

Biological Engineering Division

The Biological Engineering Division (BE) continues to grow in terms of top-quality faculty and student numbers, innovative educational programs, and forefront research programs in pursuing its mission of fostering MIT education and research that fuse engineering with biology. Our central objective is to define and lead the new biology-based engineering discipline that we term biological engineering. The central 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 (a) apply their measurement and modeling perspectives to understanding how biological systems operate, especially when perturbed by genetic, chemical, mechanical, or materials interventions, or subjected to pathogens or toxins; and (b) 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 agriculture, environment, materials, manufacturing, and defense. This should lead to a new generation capable of solving problems using modern biotechnology, emphasizing an ability to measure, model, and rationally manipulate biological systems.

The current BE faculty members (with other MIT academic unit affiliations noted in parentheses) are: Angela Belcher (Materials Science and Engineering), Peter Dedon, William Deen (Chemical Engineering), Edward DeLong (Civil and Environmental Engineering), Forbes Dewey (Mechanical Engineering), Drew Endy, Bevin Engelward, John Essigmann (Chemistry), James Fox, Linda Griffith (Mechanical Engineering), Alan Grodzinsky (Electrical Engineering and Computer Science and Mechanical Engineering), Kim Hamad-Schifferli (Mechanical Engineering), Jongyoon Han (Electrical Engineering and Computer Science), Ian Hunter (Mechanical Engineering), Darrell Irvine (Materials Science and Engineering), Roger Kamm (Mechanical Engineering), Alex Klibanov (Chemistry), Mathew Lang (Mechanical Engineering), Robert Langer (Chemical Engineering), Douglas Lauffenburger (Biology and Chemical Engineering), Harvey Lodish (Biology), Scott Manalis (Media Arts and Sciences), Paul Matsudaira (Biology), Leona Samson (Biology), Ram Sasisekharan, David Schauer, James Sherley, Peter So (Mechanical Engineering), Subra Suresh (Materials Science and Engineering), Steven Tannenbaum (Chemistry), William Thilly, Bruce Tidor (Electrical Engineering and Computer Science), Forest White, Dane Wittrup (Chemical Engineering), Gerald Wogan, and Ioannis Yannas (Mechanical Engineering and Materials Science and Engineering). Douglas Lauffenburger continues as director of BE and Peter Dedon assists him ably as associate director. Alan Grodzinsky is chair of the BE graduate program and Linda Griffith is chair of the BE undergraduate program. Rolanda Dudley-Cowans is our administrative officer, and Dalia Gabour is our academic administrator.

During fiscal year 2004, the sponsored research volume officially administered within BE was approximately \$9 million, representing a 3 percent increase over FY 2003. It is important to note that this figure represents only those sponsored projects formally

assigned to the division, which are only a minor portion of the research funding garnered by BE Division faculty. Most BE faculty members additionally operate substantial sponsored research projects supervised administratively within other departments and centers. These include the BioImaging Center, Biotechnology Process Engineering Center, Center for Biomedical Engineering, Center for Environmental Health Sciences, Computational and Systems Biology Initiative, and Division of Comparative Medicine, all of which are directed by BE faculty members (Paul Matsudaira, Linda Griffith, Alan Grodzinsky, Leona Samson, Peter Sorger, and James Fox, respectively). The total sponsored research volume undertaken by BE faculty during the past year, then, was well over \$20 million. Major research areas within BE include biological and physiological transport phenomena; biological imaging and functional measurement; biomaterials; biomolecular engineering and cell and tissue engineering; computational biology and bioinformatics; discovery, design, and delivery of molecular therapeutics; genetic toxicology; macromolecular biochemistry and biophysics; metabolism of drugs and toxins; microbial pathogenesis; carcinogenesis; biomechanics; molecular epidemiology; molecular pharmacology; genomics, proteomics, and glycomics. A special highlight of this past year, as usual, was the third annual BE Division retreat. More than 150 faculty, graduate students, and staff gathered at a conference center in Newport, RI, for a tremendously stimulating and enjoyable two days of research, education, and ethics discussions and social interactions away from campus. We are grateful to Mrs. Janet Michaels for her generous support of this important event.

Undergraduate Education

BE continues to administer two SB minor programs, in Biomedical Engineering (BME) and in Toxicology and Environmental Health (Tox/EH). In addition, it administers a five-year Master of Engineering (MEng) program in Biomedical Engineering (bioengineering track). In June 2004, we had 58 graduates with the BME minor, 7 graduates with the Tox/EH minor, and 7 graduates with the BME/BE MEng. Unusually for School of Engineering programs, the aggregate population of these graduates represents women in the majority.

We are also vigorously underway with plans for a new SB major degree program in Biological Engineering, which we hope and anticipate will be ready for approval by the Institute in academic year 2005.

Graduate Education

BE has previously operated two PhD programs, in Bioengineering and in Molecular and Systems Toxicology, along with SM programs in the same two fields. The graduate program has now been further integrated so that a single PhD in biological engineering is offered, with tracks in bioengineering and in applied bioscience. Our current total enrollment in these programs is 95; similarly to the BE Division undergraduate programs, our graduate student population represents women and men in roughly equal numbers. During this past year, we graduated 12 PhD students and 3 SM students

as we continue to grow toward a steady-state expected to attain approximately 25–30 PhD graduates per year.

BE is the deeply appreciative recipient of wonderfully generous gifts for graduate student fellowships, most notably from Andrew and Edna Viterbi for Viterbi graduate fellowships in computational biology and bioinformatics, Gordon and Adele Binder for Binder graduate fellowships in molecular and cell bioengineering, Susan Whitehead for Whitehead graduate fellowships in biological engineering, and Noubar Afeyan for Afeyan graduate fellowships in biological engineering. Additionally, we have received financial support for graduate fellowships from the Medtronic Foundation, the DuPont/MIT Alliance, the Merck/MIT Partnership, and the Whitaker Foundation.

Additionally, BE is grateful for other generous gifts toward important aspects of our ongoing program growth. These include a gift from the Grochow family for support of women faculty and students and a gift from Cliff Reid to help catalyze key division initiatives.

Douglas A. Lauffenburger
Division Head

More information about the Biological Engineering Division can be found on the web at <http://web.mit.edu/bel/>.