

BIOENGINEERING UNDERGRADUATE MAJOR

COVID-19-Related Degree Requirement Changes

For information on how Bioengineering degree requirements have been affected by the pandemic, see the "COVID-19 Policies tab (<http://exploreddegrees.stanford.edu/schoolofengineering/bioengineering/#covid19policiestext>)" in the "Bioengineering" of this bulletin. For University-wide policy changes related to the pandemic, see the "COVID-19 and Academic Continuity (<http://exploreddegrees.stanford.edu/covid-19-policy-changes/>)" section of this bulletin.

See the "Department of Bioengineering (<http://exploreddegrees.stanford.edu/schoolofengineering/bioengineering/>)" section of this bulletin for additional information on the department, and its programs and faculty.

COVID-19-Related Degree Requirement Changes

For information on how Aeronautics and Astronautics degree requirements have been affected by the pandemic, see the "COVID-19 Policies tab (<http://exploreddegrees.stanford.edu/schoolofengineering/bioengineering/#covid19policiestext>)" in the "Bioengineering" of this bulletin. For University-wide policy changes related to the pandemic, see the "COVID-19 and Academic Continuity (<http://exploreddegrees.stanford.edu/covid-19-policy-changes/>)" section of this bulletin.

Bioengineering (BIOE)

Completion of the undergraduate program in Bioengineering leads to the conferral of the Bachelor of Science in Bioengineering.

Mission of the Undergraduate Program in Bioengineering

The Stanford Bioengineering major enables students to combine engineering and the life sciences in ways that advance scientific discovery, healthcare and medicine, manufacturing, environmental quality, culture, education, and policy. Students who major in BioE earn a fundamental engineering degree for which the raw materials, underlying basic sciences, fundamental toolkit, and future frontiers are all defined by the unique properties of living systems.

Students will complete engineering fundamentals courses, including an introduction to bioengineering and computer programming. A series of core BIOE classes beginning in the second year leads to a student-selected depth area and a senior capstone design project. The department also organizes a summer Research Experience for Undergraduates (REU) (<http://bioengineering.stanford.edu/student-resources/reu/>) program. BIOE graduates are well prepared to pursue careers and lead projects in research, medicine, business, law, and policy.

Requirements

	Units
Mathematics	
14 units minimum (Prerequisites: 10 units of AP or IB credit or Mathematics 20-series) ¹	
Select one of the following sequences:	
CME 100 & CME 102	10
Vector Calculus for Engineers and Ordinary Differential Equations for Engineers (Recommended)	

MATH 51 & MATH 53	Linear Algebra, Multivariable Calculus, and Modern Applications and Ordinary Differential Equations with Linear Algebra	10
Select one of the following:		
CME 106	Introduction to Probability and Statistics for Engineers (Recommended)	4-5
or STATS 110	Statistical Methods in Engineering and the Physical Sciences	
or STATS 141	Biostatistics	
Science		
26 units minimum ²		
CHEM 31M	Chemical Principles: From Molecules to Solids (formerly 31X)	5
or CHEM 31A & CHEM 31B	Chemical Principles I and Chemical Principles II	
CHEM 33	Structure and Reactivity of Organic Molecules	5
BIO 83	Biochemistry & Molecular Biology (Recommended)	4
or BIO 82	Genetics	
BIO 84	Physiology	4
PHYSICS 41	Mechanics	4
PHYSICS 43	Electricity and Magnetism	4
Technology in Society		
BIOE 131	Ethics in Bioengineering (WIM)	3
Engineering Fundamentals		
BIOE 80	Introduction to Bioengineering (Engineering Living Matter)	4
CS 106A	Programming Methodology (or CS 106B or CS 106X)	5
Fundamentals Elective; see UGHB for approved course list; only one CS class allowed to count toward Fundamentals requirements.		3-5
Bioengineering Core		
BIOE 42	Physical Biology	4
BIOE 44	Fundamentals for Engineering Biology Lab	4
BIOE 101	Systems Biology	3
BIOE 103	Systems Physiology and Design	4
BIOE 123	Bioengineering Systems Prototyping Lab	4
BIOE 141A	Senior Capstone Design I	4
BIOE 141B	Senior Capstone Design II	4
Bioengineering Depth Electives		
Four courses, minimum 12 units:		12
BIOE 122	BioSecurity and Pandemic Resilience	
BIOE 201C	Diagnostic Devices Lab	
BIOE 209	Mathematical Modeling of Biological Systems	
BIOE 211	Biophysics of Multi-cellular Systems and Amorphous Computing	
BIOE 212	Introduction to Biomedical Informatics Research Methodology	
BIOE 214	Representations and Algorithms for Computational Molecular Biology	
BIOE 217	Translational Bioinformatics	
BIOE 220	Introduction to Imaging and Image-based Human Anatomy	
or BIOE 51	Anatomy for Bioengineers	
BIOE 221	Physics and Engineering of Radionuclide-based Medical Imaging	

BIOE 222	Physics and Engineering Principles of Multi-modality Molecular Imaging of Living Subjects
BIOE 223	Physics and Engineering of X-Ray Computed Tomography
BIOE 224	Probes and Applications for Multi-modality Molecular Imaging of Living Subjects
BIOE 225	Intro to Ultrasound Physics and Ultrasound Neuromodulation
BIOE 227	Functional MRI Methods
BIOE 231	Protein Engineering
BIOE 244	Advanced Frameworks and Approaches for Engineering Integrated Genetic Systems
BIOE 260	Tissue Engineering
BIOE 279	Computational Biology: Structure and Organization of Biomolecules and Cells
BIOE 281	Biomechanics of Movement
BIOE 291	Principles and Practice of Optogenetics for Optical Control of Biological Tissues
Total Units	104-107

1. Declare the honors program in Axess (BIOE-BSH).
2. Maintain an overall grade point average (GPA) of at least 3.5 as calculated on the unofficial transcript.
3. Complete at least two quarters of research with a minimum of nine units of BIOE 191 Bioengineering Problems and Experimental Investigation or BIOE 191X Out-of-Department Advanced Research Laboratory in Bioengineering for a letter grade; up to three units may be used towards the bioengineering depth elective requirements.
4. Submit an electronic pdf copy of their thesis, including the signature page signed by both readers, to Bioengineering student services . Students are sent email instructions on how to archive a permanent electronic copy in Terman Engineering library.
5. Present thesis synopsis at the Bioengineering Honors Poster Fair at the end of Spring Quarter.

For program deadlines, application instructions, and more information, please see the Bioengineering Honors Program (<http://bioengineering.stanford.edu/academics/undergraduate-programs/bioengineering-honors-program/>) website.

¹ It is strongly recommended that CME 100 Vector Calculus for Engineers and CME 102 Ordinary Differential Equations for Engineers be taken rather than MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications and MATH 53 Ordinary Differential Equations with Linear Algebra. If you are taking the MATH 50 series, it is strongly recommended to take CME 192 Introduction to MATLAB. CME 106 Introduction to Probability and Statistics for Engineers utilizes MATLAB, a powerful technical computing program, and should be taken rather than STATS 110 Statistical Methods in Engineering and the Physical Sciences or STATS 141 Biostatistics. Although not required, CME 104 Linear Algebra and Partial Differential Equations for Engineers is recommended for some Bioengineering courses.

² Science must include both Chemistry (CHEM 31A Chemical Principles I and CHEM 31B Chemical Principles II; or CHEM 31M Chemical Principles: From Molecules to Solids) and calculus-based Physics (PHYSICS 41 Mechanics and PHYSICS 43 Electricity and Magnetism), with two quarters of course work in each, in addition to two courses of BIO core. CHEM 31A Chemical Principles I and CHEM 31B Chemical Principles II are considered one course even though given over two quarters.

³ A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.

For additional information and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (<http://ughb.stanford.edu>). Students pursuing a premed program need to take additional courses; see the UGHB, BioE Premed 4-Year Plan.

Honors Program

The School of Engineering offers a program leading to a Bachelor of Science in Bioengineering with Honors (BIOE-BSH). This program provides the opportunity for qualified BioE majors to conduct independent research at an advanced level with a faculty research adviser and documented in an honors thesis.

In order to receive departmental honors, students admitted to the program must: