

SYSTEMS & SYNTHETIC BIOLOGY, BACHELOR OF SCIENCE

College of Biological Sciences

The Major Program

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.

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	Introduction to Data Science for Biologists	
Chemistry		21-27
CHE 002A & CHE 002B & CHE 002C	General Chemistry and General Chemistry and General Chemistry	

OR

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
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AND

CHE 008A & CHE 008B	Organic Chemistry: Brief Course and Organic Chemistry: Brief Course
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OR

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
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Mathematics 8-12

MAT 017A & MAT 017B & MAT 017C	Calculus for Biology & Medicine and Calculus for Biology & Medicine and Calculus for Biology & Medicine
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OR

MAT 021A & MAT 021B & MAT 021C	Calculus and Calculus and Calculus (Recommended)
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Physics 12

PHY 007A & PHY 007B & PHY 007C	General Physics and General Physics and General Physics
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Preparatory Subject Matter Subtotal 58-68

Depth Subject Matter

Statistics 8

STA 100	Applied Statistics for Biological Sciences
STA 101	Advanced Applied Statistics for the Biological Sciences

Genetics 4

BIS 101	Genes & Gene Expression
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Biochemistry, Bioenergetics, & Metabolism 3-6

BIS 102 & BIS 103 or BIS 105	Structure & Function of Biomolecules and Bioenergetics & Metabolism and Biomolecules & Metabolism
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Cell Biology 3

BIS 104	Cell Biology
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Systems Biology 2

BIS 134	Systems Biology: From Biological Circuits to Biological Systems
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Biomolecular Systems Engineering 4

BIM 143	Biomolecular Systems Engineering: Synthetic Biology
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Systems & Synthetic Biology 5

BIS 185L	Systems & Synthetic Biology Lab
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Restricted Electives

Choose three or more upper division courses not used to satisfy another requirement; 9 unit minimum: 9

BIS/MAT 107	Probability & Stochastic Processes with Applications to Biology
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BIS 180L	Genomics Laboratory	
BIS 183	Functional Genomics	
MIC 102	Introductory Microbiology	
MIC 103L	Introductory Microbiology Laboratory	
MIC 115	Recombinant DNA Cloning & Analysis	
MIC 117	Analysis of Molecular Genetic Circuits (Discontinued)	
MIC 170	Yeast Molecular Genetics	
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	Advanced Eukaryotic Genetics	
MCB 182	Principles of Genomics	
EBS 161	Kinetics & Bioreactor Design	
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	
BIT 150	Applied Bioinformatics	
BIT 160	Principles of Plant Biotechnology	
BIT 161B	Plant Genetics & Biotechnology Laboratory	
Depth Subject Matter Total		38-41
Total Units		96-109