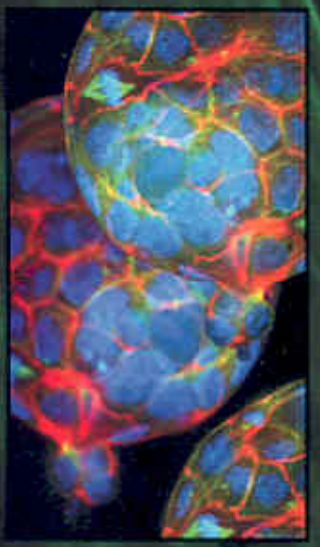
Biomedical Engineering Research and Education Fellowship Program

for physician fellows

A training program of the
Center for Engineering in Medicine

Harvard Teaching Hospitals
Shriners Burns Hospital
and Harvard Medical School



Program

Bioengineering is a dynamic and expanding field which strives to make improvements in patient care and quality of life through the application of principles and tools of the physical and biological sciences. The contributions of bioengineers have had tremendous impact on many aspects of medicine including: clinical diagnosis (e.g. computed tomography), creation of new medical disciplines (e.g. microsurgery), and the treatment of disease (e.g. artificial organs).

The Center for Engineering in Medicine (CEM) at the Massachusetts General Hospital (MGH) and other Teaching Hospitals of the Harvard Medical School (HMS) have created a unique two-year Biomedical Engineering Research and Education (BERE) fellowship program to train physicians in bioengineering. The BERE program provides physician fellows with the knowledge and skills to address important clinical problems at the interface of engineering and medicine. The BERE program consists of: (1) a didactic set of bioengineering courses designed specifically for physicians and (2) a research training activity in bioengineering.

Fellows are expected to devote 100% of their efforts to the BERE program.

Research

The research programs of the CEM faculty cover a broad spectrum of problems in bioengineering, all of which are marked by multidisciplinary collaborations and clinical relevance. The research foci can be grouped into three major thrusts:

Molecular and Cellular Therapeutics: gene and other targeted therapies, drug delivery systems, and cell transplantation and trafficking.

Tissue Engineering and Artificial Organs Development: bioartificial organs, biomechanics, preservation of cells and tissues, microfabrication of cellular systems, and biomaterials for tissue repair and design.

Functional Imaging: whole body and organ metabolic engineering using NMR and PET, and microscopic imaging of molecular and cellular processes.

The Center for Engineering in Medicine

The Harvard Medical establishment has contributed significantly to the development of the discipline of biomedical engineering, and has been the address of several "firsts" in health science technology. Until recently, no formal vehicle for the organization and advancement of bioengineering existed within the Harvard Medical School or the Harvard Teaching Hospitals. In 1995, the CEM was formed to fill this void.

The CEM was established by bioengineering investigators at the Harvard Teaching Hospitals [MGH, Brigham and Women's Hospital (BWH), Beth Israel-Deaconess Medical Center (BIDMC)], the Shriners Burns Hospital (SBH), and the Harvard-MIT Division of Health Sciences and Technology (HST). In 1995, with the help of funding made available by the Whitaker Foundation, MGH, and other private and industrial sources, the CEM launched the first program to formally train M.D. fellows in biomedical engineering.

Highlights in Harvard History

1846	First time ether used during surgery
1960	Proton beam therapy to treat tumors of the eye, neck, and brain
1962	The first successful surgical reattachment of a severed human limb
1964	Practical long-term blood storage
1970s	PET scanning
1981	The first artificial skin made from living cells
1983	Genetic marker for Huntington's disease discovered
1991	High-speed MRI scanning

Facilities

The primary core facilities available to all BERE fellows include:

Microscale Engineering Facility focuses on creating functional tissue substitutes using microtextured and micropatterned surfaces, and on developing microfluidic devices for diagnostic and monitoring purposes.

Tissue Engineering Facility contains an extensive suite of tissue culture rooms, media preparation rooms, cell isolation rooms, including rooms for viral transfection of mammalian cells.

Laser Facility contains argon and dye lasers, and a flash-lamped pumped Q-switched Nd:YAG laser equipped with tuning capability from the ultraviolet to the infrared.

Microscopy Facility includes two laser confocal microscopes, two fluorescent microscopes, intravital microscopy systems, a transmission electron microscope, and computer-aided image analysis systems.

NMR and Mass Spectrometry Facility includes an NMR spectrometer equipped with imaging accessories and two mass spectrometry systems which include ultra-trace analysis of stable isotopes.

Positron Emission Tomography (PET) Facility includes a Cyclotron and a radiochemistry laboratory with three hot cells. This is a common use facility.

Computer Facility is dedicated to computational studies and is fully equipped, including a Silicon Graphics Origin 200 with O2 workstations, and an extensive network of PC and Macintosh personal computers with software for all relevant applications.

Core Faculty

Francois Berthiaume, PhD
Surgery, MGH
Joseph Bonventre, MD, PhD
Medicine, MGH
Deborah Burstein, PhD
Radiology, BIDMC
Alan Fischman, MD, PhD
Radiology, MGH
Alex Fowler, PhD
Mech. Engineering, UMass
Martha Gray, PhD
Elect. Engineering, MIT
Jeffrey Morgan, PhD
Surgery, MGH
Charles Roth, PhD
Surgery, MGH
Martin Schmidt, PhD
Elect. Engineering, MIT
Jay Schnitzer, MD, PhD
Pediatric Surgery, MGH
Gregory Stephanopoulos, PhD
Chem. Engineering, MIT
Ronald Tompkins, MD, ScD
Surgery, MGH
Mehmet Toner, PhD
Surgery, MGH
Martin Yarmush, MD, PhD
Surgery, MGH

Affiliates

Rakesh Jain, PhD
Radiation Oncology, MGH
Ralph Mueller, PhD
Orthopedic Res., BIDMC
Bruce Rosen, MD, PhD
Radiology, MGH
Steven Skates, PhD
Biostatistics, MGH
Robert Weisskoff, PhD
Radiology, MGH
Jose Venegas, PhD
Anesthesiology, MGH

Schedule

Year 1 -

JULY - AUGUST
Laboratory in Molecular and Cellular Sciences

SEPTEMBER - DECEMBER
Fundamentals in Biomedical Engineering

Seminar Series in Biomedical Engineering

JANUARY
Biostatistics

FEBRUARY - MAY
Case Studies in Biomedical Engineering

Seminar Series in Biomedical Engineering

Year 2 -

JULY - DECEMBER
Seminar Series in Biomedical Engineering

JANUARY
Imaging in Medicine

FEBRUARY - JUNE
Seminar Series in Biomedical Engineering

Course Work

Completion of a set of courses in biomedical engineering will provide physicians with a solid background in the fundamental principles of engineering and physical sciences. A basic understanding of these principles will allow physicians to interact productively with the biomedical engineering research community, and position them to conduct significant independent research in their own investigative careers.

The set of courses has been specifically designed for physicians, and is taught by CEM faculty members. Our faculty includes a diverse group of engineers, scientists, and physicians, all with a common interest in providing in-depth training in biomedical engineering research and education.

Application Process

The BERE program is open to all physicians interested in biomedical engineering; an interest in academic medicine and an undergraduate degree in engineering, mathematics, or the physical sciences is helpful, but not required. Fellowship stipends range from $30,000 - $32,000, depending on the fellow's prior level of experience. Applications can be obtained from:

The Center for Engineering in Medicine
Massachusetts General Hospital / GRB 1401
55 Fruit Street
Boston, MA 02114

Applications must be received by November 15 and successful candidates are notified by February 1 of the following year.

THE CENTER FOR ENGINEERING IN MEDICINE
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