro in terms of biological structure and function and the connection to metabolic pathways.
- Produce sound, stable, well-organized computer programs that scale well on large datasets.
- Understand the theoretical basis of modern computer science and integrate the inherent limitations of any computing system.
- Design algorithms based on efficient data structures to a variety of computational contexts to meet specified goals.
- Apply machine learning methods by which computers can “learn” from experience and apply these methods to genomic and biomedical data.
- Become familiar with structured biological databases and computational tools for operating on these databases.
- Construct mathematical/computational models of biological systems at differing scales and analyze the strengths and weaknesses of these models.
- Learn the fundamental laboratory techniques used in modern cell and molecular biology as well as the influence of computational methods on experimental design.
- Acquire a skillset of canonical algorithms applied in modern biological research and understand how these algorithms are applied to solve biological problems.
- Gain fluency in contemporary biomedical research topics and be able to interpret primary research results in computational biology.
- Understand the role of computation in biotechnology, pharmaceutical development, and medicine.

Degree Requirements

(students entering Fall 2026)

Students completing the Bachelor of Science in Computational Biology follow certain policies that apply to all SCS students; please consult the SCS policies page (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/#policiestext) for a complete listing of these expectations.

Students must complete a **minimum of 360 units** for the degree in computational biology.

Mathematics/Statistics Core

		Units
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation	10
15-151	Mathematical Foundations for Computer Science (or 21-127/21-128 if not offered)	12
36-218	Probability Theory for Computer Scientists (Students taking 15-259 should take 36-326 or 15-260 instead. 15-260 is only open to students who have taken 15-259.)	9
or 36-226	Introduction to Statistical Inference	
or 36-326	Mathematical Statistics (Honors)	
or 36-235	Probability and Statistical Inference I	
or 15-259	Probability and Computing	
21-241	Matrices and Linear Transformations	11
or 21-242	Matrix Theory	
Total Units		**52**

General Science Core

09-105	Introduction to Modern Chemistry I	10
or 09-107	Honors Chemistry: Fundamentals, Concepts and Applications	
33-121	Physics I for Science Students	12
or 33-141	Physics I for Engineering Students	
Total Units		**22**

Biological Core

03-151	Honors Modern Biology	10
or 03-121	Modern Biology	
03-221	Genomes, Evolution, and Disease: Introduction to Quantitative Genetic Analysis	9
03-232	Biochemistry I (Students taking 03-231, including pre-med students, will take organic chemistry as a prerequisite, which will satisfy a biology elective requirement.)	9
or 03-231	Honors Biochemistry	
03-320	Cell Biology	9
Total Units		**37**

Computer Science Core

07-128	First Year Seminar (This course may be replaced by 03-201 or 03-202 if and only if 07-128 is not offered)	3
15-122	Principles of Imperative Computation	12
15-251	Great Ideas in Theoretical Computer Science	12
15-451	Algorithm Design and Analysis	12
or 15-351	Algorithms and Advanced Data Structures	
07-280	Artificial Intelligence and Machine Learning I	12
or 10-301	Introduction to Machine Learning	
02-120	Programming for Scientists	12
or 15-112	Fundamentals of Programming and Computer Science	
Total Units		**63**

Computational Biology Core

02-135	Computational Biology and Society	3
02-180	Great Ideas in Computational Biology I	5
02-181	Great Ideas in Computational Biology II	5
*02-251 is allowed if 02-180 and 02-181 are not offered		
02-261	Quantitative Cell and Molecular Biology Laboratory	12
or 02-262	Computation and Biology Integrated Research Lab	
02-402	Computational Biology Seminar	3
02-510	Computational Genomics	12
02-512	Computational Methods for Biological Modeling and Simulation	9
Total Units		**49**

Major Electives

02-3xx	Computational Biology Electives at 300 level or above	18-24
03-3xx	Biology Electives at 300 level or above (09-217 or 42-202 also count as biology electives)	9-12

xx-2xx	School of Computer Science Electives at 200 level or above, at least 9 units each. 15-150 is an acceptable 100-level course counting in this category, but the following exceptions are not allowed in this category: 02-201, 02-223, 02-250, 02-261, 02-262, 11-423, 15-351, 16-223, 17-200, 17-333, 17-562.	18-24
Total Units		**45-60**

Humanities & Arts

All candidates for the bachelor's degree in Computer Science must complete a minimum of 63 units offered by the College of Humanities & Social Sciences and/or the College of Fine Arts. These courses offer students breadth in their education and perspectives and provide students with a better appreciation of social, artistic, cultural, political and economic issues that can influence their effectiveness as computer scientists upon graduation.

Requirements for this component of the degree are listed on the SCS General Education page (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/general-education/).

Computing @ Carnegie Mellon (1 course)

The following course is required of all students to familiarize them with the campus computing environment:

99-101	Core@CMU	3

Free Electives

A free elective is any Carnegie Mellon course. However, a maximum of nine (9) units of Physical Education and/or Military Science (ROTC) and/or Student-Led (StuCo) courses may be used toward fulfilling graduation requirements.

Summary of Degree Requirements

Area	
Math/Stats Core	52
General Science Core	22
Biological Core	37
Computer Science Core	51
Computational Biology Core	46
Major Electives	45-60
General Education (Humanities & Arts)	63
Computing at Carnegie Mellon	3
Remaining Units	42-57
Total Units	**360**