

Harvard-MIT Division of Health Sciences and Technology

The Harvard-MIT Division of Health Sciences and Technology (HST) brings together MIT, Harvard Medical School (HMS), and the teaching hospitals in the greater Boston area in a unique collaboration that integrates science, medicine, and engineering to solve problems in human health. HST's administrative home is located at the Whitaker College of Health Sciences and Technology at MIT. HST also maintains an office at the HMS quadrangle campus in Boston, as one of the five medical societies at Harvard Medical School. The HST director at MIT reports to the provost and to the vice president for research and associate provost at the Institute, and the director at Harvard Medical School reports to the HMS dean of medicine and dean for graduate education.

HST trains its students to have a deep understanding of engineering, physical sciences, and the biological sciences complemented by hands-on clinical experience. HST faculty are drawn from the robust Boston-area medical community and from fields as varied as physics, chemistry, engineering, computer science, and management. This interdisciplinary approach to biomedicine, conceived at HST in 1970, creates a unique interinstitutional experience for our student body.

HST researchers explore the fundamental principles underlying health and disease while also emphasizing the importance of translational research and working to develop new diagnostics and therapeutics. Research currently focuses on biomedical imaging, medical informatics, tissue regeneration, biomedical devices and systems, and micro- and nanoscale technologies.

The HST Community

Research Program Highlights

HST faculty members published and researched in a number of areas during AY2010, as follows.

In his research, Collin Stultz, the W.M. Keck associate professor of biomedical engineering at HST, explained that a better understanding of collagen's attributes could assist with the treatment of atherosclerosis and other diseases.

HST and Howard Hughes Medical Institute professor Sangeeta Bhatia and a team of MIT bioengineers developed a new way to analyze DNA damage. The technique is based on the "comet assay," but the team's approach is unique in that it can analyze many more cells at a faster rate than the original comet assay, which was developed some 30 years ago. Additionally, Bhatia and researchers from Rockefeller University successfully grew hepatitis C outside of healthy liver cells. Bhatia was also part of a team that developed a "cocktail" of nanoparticles that locate, target, and kill cancer tumors.

Institute Professor Robert Langer worked with a team of MIT and Harvard researchers to develop "nanoburrs" to help with drug delivery in the heart. These nanoburrs are small particles that can cling to artery walls and slowly distribute drugs into the system.

The structure of the nanoburr allows it to attach to damaged arterial walls as it delivers drugs. Researchers hope that these structures can be used in addition to or instead of stents, especially in hard-to-reach areas such as arterial bifurcations.

HST student Erez Lieberman and HST faculty member Leonid Mirny were part of a group of scientists who discovered a 3D structure of the human genome, paving the way for new insights into genomic function.

Professor Elazer Edelman and his team reviewed the potentials of tissue-specific sealants used following an operation or to repair a wound. According to Professor Edelman, “The delineation of tissue-specific mechanisms for material adhesion leads the way for tailoring materials to individual needs and application. This exciting work may well change the clinical use and continued evolution of soft-tissue sealants and adhesive materials.”

Research Program Events

HST Faculty Poster Session

Approximately 40 faculty members and 50 students attended the sixth annual HST Faculty Poster Session, held on October 8, 2009, at the Tosteson Medical Education Center at HMS. Thirty-five faculty posters were on exhibit, representing all HST programs. Some posters represented broad research programs, others presented specific research projects, and many included student coauthors. This annual event familiarizes faculty members with their colleagues’ research and assists students in selecting laboratories and mentors to explore for their research.

HST Forum

The 23rd annual HST Forum was held on April 15, 2010, at the HMS New Research Building. More than 200 individuals attended the poster session, talk, awards, and reception at this extraordinary event. Dr. Christoph Westphal, chief executive officer of Sirtris, served as the forum’s keynote speaker. In his discussion of “Entrepreneurship in the 21st Century,” he focused on the importance of companies having “big ideas.” Big ideas, surrounded by strong financial backing, strategy, leadership, and high-profile founders, can lead to a company’s success.

Research Awards

Institute Professor Robert Langer received the Institute of Electrical and Electronics Engineers’s Engineering in Medicine and Biology Society Award. He was also presented the UCSF Medal from the University of California, San Francisco, the New England Institute of Chemists’s Distinguished Chemist Award, and the Massachusetts Society for Medical Research’s Biomedical Research Leaders Award. Professor Langer was elected to the Controlled Release Society’s College of Fellows and was named a Founding POLY Fellow in the American Chemical Society’s Division of Polymer Chemistry.

Professor Elazer R. Edelman, Thomas D. and Virginia W. Cabot professor of health sciences and technology at MIT, was awarded the Spanish Order of Civil Merit by

the Spanish government for his “efforts to improve scientific relations and academic interchange between Spain and the United States.”

Professor Sangeeta Bhatia received the Young Investigator Award from the American College of Clinical Pharmacology.

Honors

In 2009 and 2010, Institute Professor Robert Langer received honorary degrees from Harvard University, the Mt. Sinai School of Medicine, Rensselaer Polytechnic Institute, and Willamette University.

Professor Sangeeta Bhatia was named the John J. and Dorothy Wilson professor of health sciences and technology and electrical engineering and computer science.

Faculty Mentoring and Teaching Awards

Roger Mark, MD, PhD, and W. Hallowell (Hal) Churchill, MD, received the Irving M. London Teaching Award in honor of their dedicated and inspired teaching of Introduction to Clinical Medicine.

Professor Lee Gehrke received the 2010 Donald O’Hara Faculty Prize for Excellence in Teaching from Harvard Medical School.

Assistant professor Jeffrey Karp, PhD, received the Thomas McMahon Mentoring Award in honor of his enthusiastic, supportive mentoring of students in HST’s Medical Engineering and Medical Physics Program (MEMP).

Student Awards

The Office of the Dean for Graduate Education awarded fellowships to two HST students. Joseph Franses (MD/MEMP) received the internal MIT Chyn Duog Shiah Memorial Fellowship, and Adeeti Ullal (MEMP) received the internal MIT Henry C. and Frances Keany Rickard Fund Fellowship. Ullal was also awarded a 2010 National Science Foundation Graduate Research Fellowship.

Erez Lieberman, a PhD candidate in the Medical Engineering and Medical Physics Program, received the 2010 Lemelson-MIT Student Prize. He received significant press for his work on the iShoe, genomic sequencing, and the evolution of language. This is the third consecutive year that an HST student has received this award and the fifth time since the award’s inception in 1995. *Technology Review* named Lieberman one of the top young innovators under the age of 35.

Graduate Degree Programs

HST is among the largest biomedical engineering and physician scientist training programs in the United States, with 386 students enrolled in its graduate degree programs during AY2010:

- 180 MD and MD/PhD students
- 152 PhD students (including 4 MEMP/MD students): 112 in MEMP and 40 in Speech and Hearing Bioscience and Technology
- 31 master's students: 27 in the Biomedical Enterprise Program, 3 in Biomedical Informatics, and 1 in the Master of Engineering in Biomedical Engineering Program

HST graduate students work with faculty and affiliated faculty members from MIT, Harvard, and affiliated teaching hospitals. Whether pursuing careers in medicine, research, industry, or government, HST graduates have made outstanding contributions to advances in human health care.

MEMP trains students as engineers or physical scientists who also possess extensive knowledge of medical sciences. The program provides preclinical and clinical training to students. Typically students complete the program within seven years and in some cases also pursue an MD. Close to 75 percent of MEMP graduates pursue an academic career.

The MD program is aimed at students interested in a research-based medical career. While able to complete the program in four years, students typically complete it in five or more years due to the research component of the HST/MD curriculum. Students are strongly encouraged to conduct their research under the direction of a single faculty member during the program. Close to 80 percent of MD program alumni have a career path in academics.

Summer Institutes

Patterned after MIT's Summer Research Program, HST offers specialized Summer Institute programs in bioinformatics and integrative genomics. Twenty-nine students participated in summer 2009, and 15 are enrolled in summer 2010. In past years HST administered two summer programs: one in bioinformatics and integrative genomics and one in biomedical optics. This year Massachusetts General Hospital administered the biomedical optics program, which accounts for the lower student enrollment number at HST.

This program offers a unique opportunity for outstanding undergraduate college students considering a career in biomedical engineering and/or medical science. Through a hands-on research experience and in-depth lectures, participants learn about bioinformatics and engage in its application to solve problems in human health. Through individual tutorials and workshops, students gain the skills to communicate their research findings effectively in written and oral formats. Shared living arrangements and a variety of technical and social activities enable Summer Institute participants to develop a network of peers and build strong, enduring connections with HST faculty working in the field.

Priorities

Over the past year, the senior administrations of both MIT and Harvard Medical School made a concerted effort toward refocusing HST's educational priorities on its core academic mission: the PhD and MD programs. Three formal groups—the Faculty Transition Task Force, the Academic Task Force, and the Administrative Task Force—worked tirelessly on this review process and presented their findings to the HST directors.

HST faculty members, students, and staff met with the HST Visiting Committee in late winter. Following the meeting it remained clear that the “global recognition” of both Harvard and MIT attracts an exceptional pool of talent to the HST programs. The division is working toward streamlining its mission and operating structure so that it meets the current priorities of the Institute.

Ram Sasisekharan

Director, MIT

Edward Hood Taplin Professor of Medical and Electrical Engineering

More information about the Harvard-MIT Division of Health Sciences and Technology can be found at <http://hst.mit.edu/>.