

# SYSTEMS & SYNTHETIC BIOLOGY, BACHELOR OF SCIENCE

## College of Biological Sciences

The Systems & Synthetic Biology major provides students with a broad understanding of these two related and interdisciplinary fields. Systems Biology aims to understand how complex organismal properties and structures arise from simple components and interactions, and to identify design principles common to many types of biological regulation. Synthetic Biology focuses on the modification (or, ultimately, de novo construction) of organisms to generate novel pathways and processes. This major emphasizes integrative, computational and quantitative approaches to solving biological problems and engineering new biological outcomes.

## The Program

In the freshman and sophomore years, students majoring in Systems & Synthetic Biology build a broad scientific background, taking courses in chemistry, biology, physics, and mathematics as well as an introduction course to computing for biologists. As juniors or seniors, students can enroll in courses that introduce them to the fundamental principles in mathematics, computer science, systems theory and application, and biological engineering.

## Career Alternatives

The biotech workforce has a growing demand for biologists that are fluent in different merging disciplines that are covered by the Systems and Synthetic Biology Major. This combination of skills will allow graduates to work at the interface between biologists and engineers found in new emerging industries related to the pharmaceutical, biomedical, bioenergy, agricultural, nutrition, and microbiome industries. The program is also an excellent background for students wishing to enter graduate or other professional schools, including medicine, law, journalism or policy Honors & Honors Programs. Refer to the Academic Information section and the appropriate College section for Dean's Honors List information.

## Faculty Advisor

Siobhan Brady, Ph.D.

The major requirements below are in addition to meeting University Requirements (<https://catalog.ucdavis.edu/undergraduate-education/university-degree-requirements/>) & College Requirements (<https://catalog.ucdavis.edu/undergraduate-education/college-degree-requirements/>); unless otherwise noted. The minimum number of units required for the Systems & Synthetic Biology Bachelor of Science major is 96.

Code	Title	Units
	<i>Preparatory Subject Matter</i>	
	Biological Sciences	17

BIS 002A & BIS 002B & BIS 002C	Introduction to Biology: Essentials of Life on Earth and Introduction to Biology: Principles of Ecology & Evolution and Introduction to Biology: Biodiversity & the Tree of Life	
BIS 015L or BIS 015LV	Introduction to Data Science for Biologists Introduction to Data Science for Biologists	
Chemistry		21-27
CHE 002A & CHE 002B & CHE 002C	General Chemistry and General Chemistry and General Chemistry	
<b>OR</b>		
CHE 004A & CHE 004B & CHE 004C	General Chemistry for the Physical Sciences & Engineering and General Chemistry for the Physical Sciences & Engineering and General Chemistry for the Physical Sciences & Engineering	
<b>AND</b>		
CHE 008A & CHE 008B	Organic Chemistry: Brief Course and Organic Chemistry: Brief Course	
<b>OR</b>		
CHE 118A & CHE 118B & CHE 118C	Organic Chemistry for Health & Life Sciences and Organic Chemistry for Health & Life Sciences and Organic Chemistry for Health & Life Sciences	
Mathematics		8-12
MAT 017A & MAT 017B & MAT 017C	Calculus for Biology & Medicine and Calculus for Biology & Medicine and Calculus for Biology & Medicine	
<b>OR</b>		
MAT 021A & MAT 021B & MAT 021C	Calculus and Calculus and Calculus (Recommended)	
Physics <sup>2</sup>		12
PHY 007A & PHY 007B & PHY 007C	General Physics and General Physics and General Physics	
Preparatory Subject Matter Subtotal		58-68
<i>Depth Subject Matter</i>		
Statistics		8
STA 100	Applied Statistics for Biological Sciences	
STA 101	Advanced Applied Statistics for the Biological Sciences	
Genetics		4
BIS 101 or BIS 101V	Genes & Gene Expression Genes & Gene Expression	
Biochemistry, Bioenergetics, & Metabolism		3-6
BIS 102 & BIS 103 or BIS 105	Structure & Function of Biomolecules and Bioenergetics & Metabolism Biomolecules & Metabolism	
Cell Biology		3
BIS 104	Cell Biology	

Systems Biology		2	2
BIS 134	(Discontinued for winter 2024) <sup>1,**</sup>		
Biomolecular Systems Engineering		4	
BIM 143	Biomolecular Systems Engineering: Synthetic Biology		With BASC advisor approval, these combinations also satisfy the Physics requirement: PHY 007A-PHY 009A-PHY 049*-PHY 007C; PHY 009A-PHY 009B-PHY 049*. *PHY 049 will require approval from the Physics Department to enroll.
Systems & Synthetic Biology		5	**
BIS 185L	Systems & Synthetic Biology Lab		Course(s) discontinued; see your advisor for course options.
<i>Restricted Electives</i>			
Choose three or more upper division courses not used to satisfy another requirement; 9 unit minimum:		9	
BIM 105	Probability & Data Science for Biomedical Engineers		
BIM 117	Modeling Strategies for Biomedical Engineering		
BIM 140	Protein Engineering		
BIM 140L	Protein Engineering Laboratory		
BIM 152	Molecular Control of Biosystems		
BIS/MAT 107	Probability & Stochastic Processes with Applications to Biology		
BIS 180L	Genomics Laboratory		
BIS 183	Functional Genomics		
BIT 150	Applied Bioinformatics		
BIT 160	Principles of Plant Biotechnology		
BIT 161B	Plant Genetics & Biotechnology Laboratory		
EBS 161	Kinetics & Bioreactor Design		
MCB 120	Molecular Biology & Biochemistry Laboratory Associated Lecture		
MCB 120L	Molecular Biology & Biochemistry Laboratory		
MCB 121	Advanced Molecular Biology		
MCB 123	Behavior & Analysis of Enzyme & Receptor Systems		
MCB 124	Macromolecular Structure & Function		
MCB/PLB 126	Plant Biochemistry		
MCB 160L	Principles of Genetics Laboratory		
MCB 164	(Discontinued for spring 2025) **		
MCB 182	Principles of Genomics		
MIC 117	(Discontinued for spring 2023) **		
MMG 102	**		
MMG 103L			
	or MIC 103L DISCONTINUED FOR FALL 2026 **		
MMG 115	Recombinant DNA Cloning & Analysis		
	or MIC 115 DISC		
MMG 170	Yeast Molecular Genetics		
	or MIC 170 DISCONTINUED FOR FALL 2025 **		
Depth Subject Matter Total		38-41	
<b>Total Units</b>		<b>96-109</b>	

1

SSB students now take SSB 134.