Department of Biological Engineering

The Department of Biological Engineering (BE) continues to grow and gain prominence thanks to world-class faculty and students, innovative educational programs, and leading-edge research programs that advance our mission of fostering MIT education and research by fusing engineering with molecular life sciences. Our central objective is to define and lead a new biology-based engineering discipline that we term 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 have been 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. We are endeavoring to educate engineers and scientists who can apply their measurement and modeling perspectives to understanding how biological systems operate, especially when perturbed by genetic, chemical, mechanical, or materials interventions or when subjected to pathogens or toxins, and apply their design perspective to creating innovative biology-based technologies in medical diagnostic, therapeutic, and device industries as well as in non-health-related industrial sectors such as energy, environment, materials, manufacturing, and national defense. programs are producing a new generation of engineers and scientists capable of solving problems using modern biotechnology, emphasizing an ability to measure, model, and rationally manipulate biological systems.

Faculty and Staff

The current BE faculty members (with other MIT academic unit affiliations noted in parentheses) are as follows: Eric Alm (Civil and Environmental Engineering [CEE]), Mark Bathe (Mechanical Engineering [MechE]), Angela Belcher (Materials Science & Engineering [MSE]), Chris Burge (Biology), Arup Chakraborty (Chemical Engineering, Chemistry), Peter Dedon, Edward DeLong (CEE), Forbes Dewey (MechE), Bevin Engelward, John Essigmann (Chemistry), James Fox, Ernest Fraenkel, Linda Griffith (MechE), Alan Grodzinsky (Electrical Engineering and Computer Science [EECS], MechE), Kimberly Hamad-Schifferli (MechE), Jongyoon Han (EECS), Darrell Irvine (MSE), Alan Jasanoff, Roger Kamm (MechE), Alexander Klibanov (Chemistry), Robert Langer (ChemE, Health Sciences and Technology [HST]), Douglas Lauffenburger (Biology, ChemE), Harvey Lodish (Biology), Scott Manalis (MechE), Jacquin Niles, Katharina Ribbeck, Jonathan Runstadler, Leona Samson (Biology), Ram Sasisekharan (HST), Peter So (MechE), Steven Tannenbaum (Chemistry), William Thilly, Bruce Tidor (EECS), Christopher Voigt, Ron Weiss (EECS), Forest White, Dane Wittrup (ChemE), Michael Yaffe (Biology), and Ioannis Yannas (MechE, MSE).

Douglas Lauffenburger continues as head of BE, and Bruce Tidor assists him as associate head. Dane Wittrup and Forest White are cochairs of the BE graduate program and Scott Manalis is chair of the BE undergraduate program. Rolanda Dudley-Cowans is our administrative officer, and Dalia Fares is our academic administrator.

Research

During fiscal year 2011, the total sponsored research volume supervised by BE faculty members was more than $52 million. This figure includes sponsored projects formally administered by the department (more than $13 million) as well as projects directed by BE faculty members supervised administratively within other departments and centers, including the Center for Biomedical Engineering (Alan Grodzinsky, director), Center for Environmental Health Sciences (Leona Samson, director; Peter Dedon, deputy director), Center for Gynepathology Research (Linda Griffith, director), Computational and Systems Biology Initiative (Douglas Lauffenburger, director; Bruce Tidor, codirector), Division of Comparative Medicine (James Fox, director), and Koch Institute for Integrative Cancer Research (Dane Wittrup, associate director). 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 10th annual BE retreat. More than 150 faculty, graduate students, and staff gathered at a conference center in Randolph, MA, 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 45 graduating seniors in June 2011 and now have approximately 50 rising seniors, 65 rising juniors, and 75 rising sophomores for the forthcoming 2011–2012 academic year. From our perspective, there is no similar undergraduate degree program elsewhere nationally that is centered 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, transport, fields, 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, in biomedical engineering (BME) and toxicology and environmental health (Tox/EH). In addition, we administer a five-year MEng program in biomedical engineering with a bioengineering track.

Graduate Education

BE continues to administer a PhD in biological engineering with two intimately integrated tracks, one in bioengineering and one in applied bioscience. Our current enrollment is 122, with 64 students in the bioengineering track, 34 students in the applied biosciences track, and 24 incoming students who have not yet designated their track. Similarly to the BE undergraduate programs, our graduate student population represents women and men in roughly equal numbers. The department graduated 13 PhD students in June 2011, with eight in the bioengineering track and five in the applied biosciences track.

We are deeply appreciative of wonderfully generous gifts for graduate student fellowships, most notably from Andrew and Erna Viterbi for the Viterbi graduate fellowships in systems biology, Gordon and Adele Binder for the Binder graduate fellowships in biotechnology, Susan Whitehead for the Whitehead graduate fellowships in biological engineering, Noubar Afeyan for the Afeyan graduate fellowships in biological engineering, Cynthia Cargill for the Cargill graduate fellowships in applied bioscience, and Momenta Pharmaceuticals for the presidential graduate fellowships. Additionally, we have received financial support for graduate fellowships from the Medtronic Foundation and the MIT Energy Initiative.

BE is grateful for other generous gifts toward important aspects of our ongoing program growth, including major gifts from Andrew Viterbi and Cliff Reid for important departmental initiatives.

Douglas A. Lauffenburger
Department Head
Ford Professor of Engineering