

## Department of Biological Engineering

The Department of Biological Engineering (BE) continues to grow in terms of world-class faculty and students, innovative educational programs, and forefront research programs that advance its mission of fostering education and research that fuse engineering with molecular life sciences. Our central objective is to define and lead the new biology-based engineering discipline that is called biological engineering. The foundational premise of BE is that the science of biology will be as important to technology and society in the next century as physics and chemistry were in the previous one. Therefore, to translate the revolution in modern biology into a corresponding revolution in biology-based technologies, a new biology-based discipline of bioengineering must be established. Our central theme is creating biological technologies, from discovery to design, or more colloquially designing the biology, not just the box.

### Faculty and Staff

The current BE faculty members (with other MIT academic unit affiliations noted in parentheses) are Eric Alm (Civil and Environmental Engineering), Mark Bathe (Mechanical Engineering [MechE]), Angela Belcher (Materials Science and Engineering [MSE]), Michael Birnbaum, Paul Blainey, Ed Boyden (Brain and Cognitive Sciences [BCS], Media Laboratory), Laurie Boyer (Biology), Chris Burge (Biology), Arup Chakraborty (Chemical Engineering [ChemE], Chemistry), Jim Collins (Institute for Medical Engineering and Science), Peter Dedon, Bevin Engelward, John Essigmann (Chemistry), James Fox, Ernest Fraenkel, David Gifford (Electrical Engineering and Computer Science [EECS]), Linda Griffith (MechE), Alan Grodzinsky (EECS, MechE), Jongyoon Han (EECS), Darrell Irvine (MSE), Alan Jasanoff (BCS), Roger Kamm (MechE), Amy Keating (Biology), Alexander Klibanov (Chemistry), Angela Koehler, Robert Langer (ChemE), Douglas Lauffenburger (Biology, ChemE), Harvey Lodish (Biology), Timothy K. Lu (EECS), Scott Manalis (MechE), Jacquin Niles, Katharina Ribbeck, Jonathan Runstadler, Leona Samson (Biology), Ram Sasisekharan, Peter So (MechE), Steven Tannenbaum (Chemistry), William Thilly, Bruce Tidor (EECS), Krystyn Van Vliet (MSE), Christopher Voigt, Ron Weiss (EECS), Forest White, Dane Wittrup (ChemE), Michael Yaffe (Biology), and Feng Zhang (BCS). Bryan David Bryson will be joining BE in 2018 as an assistant professor.

Douglas Lauffenburger continues as head of BE and Leona Samson assists him as associate head. Forest White and Chris Voigt are co-chairs of the BE graduate program, and Scott Manalis is chair of the BE undergraduate program. Rolanda Dudley-Cowans is the department's administrative officer, and Dalia Fares is the academic administrator.

### Research

During fiscal year 2017, the total amount of sponsored research volume supervised by BE faculty members was more than \$67 million. This figure includes sponsored projects formally administered by the department (more than \$41 million) as well as projects directed by BE faculty members supervised administratively within other departments and centers, including but not limited to the Center for Biomedical Engineering, the

Center for Environmental Health Sciences, the Computational and Systems Biology Initiative, the Division of Comparative Medicine, the Institute for Medical Engineering and Science, and the Koch Institute for Integrative Cancer Research. Major research areas within BE include biological imaging; biomaterials; biomolecular engineering; cell and tissue engineering; computational biology and bioinformatics; discovery, design, and delivery of molecular therapeutics; molecular and cellular biophysics; infectious disease and immunology; microbial ecosystems; neurobiology and neuroengineering; biomechanics; molecular epidemiology; molecular pharmacology and toxicology; genomics, proteomics, and glycomics; systems biology; and synthetic biology.

A special highlight of this past year was the 14th annual BE retreat. More than 180 faculty, graduate students, postdocs, and staff gathered for a stimulating and enjoyable day of research, education, and ethics discussions and social interactions away from campus.

### **Undergraduate Education**

We are excited about the continuing growth of our pioneering Course 20 SB major program. We had 49 graduating seniors in June 2017, and there are approximately 39 rising seniors, 56 rising juniors, and 54 rising sophomores for the 2017–2018 academic year. To our knowledge, there is no similar undergraduate degree program elsewhere that centers on genetics, biochemistry, molecular biology, and cell biology as its science foundation and that fuses this science with quantitative, integrative-systems design-oriented engineering principles and approaches (e.g., thermodynamics, kinetics, mechanics, transportation, instrumentation, and computation), including two hands-on laboratory subjects. Judging from our initial cohort of graduates, we expect that our uniquely educated Course 20 students will continue to find attractive career opportunities across a spectrum of industrial, academic, and professional areas. We also continue to administer two SB minor programs, one in biomedical engineering and the other in toxicology and environmental health. In addition, we administer a five-year MEng program in a biomedical engineering, bioengineering track.

### **Graduate Education**

We have a single-track biological engineering PhD curriculum. The current enrollment is 137, with 24 PhD students for the 2017–2018 academic year. As is the case with the BE undergraduate programs, the department's graduate student population represents women and men in roughly equal numbers. In June 2017, the department graduated 26 PhD students and three SM students (one biological engineering student and two MEng students).

We are deeply appreciative of the wonderfully generous gifts for graduate student fellowships, most notably from Andrew and Erna Viterbi, Susan Whitehead, Diane Green, and David R. Fett. Additionally, we have received financial support for campus-administered graduate fellowships from the MIT Energy Initiative and Momenta Pharmaceuticals.

BE is further grateful for other generous gifts toward important aspects of its ongoing program growth, including major gifts from Andrew Viterbi, Cliff Reid, Noubar Afeyan,

David R. Fett, Jono Goldstein, the Gates Foundation, the Manton Foundation, and Pfizer Inc. for important departmental initiatives.

**Douglas A. Lauffenburger**  
**Department Head**  
**Ford Professor of Engineering**