

# SYSTEMS BIOLOGY MAJOR

## Program Curriculum

Code	Title	Credits
<b>Degree Core Requirements</b>		
SYSB 2024	Fundamentals of Systems Biology <sup>1,2</sup>	3
SYSB 3035	Genomics and Bioinformatics <sup>1,2</sup>	4
SYSB 3115	Network Dynamics and Cell Physiology <sup>1,2</sup>	4
SYSB 4065	Research Experience in Systems Biology <sup>1,2</sup>	2
SYSB 4024	Careers and Professionalism in Systems Biology <sup>1,2</sup>	2
SYSB 2034	Mathematical Methods in Systems Biology <sup>1,2</sup>	3
SYSB 3036	Genomics and Bioinformatics <sup>1,2</sup>	4
SYSB 3116	Network Dynamics and Cell Physiology <sup>1,2</sup>	4
SYSB 4066	Research Experience in Systems Biology <sup>1,2</sup>	2
SYSB 4114	Applied Models of Gene Regulatory Networks <sup>1</sup>	3
Subtotal		31
<b>Additional Mathematics and Science</b>		
BIOL 1105	Principles of Biology <sup>2</sup>	3
BIOL 1106	Principles of Biology <sup>2</sup>	3
BIOL 1115	Principles of Biology Laboratory <sup>1,2</sup>	1
BIOL 1116	Principles of Biology Laboratory <sup>1,2</sup>	1
BIOL 2004	Genetics <sup>1,2</sup>	3
MATH 1114	Elementary Linear Algebra <sup>2</sup>	2
CHEM 1035	General Chemistry <sup>1,2</sup>	3
CHEM 1036	General Chemistry <sup>1,2</sup>	3
CHEM 1045	General Chemistry Laboratory <sup>1,2</sup>	1
CHEM 1046	General Chemistry Laboratory <sup>1,2</sup>	1
CHEM 2535	Organic Chemistry <sup>1,2</sup>	3
CHEM 2545	Organic Chemistry Laboratory <sup>1,2</sup>	1
CS 1064	Introduction to Programming in Python <sup>2</sup>	3
Subtotal		28
<b>Restricted Electives</b>		
Select four or more of the following: <sup>3</sup>		12
BCHM 2024	Concepts of Biochemistry <sup>1,2</sup>	
BCHM 3114	Biochemistry for Biotechnology and the Life Sciences <sup>1,2</sup>	
BCHM 4115	General Biochemistry <sup>1,2</sup>	
BIOL 4704	Immunology <sup>1,2</sup>	
BIOL 4634	Microbial Physiology <sup>1,2</sup>	
BIOL 4844	Proteomics and Biological Mass Spectrometry <sup>1,2</sup>	
BIOL 4884	Cell Biology <sup>1,2</sup>	
CHEM 2536	Organic Chemistry <sup>1,2</sup>	
CHEM 3615	Physical Chemistry <sup>1,2</sup>	
CHEM 4615	Physical Chemistry for the Life Sciences <sup>1,2</sup>	
CMDA 3605	Mathematical Modeling: Methods and Tools <sup>1,2</sup>	
CMDA/CS/ STAT 3654	Introductory Data Analytics and Visualization <sup>1,2</sup>	
CS 2114	Software Design and Data Structures <sup>1,2</sup>	
CS/CMDA 3634	Computer Science Foundations for Computational Modeling and Data Analytics <sup>1,2</sup>	

CS 3824	Introduction to Computational Biology and Bioinformatics <sup>1,2</sup>	
CS 4884	Computational Biology and Bioinformatics Capstone <sup>1,2</sup>	
MATH 2214	Introduction to Differential Equations <sup>1,2</sup>	
MATH 4254	Chaos and Dynamical Systems <sup>1,2</sup>	
MATH 4445	Introduction to Numerical Analysis <sup>1,2</sup>	
PHYS 4714	Introduction to Biophysics <sup>1,2</sup>	
STAT 3006	Statistical Methods <sup>1,2</sup>	
STAT 3616	Biological Statistics <sup>1,2</sup>	
STAT 4094	Introduction to Programming in R <sup>1,2</sup>	
BIOL 2134	Cell Function and Differentiation <sup>1,2</sup>	
BIOL 3134	Human Genetics <sup>1,2</sup>	
BIOL 3774	Molecular Biology <sup>1,2</sup>	
BIOL 4624	Microbial Genetics <sup>1,2</sup>	
BIOL 4734	Inflammation Biology <sup>1,2</sup>	
BIOL 4874	Cancer Biology <sup>1,2</sup>	
BIOL 4854	Cytogenetics <sup>1,2</sup>	
CHEM 2546	Organic Chemistry Laboratory <sup>1,2</sup>	
CHEM 4584	Bioorganic Chemistry <sup>1,2</sup>	
CHEM 4616	Physical Chemistry for the Life Sciences <sup>1,2</sup>	
CMDA 3606	Mathematical Modeling: Methods and Tools <sup>1,2</sup>	
CMDA/CS/ STAT 4654	Intermediate Data Analytics and Machine Learning <sup>1,2</sup>	
CS/MATH 3414	Numerical Methods <sup>1,2</sup>	
CS 4214	Simulation and Modeling <sup>1,2</sup>	
CS 4824	Machine Learning <sup>1,2</sup>	
MATH 2204	Introduction to Multivariable Calculus <sup>1,2</sup>	
MATH 4454	Applied Mathematical Modeling <sup>1,2</sup>	
MATH 4446	Introduction to Numerical Analysis <sup>1,2</sup>	
STAT 3104	Probability and Distributions <sup>1,2</sup>	
STAT 4364	Introduction to Statistical Genomics <sup>1,2</sup>	
STAT/CMDA 4664	Computational Intensive Stochastic Modeling <sup>1,2</sup>	
Subtotal		12

### Pathways to General Education

#### Pathways Concept 1 - Discourse

Select six credits in Pathway 1f ([https://catalog.vt.edu/course-search/?attrs\\_pathways=attrs\\_pathways\\_G01F](https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G01F)) 6

Select three credits in Pathway 1a ([https://catalog.vt.edu/course-search/?attrs\\_pathways=attrs\\_pathways\\_G01A](https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G01A)) 3

#### Pathways Concept 2 - Critical Thinking in the Humanities

Select six credits in Pathway 2 ([https://catalog.vt.edu/course-search/?attrs\\_pathways=attrs\\_pathways\\_G02](https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G02)) 6

#### Pathways Concept 3 - Reasoning in the Social Sciences

Select six credits in Pathway 3 ([https://catalog.vt.edu/course-search/?attrs\\_pathways=attrs\\_pathways\\_G03](https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G03)) 6

#### Pathways Concept 4 - Reasoning in the Natural Sciences

PHYS 2205 General Physics <sup>1,2</sup> 3

PHYS 2215 General Physics Laboratory <sup>1,2</sup> 1

PHYS 2206 General Physics <sup>1,2</sup> 3

PHYS 2216 General Physics Laboratory <sup>1,2</sup> 1

#### Pathways Concept 5 - Quantitative and Computational Thinking

MATH 1225	Calculus of a Single Variable (5F) <sup>2</sup>	4
MATH 1226	Calculus of a Single Variable (5F) <sup>2</sup>	4
STAT 3005	Statistical Methods (5A) <sup>1,2</sup>	3
or STAT 3615	Biological Statistics	
<i>Pathways Concept 6 - Critique and Practice in Design and the Arts</i>		
Select three credits in Pathway 6a ( <a href="https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06A">https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06A</a> )		3
Select three credits in Pathway 6d ( <a href="https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06D">https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06D</a> )		3
<i>Pathways Concept 7 - Critical Analysis of Identity and Equity in the United States</i>		
Select three credits in Pathway 7 ( <a href="https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G07">https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G07</a> )		3
Subtotal		49
<b>Total Credits</b>		<b>120</b>

<sup>1</sup> Courses have prerequisites or corequisites.

<sup>2</sup> **In Major GPA:** Courses used to calculate in-major GPA.

<sup>3</sup> At least 6 hours must be at the 3000 or 4000 level; at least 3 credit hours must be at least 4000 level.

## Prerequisites

Courses in this checksheet marked with Footnote 1 have prerequisites or corequisites. Students are required to double check course prerequisites and equivalents. Please see your advisor or consult the Undergraduate Course Catalog for more information.

## Acceptable Substitutions

- BIOL 1105 Principles of Biology, BIOL 1115 Principles of Biology Laboratory-BIOL 1116 Principles of Biology Laboratory, CHEM 1035 General Chemistry-CHEM 1036 General Chemistry, CHEM 1045 General Chemistry Laboratory-CHEM 1046 General Chemistry Laboratory MATH 1114 Elementary Linear Algebra, PHYS 2205 General Physics-PHYS 2206 General Physics, PHYS 2215 General Physics Laboratory-PHYS 2216 General Physics Laboratory can be substituted with ISC 1105 Integrated Science I-ISC 1106 Integrated Science I, ISC 1115 Integrated Science Laboratory I-ISC 1116 Integrated Science Laboratory I, ISC 2105 Integrated Science II-ISC 2106 Integrated Science II, ISC 2115 Integrated Science Laboratory II-ISC 2116 Integrated Science Laboratory II
- CHEM 1035 General Chemistry/CHEM 1036 General Chemistry can be substituted with CHEM 1055 General Chemistry for Chemistry Majors/CHEM 1056 General Chemistry for Chemistry Majors
- CHEM 1045 General Chemistry Laboratory/CHEM 1046 General Chemistry Laboratory can be substituted with CHEM 1065 General Chemistry for Chemistry Majors Lab/CHEM 1066 General Chemistry for Chemistry Majors Lab
- CHEM 2535 Organic Chemistry can be substituted with CHEM 2565 Principles of Organic Chemistry.
- CHEM 2545 Organic Chemistry Laboratory can be substituted with CHEM 2555 Organic Synthesis and Techniques Lab.
- CHEM 4615 Physical Chemistry for the Life Sciences/CHEM 4616 Physical Chemistry for the Life Sciences can be substituted with CHEM 3615 Physical Chemistry/CHEM 3616 Physical Chemistry
- CS 1064 Introduction to Programming in Python can be substituted with CS 1114 Introduction to Software Design

- MATH 1114 Elementary Linear Algebra can be substituted with MATH 2114 Introduction to Linear Algebra or MATH 2114H Introduction to Linear Algebra
- PHYS 2205 General Physics, PHYS 2206 General Physics, PHYS 2215 General Physics Laboratory & PHYS 2216 General Physics Laboratory can be substituted with PHYS 2305 Foundations of Physics, PHYS 2306 Foundations of Physics.

## Foreign Language Requirement

Students who did not successfully complete at least two years of a single foreign, classical, or sign language during high school must successfully complete six semester hours of a single foreign, classical, or sign language at the college level. Courses taken to meet this requirement do not count toward the hours required for graduation. Please consult the Undergrad. Catalog for details.

## Satisfactory Progress Towards Degree

Upon having completed 72 credit hours (including transfer, AP, advanced standing, credit by examination, course withdrawal) students must have completed the following courses with a grade of C- or better in two or fewer attempts (including attempts that were withdrawn): BIOL 1105 Principles of Biology, BIOL 1106 Principles of Biology, BIOL 1115 Principles of Biology Laboratory, BIOL 1116 Principles of Biology Laboratory, BIOL 2004 Genetics, CHEM 1035 General Chemistry-CHEM 1036 General Chemistry, CHEM 1045 General Chemistry Laboratory-CHEM 1046 General Chemistry Laboratory, CHEM 2535 Organic Chemistry, MATH 1225 Calculus of a Single Variable-MATH 1226 Calculus of a Single Variable, PHYS 2205 General Physics-PHYS 2206 General Physics, and PHYS 2215 General Physics Laboratory-PHYS 2216 General Physics Laboratory. This also applies to acceptable substitutions

## Graduation Requirements

120 credit hours are required for graduation. These credits must include the courses required for the major (see above section). To graduate, a student must have at least a 2.0 in-major GPA and 2.0 overall GPA. If 120 credit hours are reached and a student does not meet the GPA requirement, the student must take additional in-major courses to raise the in-major GPA to a 2.0.