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 pioneering research programs. The department's mission is to foster MIT education and research that is investigating fusing engineering with molecular life sciences. The 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 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. Our central theme is "creating biological technologies, from discovery to design," or more colloquially, "designing the biology, not just the 'box.'"

Faculty and Staff

Current BE faculty members have affiliations with a number of other MIT departments, including Biology, Civil and Environmental Engineering, Brain and Cognitive Sciences, and Chemistry. The full list (with other MIT academic unit affiliations noted in parentheses) includes Eric Alm (Civil and Environmental Engineering), Mark Bathe (Mechanical Engineering), Angela Belcher (Materials Science and Engineering), Michael Birnbaum, Paul Blainey, Edward Boyden (Brain and Cognitive Sciences, Media Lab of Arts and Sciences), Laurie Boyer (Biology), Bryan Bryson, James J. 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), Linda Griffith (Mechanical Engineering), Alan Grodzinsky (Electrical Engineering and Computer Science, Mechanical Engineering), Jongyoon Han (Electrical Engineering and Computer Science), Darrell Irvine (Materials Science and Engineering), Alan Jasanoff (Brain and Cognitive Sciences), Roger Kamm (Mechanical Engineering), Amy Keating (Biology), Alexander Klibanov (Chemistry), Angela Koehler, Robert Langer (Chemical Engineering), Douglas Lauffenburger (Biology, Chemical Engineering), Harvey Lodish (Biology), Timothy K. Lu (Electrical Engineering and Computer Science), Scott Manalis (Mechanical Engineering), Jacquin Niles, Katharina Ribbeck, Ram Sasisekharan, Peter So (Mechanical Engineering), Steven Tannenbaum (Chemistry), William Thilly, Bruce Tidor (Electrical Engineering and Computer Science), Krystyn Van Vliet (Materials Science and Engineering), Christopher Voigt, Ron Weiss (Electrical Engineering and Computer Science), Forest White, Dane Wittrup (Chemical Engineering), Michael Yaffe (Biology), and Feng Zhang (Brain and Cognitive Sciences). In 2019, Anders Hansen (University of California, Berkeley) was recruited to join the department as an assistant professor in early 2020.

Douglas Lauffenburger continued as head of BE, with Angela Belcher assisting him as associate head, through June 2019. Forest White and Katharina Ribbeck were co-chairs of the BE graduate program. Scott Manalis and Linda Griffith were co-chairs of the BE undergraduate program. Rolanda Dudley-Cowans is the department's administrative officer. Dalia Fares is the academic administrator.

Research

During fiscal year 2019, the total sponsored research volume supervised by BE faculty members was approximately $79.7 million. This figure includes sponsored projects formally administered by the department (more than $37 million), as well as projects that were directed by BE faculty members and supervised administratively within other departments and centers, including the Center for Biomedical Engineering, the Center for Environmntal 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.

The 16th annual BE retreat was a highlight of this past year. More than 180 faculty members, graduate students, postdoctoral associates, and staff gathered at the Hotel Commonwealth for an enjoyable day of research, education, and ethics discussions and social interactions away from campus.

Undergraduate Education

The department is excited about the continuing growth of the bachelor of science program in Course 20 Biological Engineering. There were 46 graduating seniors in 2019; there are approximately 52 rising seniors, 55 rising juniors, and 66 rising sophomores for academic year 2020. There is no similar undergraduate degree program anywhere else in the country. Course 20 is centered on genetics, biochemistry, molecular biology, and cell biology as its science foundation. This science is then fused 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 the initial cohort of graduates, the department expects that Course 20 students will continue to find attractive career opportunities across a spectrum of industrial, academic, and professional areas. In addition to the BE major program, the department continues to administer two SB minor programs, in biomedical engineering and in toxicology and environmental health. The department also administers a five-year master's of engineering program in a biomedical engineering–bioengineering track.

Graduate Education

The department's current enrollment is 136 graduate students, predominantly in the PhD program. The department graduated 27 PhD students and one ScD student in academic year 2019. As is the case in the BE undergraduate programs, the graduate student population comprises women and men in roughly equal numbers.

Resource Development

The Department of Biological Engineering is grateful for generous gifts toward important aspects of our ongoing program growth, including major gifts from Pearl Huang and Peter Hobbs (for the Huang-Hobbs BioMaker Laboratory), the Noubar and Anna Afeyan Foundation (for the Daniel I. C. Wang Professorship in Advanced Biotechnology), Susan Whitehead (for the Whitehead Fellowship and BE Fellowship) and the Karine and John Begg Fund (for the Center for Gynepathology Research).

Douglas A. Lauffenburger
Department Head
Ford Professor of Engineering