

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 |
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| <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

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| 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

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

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| 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

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| 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

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

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| 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

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

Genetics 4

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

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

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| BIS 104 | Cell Biology |
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Systems Biology 2

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| BIS 134 | Systems Biology: From Biological Circuits to Biological Systems (Discontinued) |
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Biomolecular Systems Engineering 4

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

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| 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

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| 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 |