

## 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 academic and medical communities 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.

### Graduate Degree Programs

HST is among the largest biomedical engineering and physician scientist training programs in the US, with 364 students enrolled in its graduate degree programs during AY2011:

- 176 MD and MD/PhD students (does not include MD/PhD students enrolled in Medical Engineering and Medical Physics Program [MEMPP])
- 152 PhD-only students: 110 in MEMPP and 42 in Speech and Hearing Bioscience and Technology
- 6 MD/PhD students enrolled in MEMPP
- 30 master's students: 27 in the Biomedical Enterprise Program (BEP), 2 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.

MEMPP 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.

The MD program is aimed at students interested in a research-based medical career. While eligible 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 Institute**

Patterned after MIT's Summer Research Program, HST offers a specialized Summer Institute program in bioinformatics and integrative genomics. Fifteen students participated in summer 2010, and 16 are enrolled in summer 2011.

This program offers a unique opportunity for outstanding undergraduate college students considering a career in biomedical engineering and/or medical science. Through hands-on research 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 learn 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.

### **Faculty Honors and Promotions**

Dr. Elfar Adalsteinsson, associate professor of electrical engineering and health sciences and technology, was awarded tenure.

Dr. Daniel Griffith Anderson joined HST as an associate professor of health sciences and technology and chemical engineering.

HST director Dr. David Cohen, Robert H. Ebert professor of medicine and health sciences and technology and director of hepatology at Brigham and Women's Hospital, was promoted to full professor.

David H. Koch Institute Professor Robert Langer received the American Chemical Society's 2012 Priestley Medal, the society's most prestigious prize. Professor Langer also received the Founders Award from the National Academy of Engineering [at the academy's annual meeting](#) in October. He was honored for "the invention, development, and commercialization of methods and materials for drug delivery and tissue engineering, mentoring of young scientists, and the promotion of the nation's health."

Professor Bruce Rosen, director of the Athinoula A. Martinos Center for Biomedical Imaging at Massachusetts General Hospital, was among the 65 new appointees to the Institute of Medicine of the National Academy of Sciences.

Dr. Collin Stultz, associate professor of electrical engineering and health sciences and technology, was awarded tenure.

## Faculty Mentoring and Teaching Awards

Professor Sangeeta Bhatia received the Thomas McMahon Mentoring Award for her exceptionally dedicated, caring, and empowering mentoring of PhD students.

Assistant professor Mary Boussein received the Seidman Prize for MD Research Mentorship for her tireless, enthusiastic, and confidence-building mentoring.

Professor Matthew Frosch received the Irving M. London Teaching Award for his captivating ability to bring the human brain to life in the neuroanatomy portion of HST.130 Introduction to Neuroscience. Professor Frosch also received the 2011 Donald O'Hara Faculty Prize for Excellence in Teaching from Harvard Medical School.

Assistant professor Robert Padera received the Biomedical Enterprise Program Teaching Award for his tremendous clarity in his teaching in pathology (HST.030/HST.031 Human Pathology) and biomaterials (HST.521 Biomaterials, Tissue Engineering, and Regenerative Therapeutics) and for consistently “going beyond” to help Biomedical Enterprise Program students achieve a solid clinical foundation.

## Student Honors and Awards

The Office of the Dean for Graduate Education awarded fellowships to two PhD candidates in the MEMP program. Sarah Lumpkins received the internal Henry C. and Frances Keany Rickard Fund Fellowship, and James Ankrum received the internal Hugh Hampton Young Memorial Fund Fellowship.

Ankrum was also honored as one of three MIT doctoral candidates selected to attend the 61st Lindau Meeting of Nobel Laureates in Germany. This annual meeting provides a globally recognized forum for the transfer of knowledge between 20 Nobel laureates and 550 young researchers from around the world.

The following PhD candidates in the MEMP program all received National Science Foundation fellowships: Kendall Clement, Alex German, Luvena Ong, Meena Siddiqui, Laura Tanenbaum (incoming), and Stephani Yaung. Siddiqui also received a Ford Foundation Fellowship.

Melissa Gymrek, an incoming PhD candidate in the Speech and Hearing Bioscience and Technology program, and Jesse Engritz and Alex Nichols, PhD candidates in the MEMP program, each received a National Defense Science and Engineering Graduate Fellowship. Engritz also received a Hertz Foundation Fellowship.

Melis Anahtar, an MD/PhD candidate, and David Reshef, an incoming MD candidate, each received 2011 Paul & Daisy Soros Fellowships for New Americans.

Nancy Chen, a PhD candidate in the Speech and Hearing Bioscience and Technology program, received the Institute of Electrical and Electronics Engineers Spoken Language Processing Student Grant for her paper “Informative Dialect Recognition Using Context-dependent Pronunciation Modeling,” coauthored with Wade Shen, Joseph P. Campbell, and Pedro A. Torres-Carrasquillo.

Zach Wissner-Gross, a PhD candidate in the MEMP program, received the Biophysical Society's Student Research Achievement Award for his work on symmetry breaking in developing neurons.

Ovid Amadi, PhD candidate in the MEMP program, received the United Negro College Fund/Merck Graduate Science Research Dissertation Fellowship.

Yenfu Cheng, a PhD candidate in the Speech and Hearing Bioscience and Technology Program, received the Amelia Peabody Scholarship.

Carlos Pardo, PhD candidate in the MEMP program, received the Howard Hughes Medical Institute (HHMI) International Student Research Fellowship.

Benjamin Larman, PhD candidate in the MEMP program, received the Harold M. Weintraub Graduate Student Award.

Alice Chen, PhD candidate in the MEMP program, received the 2011 Lemelson-MIT Student Prize. This is the fourth consecutive year that an HST student has been presented with this award and the sixth time since the award's inception in 1995. Chen received the award for her innovative applications of microtechnology to study human health and disease. Combining micro- and nanotechnology-based approaches to biological questions, Chen's most recent inventive breakthrough—a humanized mouse with a tissue-engineered human liver—is intended to bridge a gap in the drug development pipeline between laboratory animal studies and clinical trials.

## Research Program

### Highlights

Four HST faculty members were invited to join the new David H. Koch Institute for Integrative Cancer Research at MIT, a pioneering cancer research center that brings life scientists and engineers together in one building. The newly dedicated institute (Building 76) now houses the labs of Ram Sasisekharan, HST director and Edward Hood Taplin professor of health sciences and technology and biological engineering; Professor Langer; Professor Bhatia, the John and Dorothy Wilson professor of health sciences and technology, professor of electrical engineering and computer science, and HHMI investigator; and Associate Professor Anderson.

HST faculty members published and researched in a number of areas during AY2011, as follows.

A team of researchers from MIT, the Sanford-Burnham Medical Research Institute, and the University of California, San Diego, has designed a new type of delivery system in which a first wave of nanoparticles homes in on a tumor, and then calls in a much larger second wave that dispenses a cancer drug. This communication between nanoparticles, enabled by the body's own biochemistry, boosted drug delivery to tumors by more than 40-fold in a mouse study. Professor Bhatia was senior author of the paper describing the study ("Nanoparticles That Communicate In Vivo to Amplify Tumour Targeting"), which appeared in the June 19 online edition of *Nature Materials*.

Dr. Emery Neal Brown, professor of brain and cognitive sciences and health sciences and technology, coauthored a study in the *New England Journal of Medicine* outlining what scientists know and don't know about anesthesia. Unlocking its many mysteries, he says, will help scientists better understand consciousness and sleep—and could lead to new treatments for pain, depression, and sleep disorders. This study also received extensive coverage in the general press, including *The New York Times* and National Public Radio. Professor Brown is a practicing physician at Massachusetts General Hospital and holds the Warren M. Zapol professorship of anesthesia at HMS in addition to his MIT appointment.

Associate Professor Anderson coauthored a paper in *Nature Materials* in which MIT researchers, together with colleagues at the Scripps Research Institute and the University of Rochester, demonstrated that tiny particles of gold and balls of protein known as virus-like particles, both with strands of DNA attached to them, would spontaneously organize themselves into a lattice-like structure. According to Dr. Anderson, nanodevices that combine organic and inorganic molecules could “take potentially therapeutic molecules and get them where they need to go.”

Professor Langer was senior author on a study appearing online in the *Proceedings of the National Academy of Sciences* in which drug-carrying nanoparticles designed by MIT and Brigham and Women's Hospital researchers were decorated with tags that bind to molecules found on the surface of tumor cells. These new nanoparticles could improve cancer treatment by delivering a combination of chemotherapy drugs directly to cancer cells. In this study, the researchers tailored their particles to deliver cisplatin and docetaxel, two drugs commonly used to treat many different types of cancer.

## Events

### HST Faculty Poster Session

Approximately 40 faculty members and 75 students attended the seventh annual HST Faculty Poster Session, held on October 21, at the Tosteson Medical Education Center at HMS. Thirty-seven faculty posters were on exhibit, representing all HST programs. Some posters represented broad research programs, while others presented specific research projects; 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 24th HST Forum was held on April 14 at the Tosteson Medical Education Center at HMS. At this event showcasing student research, the exciting depth and breadth of HST science and accomplishment are highlighted for MD and PhD candidates, faculty, staff, and other members of the HST, HMS, and MIT communities.

This year 150 people attended the forum, including 42 students who presented posters on their current research. The poster session was followed by a keynote address given by professor R. Rox Anderson, MD (HST '84), on “Magic Bullet-ology.” The speech was very well received by current as well as prospective members of the HST community.

In the context of an impressive array of articulately presented student research, the following students received the Martha Gray Prize for Excellence in Research in the categories named:

- Vineeta Agarwala (MD/PhD program), Bioinformatics and Integrative Genomics
- David Lin (MD program), Physiology and Systems Biology
- Mark Scott (MEMP), Imaging, Acoustics, and Optics
- Vikram Pattanayak (MD/PhD program), Biomedical Devices
- Sidharth Puram (MD/PhD program), Cell and Molecular Biology
- Alice A. Chen (MEMP), Regenerative and Rehabilitative Biomedical Engineering
- Mitra Dowlatshahi (MD program), Cell and Molecular Biology

### **Priorities**

The senior administrations of both MIT and HMS continued their concerted efforts toward refocusing HST's educational priorities on its core academic mission: the PhD and MD programs. In February, MIT's provost Dr. Rafael Reif charged an ad hoc committee of highly respected senior faculty with exploring options for the structure of the HST effort at MIT. This committee met throughout the spring semester with members of the HST faculty, student, and alumni bodies; with senior administrators from HMS and the MIT Schools of Engineering and Science; and with many members of the wider HST community. The committee's recommendations were outlined in a [report \(PDF\)](#) issued on May 26.

It remains clear that the global recognition of both Harvard and MIT attracts an exceptional pool of talent to the HST programs. The division is working with the administrations of both MIT and HMS to streamline its mission and operating structure so that it continues to be a pioneer program, developing interdisciplinary educational and research programs designed to educate outstanding minds, cultivate leaders, create knowledge, and generate cost-effective preventive, diagnostic, and therapeutic innovations, as it has for more than 40 years.

**Ram Sasisekharan**

**Director, MIT**

**Edward Hood Taplin Professor of Health Sciences and Technology and Biological Engineering**