Section 1
Facts and History

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The Massachusetts Institute of Technology is one of the world's preeminent research universities, dedicated to advancing knowledge and educating students in science, technology, and other areas of scholarship that will best serve the nation and the world. It is known for rigorous academic programs, cutting-edge research, a diverse campus community, and its long-standing commitment to working with the public and private sectors to bring new knowledge to bear on the world's great challenges.

William Barton Rogers, the Institute's founding president, believed that education should be both broad and useful, enabling students to participate in "the humane culture of the community" and to discover and apply knowledge for the benefit of society. His emphasis on "learning by doing," on combining liberal and professional education, and on the value of useful knowledge continues to be at the heart of MIT's educational mission.

MIT's founder, William Barton Rogers, 1879
Courtesy MIT Museum

MIT's commitment to innovation has led to a host of scientific breakthroughs and technological advances. Achievements of the Institute's faculty and graduates have included the first chemical synthesis of penicillin and vitamin A, the development of inertial guidance systems, modern technologies for artificial limbs, and the magnetic core memory that enabled the development of digital computers. Exciting areas of research and education today include neuroscience and the study of the brain and mind, bioengineering, energy, the environment and sustainable development, information sciences and technology, new media, financial technology, and entrepreneurship.

University research is one of the mainsprings of growth in an economy that is increasingly defined by technology. A study released in February 2009 by the Kauffman Foundation estimated that MIT graduates had founded 25,800 active companies. These firms employed about 3.3 million people, and generated annual world sales of $2 trillion, or the equivalent of the eleventh-largest economy in the world.

MIT has forged educational and research collaborations with universities, governments, and companies throughout the world, and draws its faculty and students from every corner of the globe. The result is a vigorous mix of people, ideas, and programs dedicated to enhancing the world's well-being.

Fields of Study

MIT supports a large variety of fields of study, from science and engineering to the arts. MIT's five academic schools are organized into departments and other degree-granting programs. In addition, several programs, laboratories, and centers cross traditional boundaries and encourage creative thought and research.

School of Architecture and Planning
Architecture
Media Arts and Sciences
Urban Studies and Planning
Center for Real Estate

School of Engineering
Aeronautics and Astronautics
Biological Engineering
Chemical Engineering
Civil and Environmental Engineering
Electrical Engineering and Computer Science
Engineering Systems
Materials Science and Engineering
Mechanical Engineering
Nuclear Science and Engineering
Institute of Medical Engineering and Science

School of Humanities, Arts, and Social Sciences
Anthropology
Comparative Media Studies/Writing
Economics
Global Studies and Languages
History
Humanities
Linguistics and Philosophy
Literature
Music and Theatre Arts
Political Science
Science, Technology, and Society

Sloan School of Management
Management

School of Science
Biology
Brain and Cognitive Sciences
Chemistry
Earth, Atmospheric, and Planetary Sciences
Mathematics
Physics

Interdisciplinary Undergraduate Programs
American Studies
Ancient and Medieval Studies
Computer Science and Molecular Biology
Program in Psychology
Women's and Gender Studies

Interdisciplinary Graduate Programs
Computation for Design and Optimization
Computational and Systems Biology
Computational Science and Engineering
Computer Science and Molecular Biology
Engineering Systems
Harvard-MIT Health Sciences and Technology Program
Joint Program with Woods Hole Oceanographic Institution
Leaders for Global Operations
Microbiology
Operations Research
Polymer Science and Technology
System Design and Management
Technology and Policy
Transportation

Digital Learning

Practically since the advent of digital computing, MIT has been at the forefront of innovation in educational technology, whether through individual faculty initiatives, departmental projects, or Institute-wide programs. Literally hundreds of technology projects, each building on the lessons of those before, have helped to change the face of education at MIT and throughout the global academic community.

But in the last few years, technology-enabled change in how we teach and learn has been accelerating. We have seen remarkable educational experiments throughout higher education that are resulting in unprecedented breakthroughs:

- New pedagogies. Examples include "flipped classrooms" (content delivery as homework and problem-solving/lab/customized instructor intervention in class), "chunked" (modularized) lessons, individually-paced/assessment-based teaching and learning, and machine-mediated frequent feedback to students. Many MIT faculty are experimenting with these new ways of teaching and learning.

- Scalable teaching. Innovative technologies such as robust learning management platforms with short videos, embedded quizzes with instant feedback, student-ranked questions that prioritize topical focus for instructors, automated grading and assessment, discussion forums, personalization, etc. make it possible to increase student cohort size from tens or hundreds in a campus classroom to tens of thousands around the globe via the Internet. MITx in partnership with edX—originally an MIT-Harvard alliance, which has since expanded to include many top-tier universities worldwide—brings MIT faculty and their "MOOC" courses to many thousands of learners everywhere.

- Open educational resources (OER). The OER movement, pioneered in large part by MIT's OpenCourseWare project—and since joined by hundreds more institutions worldwide—lowers financial, geographical, and political barriers to accessing quality educational content.

- Learning analytics and educational data mining. Online learning systems have the ability to amass huge volumes of data on student use, navigation, and assessment as they work their way through courses. In the aggregate, these data can be used to model student learning approaches and performance. So, for example, it is now possible to monitor and predict students' learning performance and spot potential issues early so that automated or instructor-initiated interventions can be provided. MIT faculty and other collaborators use these data for educational research to advance understanding of how people learn and identify effective pedagogical strategies.

- Online software innovations. New tools such as internet labs, gaming, MIT STAR (Software Tools for Academics and Researchers), and other resources provide adaptive learning aids that present educational materials according to students' varying needs and learning styles. MIT faculty have conceived and implemented many teaching tools, simulations, and learning aids. One remarkable example: iLabs enriches science and engineering education by enabling students to use real instruments via remote online laboratories. Unlike conventional laboratories, iLabs can be shared via the Internet, delivering the educational benefits of hands-on experimentation both to our own students and to students around the world.

In 2012, MIT established the Office of Digital Learning (ODL) to harness the Institute's educational technology resources to ensure that MIT remains at the forefront of developments like these. The new ODL integrates formerly independent organizational units related to digital learning into a structure that focuses on these strategic priorities:

1. Residential Education. Collaborate with faculty to explore, test, and institutionalize pedagogical models that enhance MIT education through digital and open learning technology and practices.

2. Open Education. Build out MIT's edX portfolio with exemplary courses and modules, and continue to publish new and updated MIT course materials and other teaching/learning resources through MIT OpenCourseWare, enabling global access to MIT courses and ideas.

3. Strategic Education Initiatives. Undertake open education and digital learning experiments and implementations, sometimes in collaboration with other institutions.

4. Digital Learning Research. Encourage and support digital learning research across MIT, and seek opportunities to exchange data, research and lessons about digital learning.

http://odl.mit.edu/

Research Laboratories, Centers, and Programs

In addition to teaching and conducting research within their departments, faculty, students, and staff work in laboratories, centers, and programs.

Some of these include:

Center for Advanced Urbanism
Center for Archaeological Materials
Center for Biomedical Engineering
Center for Civic Media
Center for Collective Intelligence
Center for Computational Engineering
Center for Computational Research in Economics and Management Science
Center for Educational Computing Initiatives
Center for Energy and Environmental Policy Research
Center for Environmental Health Sciences
Center for Global Change Science
Center for Gynepathology Research
Center for International Studies
Center for Materials Science and Engineering
Center for Real Estate
Center for Transportation and Logistics
Computer Science and Artificial Intelligence Laboratory
Deshpande Center for Technological Innovation
Division of Comparative Medicine
Francis Bitter Magnet Laboratory
Haystack Observatory
Institute for Medical Engineering and Science
Institute for Soldier Nanotechnologies
Institute for Work and Employment Research
Joint Program on the Science and Policy of Global Change
Knight Science Journalism Program
David H. Koch Institute for Integrative Cancer Research
Laboratory for Financial Engineering
Laboratory for Information and Decision Systems
Laboratory for Manufacturing and Productivity
Laboratory for Nuclear Science
Lean Advancement Initiative
Legatum Center for Development and Entrepreneurship
Lincoln Laboratory
Martin Trust Center for MIT Entrepreneurship
Materials Processing Center
McGovern Institute for Brain Research
Media Laboratory
Microsystems Technology Laboratories
MIT Catalyst Clinical Research Center
MIT Center for Art, Science, and Technology
MIT Center for Digital Business
MIT Energy Initiative
MIT Kavli Institute for Astrophysics and Space Research
MIT Portugal Program
MIT Professional Education
MIT Program in Art, Culture and Technology
MIT Sea Grant College Program
Nuclear Reactor Laboratory
Operations Research Center
Picower Institute for Learning and Memory
Plasma Science and Fusion Center
Research Laboratory of Electronics
Simons Center for the Social Brain
Singapore-MIT Alliance for Research and Technology
Sociotechnical Systems Research Center
Spectroscopy Laboratory

http://web.mit.edu/research/

Academic and Research Affiliations

Collaborative Partnership

edX

A not-for-profit enterprise of its founding partners Harvard University and the Massachusetts Institute of Technology, edX is focused on transforming online and on-campus learning through groundbreaking methodologies, game-like experiences, and cutting-edge research on an open source platform. See pages 12-13 for more information.

Idaho National Laboratory

The Idaho National Laboratory (INL) is dedicated to supporting the U.S. Department of Energy's missions in nuclear and energy research, science, and national defense. The INL established a National Universities Consortium (NUC) of universities from around the nation to engage in collaborative research in the nation's strategic nuclear energy objectives. The NUC consists of MIT, Oregon State University, North Carolina State University, The Ohio State University, and University of New Mexico.

https://www.inl.gov/inl-initiatives/education/nuc/

Magellan Project

The Magellan Project is a five-university partnership that constructed, and now operates, two 6.5-meter optical telescopes at the Las Campanas Observatory in Chile. The telescopes allow researchers to observe planets orbiting stars in solar systems beyond our own and to explore the first galaxies that formed near the edge of the observable universe. Collaborating with MIT on the Magellan Project are Carnegie Institute of Washington, Harvard University, University of Arizona, and University of Michigan.

Massachusetts Green High Performance Computing Center

The Massachusetts Green High Performance Computing Center (MGHPCC) is a collaboration of five of the state's most research-intensive universities—Boston University, Harvard University, MIT, Northeastern University, and the University of Massachusetts—the Commonwealth of Massachusetts, CISCO, and EMC. The MGHPCC is a datacenter dedicated to providing the growing research computing capacity needed to support breakthroughs in science.

http://www.mghpcc.org/

MIT and Masdar Institute Cooperative Program

A collaboration between MIT and the government of Abu Dhabi to establish a graduate research university focused on alternative energy, sustainability, and advanced technology. The MIT and Masdar Institute Cooperative Program supports Abu Dhabi's goal of developing human capital for a diversified knowledge-based economy. See page 100 for more information.

Northeast Radio Observatory Corporation

The Northeast Radio Observatory Corporation (NEROC) is a nonprofit consortium of educational and research institutions that was formed in 1967 to plan an advanced radio and radar research facility in the Northeast. NEROC consists of nine educational and research institutions, these are MIT, Boston University, Brandeis University, Dartmouth College, Harvard University, Harvard-Smithsonian Center for Astrophysics, University of Massachusetts, University of New Hampshire, and Wellesley College.

http://www.haystack.mit.edu/hay/neroc.html

Singapore-MIT Alliance for Research and Technology Centre

The Singapore-MIT Alliance for Research and Technology (SMART) Centre is a major research enterprise established by MIT in partnership with the National Research Foundation of Singapore. The SMART Centre serves as an intellectual hub for research interactions between MIT and Singapore at the frontiers of science and technology. See page 98 for more information.

http://smart.mit.edu/

MIT Skoltech Initiative

The MIT Skoltech Initiative is a multi-year collaboration between the Skolkovo Foundation, The Skolkovo Institute of Technology (Skoltech), and MIT to help conceive and launch a new concept for a graduate university focused on a small number of pressing global issues and designed to stimulate the development of a research and innovation ecosystem in Russia. See page 98 for more information.

Synthetic Biology Engineering Research Center

The Synthetic Biology Engineering Research Center (Synberc) is a multi-institution research effort to lay the foundation for synthetic biology. The core universities partners are MIT, University of California at Berkeley, University of California at San Francisco, Harvard University, and Stanford University. Synberc foundational research will be motivated by pressing biotechnology applications.

http://synberc.org/

Major Collaborator

Broad Institute

The Broad Institute seeks to transform medicine by empowering creative and energetic scientists of all disciplines from across the MIT, Harvard, and Harvard-affiliated hospital communities to work together to address even the most difficult challenges in biomedical research. The Broad Institute was founded in 2003; Eli and Edythe Broad, MIT, and Harvard University were founding partners.

http://www.broadinstitute.org/

Charles Stark Draper Laboratory

Founded as MIT's Instrumentation Laboratory, Draper Laboratory separated from MIT in 1973 to become an independent not-for-profit research and educational organization. Much of Draper's current research and development focuses on problems that arise in the measurement, analysis, simulation, and control of complex dynamic systems. This research and development covers a wide range of application areas, including guidance, navigation and control, microsystems, complex reliable systems, autonomous systems, information and decision systems, biomedical and chemical systems, secure networking and communications, energy systems, and commercial space systems.

http://www.draper.com/

Howard Hughes Medical Institute

The Howard Hughes Medical Institute (HHMI) is a scientific and philanthropic organization that conducts biomedical research in collaboration with universities, academic medical centers, hospitals, and other research institutions throughout the country. Seventeen HHMI investigators hold faculty appointments at MIT.

http://www.hhmi.org/

Ragon Institute of MGH, MIT and Harvard

The Ragon Institute was established at Massachusetts General Hospital, MIT, and Harvard in February 2009. The Institute brings scientists and clinicians together with engineers in an interdisciplinary effort to better understand how the body fights infections and, ultimately, to apply that understanding against a wide range of infectious diseases and cancers. The dual mission of the Institute is to contribute to the discovery of an HIV/AIDS vaccine and the collaborative study of immunology.

http://ragoninstitute.org/

Whitehead Institute for Biomedical Research

The Whitehead Institute for Biomedical Research is a nonprofit, independent research institution whose research excellence is nurtured by the collaborative spirit of its faculty and the creativity and dedication of its graduate students and postdoctoral scientists. Whitehead's primary focus is basic science, with an emphasis on molecular and cell biology, genetics and genomics, and developmental biology. Specific areas of inquiry at Whitehead include cancer, transgenic science, stem cells, regenerative biology, genetics, genomics, membrane biology, vertebrate development, and neurological disorders. Whitehead is affiliated with MIT through its members, who hold faculty positions at MIT. A small number of junior investigators also hold positions at Whitehead Institute as part of the Whitehead Fellows program.

http://wi.mit.edu/

Other Affiliation

MIT-Woods Hole Oceanographic Institution Joint Program in Oceanography and Applied Ocean Science and Engineering

The Woods Hole Oceanographic Institution (WHOI) is the largest independent oceanographic institution in the world. The MIT/WHOI Joint Program provides a high quality doctoral education leading to an internationally-recognized Ph.D. degree awarded by both institutions. The Joint Program is organized within five sub-disciplinary areas, each administered by a Joint Committee consisting of MIT faculty and WHOI scientists: Applied Ocean Science and Engineering, Biological Oceanography, Chemical Oceanography, Marine Geology and Geophysics, and Physical Oceanography.

http://mit.whoi.edu/

Naval Construction and Engineering

The graduate program in Naval Construction and Engineering (Course 2N) is intended for active duty officers in the U.S. Navy, U.S. Coast Guard, and foreign Navies who have been designated for specialization in the design, construction, and repair of naval ships. The curriculum prepares Navy, Coast Guard, and foreign officers for careers in ship design and construction and is sponsored by Commander, Naval Sea Systems Command. Besides providing the officers a comprehensive education in naval engineering, the program emphasizes their future roles as advocates for innovation in ship design and acquisition.

http://web.mit.edu/2n/

Reserve Officer Training Corps Programs

Military training has existed at MIT since students first arrived in 1865. In 1917, MIT established the nation's first Army Reserve Officer Training Corps (ROTC) unit. Today, Air Force, Army, and Naval ROTC units are based at MIT. These programs enable students to become commissioned military officers upon graduation. More than 12,000 officers have been commissioned from MIT, and more than 150 have achieved the rank of general or admiral.

https://due.mit.edu/rotc/rotc-programs/

Study at Other Institutions

MIT has cross-registration arrangements with several area schools. At the undergraduate level, students may cross-register at Harvard University, Wellesley College, Massachusetts College of Art and Design, and the School of the Museum of Fine Arts. At the graduate level, qualified students may enroll in courses at Harvard University, Wellesley College, Boston University, Brandeis University, and Tufts University. International study opportunities including the Cambridge-MIT Exchange, departmental exchanges, and the MIT-Madrid Program are described on page 101.

Initiatives

Initiatives are created to serve the advancement of education and research. A selection of these initiatives are described here.

Convergence

Convergence is the merging of distinct technologies, processing disciplines, or devices into a unified whole that creates a host of new pathways and opportunities. It involves the coming together of different fields of study—particularly engineering, physical sciences, and life sciences—through collaboration among research groups and the integration of approaches that were originally viewed as distinct and potentially contradictory. Convergence means a broad rethinking of how all scientific research can be conducted, so that we capitalize on a range of knowledge bases, from microbiology to computer science to engineering design.

Convergence is a blueprint for innovation. It takes the tools and approaches of one field of study and applies them to another, paving the way for advances in all of the fields involved. Just as engineering and physical science are transforming the life sciences, biological models are transforming engineering and physical science: Advances in biofuels, biomaterials, and viral self-assembly are just a few examples of this reciprocal relationship.

A number of university-housed centers have already emerged as showcases of convergence, providing the intellectual and research space for life scientists to interact and collaborate with physical scientists and engineers. For example, the National Cancer Institute created Centers of Cancer Nanotechnology Excellence—one being the MIT-Harvard Center of Cancer Nanotechnology Excellence—for interdisciplinary and cross-university projects. These centers are pursuing a variety of activities, including developing nanoscale devices for targeted drug delivery, for diagnostics, for noninvasive brain imaging, and for molecular sensing of cancers, with an emphasis on prostate, brain, lung, ovarian, and colon cancers.

http://www.convergencerevolution.net/

Cybersecurity Initiatives

In 2015 MIT launched three campus-wide cybersecurity efforts aimed at addressing the technical, regulatory and managerial aspects of cybersecurity. The MIT Cybersecurity Policy Initiative (CPI), Cybersecurity@CSAIL, and the MIT Sloan's Interdisciplinary Consortium for Improving Critical Infrastructure Cybersecurity (IC)3 are intended to provide a cohesive, cross-disciplinary strategy to tackling the complex problems involved in keeping digital information safe.

Cybersecurity Policy Initiative (CPI) is overseen by the Vice President for Research and is administered by CSAIL. It is funded by a generous gift from the Hewlett Foundation and focuses a cross disciplinary engineering, social science and management team on developing a more sophisticated understanding of the security behavior of large-scale digital systems. The team will establish quantitative metrics and qualitative models to help inform and generate collaboration amongst decision makers in policy, industry, law, economics and technology.

Cybersecurity@CSAIL is focused on the technical aspects of preventing, working through and recovering from web-based attacks. The effort engages a small group of member companies and CSAIL researchers with the aim of addressing the technical challenges of cybersecurity more holistically. The CSAIL approach is to develop technologies that prevent even the most sophisticated attacks systematically rather than manage attacks retroactively.

MIT Sloan's Interdisciplinary Consortium for Improving Critical Infrastructure Cybersecurity $(IC)^3$ addresses the strategic, managerial and operational issues related to cybersecurity of the nation's critical infrastructure, ranging from energy and healthcare to financial services. An MIT cross disciplinary team lead by Sloan, along with industry partners, looks to address such issues as risk analysis, return on cybersecurity investment, application of cybersafety models, incentives for more effective information sharing, methods for disrupting the cybercrime ecosystem, and metrics and models to better protect organizations.

Environmental Solutions Initiative

The Environmental Solutions Initiative (ESI) is designed to leverage the traditionally open atmosphere at MIT, which fosters interactions among people working in very different fields of study. That spirit of collaboration, and the possibilities it unleashes, are very powerful. ESI is designed to advance new interdisciplinary approaches spanning science, engineering, management, policy, and more to help drive the kind of progress required in time to make a difference.

MIT is already a powerhouse of environmentally oriented research and innovation. ESI is building on this vibrant foundation using seed grants to encourage new, cross-disciplinary research partnerships that advance progress and solutions on issues of environmental significance to humanity. A total of 59 teams of faculty, research staff and students responded to the first call for proposals, from which nine winners were announced on March 13, 2015. Projects will ramp up over the summer to start in September.

Education—both curricular and experiential—is also integral to ESI's mission. Understanding the essential relationship between environmental quality and human welfare must become an essential part of MIT's basic educational message delivered in the classroom, in the lab and in the field. To that end, ESI has formed a special Education Committee composed of faculty, staff and students to advance this agenda, with an immediate focus on creating a new Institute Minor in Environment and Sustainability.

http://environmentalsolutions.mit.edu/

Innovation Initiative

The MIT Innovation Initiative is an ambitious, Institute-wide multi-year agenda lead by faculty Co-Directors from the School of Engineering and the Sloan School of Management to transform the Institute's innovation ecosystem—internally, around the globe, and with its partners—for accelerated impact well into the 21st century. It builds upon MIT's foundation of fundamental research excellence and supports the aspirations for impact through innovation of all members of the MIT community. It supports MIT's focus on solving a range of critical challenges in energy, the health of the planet, human health and beyond.

The Initiative advances four tightly connected parts designed to focus the Institute's efforts on scalable innovation with impact:

- Focus on enhancing capabilities for idea-to-impact education and research. MIT strives to become the world leader in fostering idea-to-impact education—an approach to teaching and learning that doesn't simply expand knowledge of an academic discipline, but contributes to our culture and economy. In addition, research is supplemented with activities and programs designed to extend the endpoint beyond publication to practical solutions to real world challenges.

- Foster innovation communities. In order to enable students, faculty and external partners to maximize impact on the innovation economy, we are fostering vibrant innovation communities that connect stakeholders across industries and sectors. These innovation communities bring together the five major stakeholder groups—entrepreneurs, academics, corporates, risk capitalists and government officials—to dive deeply into problem exploration, research and implementation of solutions at scale.

- Rewire our human capital, physical and digital infrastructure to accelerate innovation. We are creating new labs, new spaces for scale up, new funding mechanisms and new human capital roles on campus to foster innovation on a global scale. Through changes on campus as well as a global network of "innovation embassies" we are putting in place the foundations that provide the knowledge, tools and networks that empower our community to turn ideas into important solutions worldwide.

- Develop the science of innovation to inform action and policy. While the practice of innovation is an art, the innovation process—its drivers and outcomes—can be the subject of rigorous, multi-disciplinary analysis. The world is our laboratory, and so as we strive to increase our impact, the Innovation Initiative seeks to develop the science of innovation and understand how innovation is generated more constructively, efficiently and effectively. By evaluating our successes and failures, we are pioneering this new discipline, increasing our convening power in the global innovation economy and developing key evidence-based policy recommendations.

http://innovation.mit.edu/

Abdul Latif Jameel World Water and Food Security Lab (J-WAFS)

The new Abdul Latif Jameel World Water and Food Security Lab (J-WAFS) serves to organize and promote food and water research around campus, emphasizing innovation and deployment of effective technologies, programs, and policies in order to have measurable impact as humankind adapts to a rapidly changing planet and combats water and food-supply scarcity. The lab aims to address the collective pressures of population growth, urbanization, development, and climate change—factors that endanger food and water systems in developing and developed countries alike. To accomplish this, the lab seeks to develop broad-based approaches employing MIT's interdisciplinary strengths and expertise in science, engineering and technology, climate and hydrology, energy and urban design, business, social science, and policy. J-WAFS, as an interdepartmental lab reporting to the Vice President for Research, aims to spearhead the efforts of MIT's faculty, labs, and centers to work towards solutions for water and food security that are environmentally benign and energy-efficient, including the development of transformative water and food technologies. These efforts will be supported in part through seed grants distributed competitively to MIT researchers from J-WAFS' endowment, established in 2014 through a generous gift by alumnus Mohammed Abdul Latif Jameel '78.

J-WAFS will also seek to partner with other institutions, foundations, industry, philanthropists, and governments to develop regionally appropriate solutions and innovations, whether for fast-growing megacities or for the rural developing world. Water supply in urban settings, for example, may benefit from conservation policies and infrastructure-scale systems, whereas rural populations may need small-scale, locally powered water purifiers. Ensuring stable food supplies requires a similarly varied approach that engages technology, biological and environment science, policy, and business innovation. J-WAFS also aims to support graduate student-driven food and water research and business communities on campus, through fellowships, conference sponsorship, and other mentoring and assistance.

http://web.mit.edu/jwafs/

MIT Energy Initiative

The MIT Energy Initiative (MITEI) works to help transform global energy systems. It is a research, education, and outreach program that, in its depth and breadth, is without peer at U.S. academic institutions. An Institute-wide initiative, MITEI pairs MIT's world-class research teams with key players across the innovation spectrum to help improve today's energy systems and shape tomorrow's global energy marketplace. It is also a resource for policy makers and the public, providing unbiased analysis and serving as an honest broker for industry and government. MITEI has more than 68 industry and public partners and has funded more than 128 novel or early-stage energy research projects submitted by faculty from across MIT.

MITEI's educational offerings combine single-discipline depth with multidiscipline breadth, transforming the MIT campus into an energy learning laboratory. In the 2013–2014 academic year, the fifth and largest class of undergraduate Energy Minor students graduated from MIT: 35 students with majors from all five MIT Schools. Students overwhelmingly report positive experiences with the Minor, particularly regarding its multidisciplinary, project-based approach. MITEI is committed to ensuring that the Energy Minor experience continues to be powerfully integrative. This is an important challenge: teaching resources at MIT are typically distributed along departmental lines. Interdisciplinary subjects are not priorities for departmental resources, and thus we continue to seek creative ways to provide ongoing support for classes that bring faculty and instructors from multiple departments—even multiple schools—together to teach energy.

In June 2014, The Hoover Institution and MITEI released the product of a multiyear collaboration: *Game Changers: Energy on the Move*. The book, which highlights the historic and current effects of five research and development efforts from U.S. universities, stresses the importance of sustained support for basic energy research and development if the United States is to meet its goal of a cheaper, cleaner, and more secure national energy system.

Drawing from the efforts of Stanford University, MIT, and other leading university research centers, the book describes innovations that are transforming our energy landscape and how these innovations, now vital to our national energy economy, had their roots in previous university-based basic scientific research: natural gas from shale, solar photovoltaics, grid-scale electricity storage, electric cars, and LED lighting.

For more information on Game Changers, visit http://www.energygamechangers.org.

http://mitei.mit.edu/

Education Highlights

MIT has long maintained that professional competence is best fostered by coupling teaching with research and by focusing education on practical problems. This hands-on approach has made MIT a consistent leader in outside surveys of the nation's best colleges. MIT was the first university in the country to offer curriculums in architecture (1865), electrical engineering (1882), sanitary engineering (1889), naval architecture and marine engineering (1895), aeronautical engineering (1914), meteorology (1928), nuclear physics (1935), and artificial intelligence (1960s). More than 4,000 MIT graduates are professors at colleges and universities around the world. MIT faculty have written some of the best-selling textbooks of all time, such as *Economics* by Paul A. Samuelson and *Calculus and Analytic Geometry* by George Thomas. The following are some notable MIT teaching milestones since 1968.

1968 MIT and Woods Hole Oceanographic Institute create a joint program for graduate studies in oceanography. This is the first higher education partnership of its kind.

1969 MIT launches the Undergraduate Research Opportunities Program (UROP), the first of its kind. The program, which enables undergraduates to work directly with faculty on professional research, subsequently is copied in universities throughout the world.

1970 The Harvard-MIT Program in Health Sciences and Technology is established to focus advances in science and technology on human health and to train physicians with a strong base in engineering and science.

1970 Department of Mechanical Engineering initiates the course 2.70 (now 2.007) design contest, created by professor Woodie C. Flowers. The competition was to build a mechanical device, out of a set of relatively simple wooden and metal parts, that would roll down a ramp at a precisely controlled rate.

1971 MIT holds its first Independent Activities Period (IAP), a January program that emphasizes creativity and flexibility in teaching and learning.

1974 The Minority Introduction to Engineering and Science (MITES) program is established to provide a rigorous six-week residential, academic summer program for promising high school juniors who are interested in careers in science and engineering.

1977 Whitaker College of Health Sciences, Technology, and Management is established to strengthen MIT's ability to engage in health related research and education.

1977 MIT organizes the Program in Science, Technology, and Society to explore and teach courses on the social context and consequences of science and technology—one of the first programs of its kind in the U.S.

1981 MIT-Japan Program is created to send MIT students to Japan for internships. In 1994, the program becomes part of the MIT International Science and Technology Initiatives (MISTI). Today, the program also fosters research collaboration between faculty at MIT and in Asia through the MISTI Hayashi Seed Fund.

1981 MIT launches Project Athena, a $70 million program to explore the use of computers in education. Digital Equipment Corporation and IBM each contribute $25 million in computer equipment.

1981 The MIT Sloan School of Management launches its Management of Technology program, the world's first master's program to focus on the strategic management of technology and innovation.

1983 MIT establishes the Center for Real Estate and the first Master of Science in Real Estate Development (MSRED) degree program in the U.S.

1983–1990 MIT language and computer science faculty join in the Athena Language Learning Project to develop interactive videos that immerse students in the language and character of other cultures. The work pioneers a new generation of language learning tools.

1984 MIT establishes the Media Laboratory, bringing together pioneering educational programs in computer music, film, graphics, holography, lasers, and other media technologies.

1990 MIT initiates an artist-in-residence program to provide students with opportunities to interact with nationally and internationally recognized artists through master classes, lecture-demonstrations, performances and workshops.

1991 The Department of Mechanical Engineering's course 2.70 (2.007) design contest goes international, with students competing from Japan, England and Germany.

1992 MIT establishes the MacVicar Faculty Fellows Program, named in honor of the late Margaret A. MacVicar, to recognize outstanding contributions to teaching. MacVicar, a professor of physics, had conceived of, designed, and launched UROP (see 1969, above).

1992 MIT launches the Laboratory for Advanced Technology in the Humanities to extend its pioneering work in computer- and video-assisted language learning to other disciplines. Its first venture was a text and performance multimedia archive for studies of Shakespeare's plays.

1992 MIT Faculty approves the M.Eng. program in Electrical Engineering and Computer Science, an integrated five-year program leading to the simultaneous award of a bachelor's and a master's degree.

1993 In recognition of the increasing importance of molecular and cell biology, MIT becomes the first college in the nation to add biology to its undergraduate requirement.

1994 The MIT International Science and Technology Initiatives (MISTI) are created to connect MIT students to internships and research around the world. MIT's primary international program, MISTI is a pioneer in applied international studies—a distinctively MIT concept.

1994 The MIT-China Program is created within MISTI to send MIT students to China for internships.

1995 The School of Engineering and the Sloan School of Management join to create a graduate program in system design and management (SDM), in which students can complete most course requirements at their job sites through interactive distance-learning.

1995 MIT's Political Science Department establishes the Washington Summer Internship Program to provide undergraduates the opportunity to apply their scientific and technical training to public policy issues.

1997 The MIT-Germany Program is created within MISTI to send MIT students to Germany for internships.

1998 MIT teams up with Singapore's two leading research universities to create a global model for long-distance engineering education and research. This large-scale experiment, the first truly global collaboration in graduate engineering education and research, is a model for today's distance education.

1998 MIT-India Program is created within MISTI to send MIT students to India for internships.

1998 The Division of Bioengineering & Environmental Health (BEH) begins operation with the mission of fostering MIT education and research fusing engineering with biology.

1998 The School of Engineering establishes the Engineering Systems Division (ESD), focused on the development of new approaches, frameworks, and theories to better understand engineering systems behavior and design.

1999 MIT-Italy Program is created within MISTI to send MIT students to Italy for internships.

1999 The University of Cambridge and MIT establish the Cambridge-MIT Institute, whose programs include student and faculty exchanges, an integrated research program, professional practice education, and a national competitiveness network in Britain.

1999 MIT establishes the Society of Presidential Fellows to honor the most outstanding students worldwide entering the Institute's graduate programs. With gifts provided by lead donors, presidential fellows are awarded fellowships that fund first year tuition and living expenses.

2000 MIT Faculty approve the Communication Requirement (CR), which went into effect for the Class of 2005. The CR integrates substantial instruction and practice in writing and speaking into all four years and across all parts of MIT's undergraduate program. Students participate regularly in activities designed to develop both general and technical communication skills.

2001 Studio Physics is introduced to teach freshman physics. Incorporating a highly collaborative, hands-on environment that uses networked laptops and desktop experiments, the new curriculum lets students work directly with complicated and unfamiliar concepts as their professors introduce them.

2001 MIT launches OpenCourseWare, a program that makes materials for nearly all of its courses freely available on the web and serves as a model for sharing knowledge to benefit all humankind.

2001 The MIT-France Program is created within MISTI to send MIT students to France for internships and enhance research collaboration between faculty at MIT and in France through the MIT-France Seed Fund.

2001 MIT establishes WebLab, a microelectronics teaching laboratory that allows students to interact remotely on the Web with transistors and other microelectronics devices anywhere and at any time.

2001 MIT's Earth System Initiative launches Terrascope, a freshman course in which students work in teams to solve complex earth sciences problems. Bringing together physics, mathematics, chemistry, biology, management, and communications, the course has enabled students to devise strategies for preserving tropical rainforests, understand the costs and the benefits of oil drilling in the Arctic National Wildlife Refuge, and plan a mission to Mars.

2002 To give engineering students the opportunity to develop the skills they'll need to be leaders in the workplace, MIT introduces the Undergraduate Practice Opportunities Program (UPOP). The program involves a corporate training workshop, job seminars taught by alumni, and a 10-week summer internship.

2003 MIT Libraries introduce DSpace, a digital repository that gathers, stores, and preserves the intellectual output of MIT's faculty and research staff, and makes it freely available to research institutions worldwide. Within a year of its launch, DSpace material had been downloaded more than 8,000 times, and more than 100 organizations had adopted the system for their own use.

2003 MIT's Program in Computational and Systems Biology (CSBi), an Institute-wide program linking biology, engineering, and computer science in a systems biology approach to the study of cell-to-cell signaling, tissue formation, and cancer, begins accepting students for a new Ph.D. program that will give them the tools for treating biological entities as complex living systems.

2004 The MIT-Mexico Program is created within MISTI to send MIT students to Mexico for internships.

2005 Combining courses from engineering, mathematics, and management, MIT launches its master's program in Computation for Design and Optimization, one of the first curriculums in the country to focus on the computational modeling and design of complex engineered systems. The program prepares engineers for the challenges of making systems ranging from computational biology to airline scheduling to telecommunications design and operations run with maximum effectiveness and efficiency.

2006 MIT creates the Campaign for Students, a fund-raising effort dedicated to enhancing the educational experience at MIT through creating scholarships and fellowships, and supporting multidisciplinary education and student life.

2006 The MIT-Spain Program is created within MISTI to send MIT students to Spain for internships.

2007 MIT makes material from virtually all MIT courses available online for free on OpenCourseWare. The publication marks the beginning of a worldwide movement toward open education that now involves more than 160 universities and 5,000 courses.

2008 The MIT-Israel Program is created within MISTI to train and send MIT students to Israel for internships; strengthen collaborations between MIT and Israel; and organize workshops, conferences, symposia and lectures at MIT and in Israel.

2009 MIT launches the Bernard M. Gordon-MIT Engineering Leadership Program. Through interaction with industry leaders, faculty, and fellow students, the program aims to help undergraduate engineering students develop the skills, tools, and character they will need as future engineering leaders.

2009 The MIT-Brazil Program is created within MISTI to send MIT students to Brazil for internships and encourage research collaboration between faculty at MIT and in Brazil through the MIT-Brazil Seed Fund.

2009 MIT introduces a minor in energy studies, open to all undergraduates. The new minor, unlike most energy concentrations available at other institutions, and unlike any other concentration at MIT, is designed to be inherently cross-disciplinary, encompassing all of MIT's five schools. It can be combined with any major subject. The minor aims to allow students to develop expertise and depth in their major disciplines, but then complement that with the breadth of understanding offered by the energy minor.

2010 MIT introduces the flexible engineering degree for undergraduates. The degree, the first of its kind, allows students to complement a deep disciplinary core with an additional subject concentration. The additional concentration can be broad and interdisciplinary in nature (energy, transportation, or the environment), or focused on areas that can be applied to multiple fields (robotics and controls, computational engineering, or engineering management).

2011 MIT announces MITx, an online learning initiative that will offer a portfolio of free MIT courses through an online interactive learning platform. The Institute expects the platform to enhance the educational experience of its on-campus students and serve as a host for a virtual community of millions of learners around the world. The MITx prototype course—6.002x or "Circuits and Electronics"—debuts in March 2012 with almost 155,000 people registering for the course.

2012 MIT and Harvard University announce edX, a transformational new partnership in online education. Through edX, the two institutions will collaborate to enhance campus-based teaching and learning and build a global community of online learners. An open-source technology platform will deliver online courses that move beyond the standard model of online education that relies on watching video content and will offer an interactive experience for students. The University of California at Berkeley later joins edX. The three institutions offer the first edX courses in fall 2012.

2012 Lincoln Laboratory debuts a new outreach program—a two-week summer residential program for high-school students. The program, Lincoln Laboratory Radar Introduction for Student Engineers, focuses on radar technology. The project-based curriculum is based on a popular class offered during MIT's Independent Activities Period (IAP) and taught by Laboratory technical staff. While the instructors adapted the IAP course to suit high-school students, they retained the challenging nature of the original class. The goal of the program is that students take away not only an understanding of radar systems but also the realization that engineering is about problem-solving and applying knowledge in innovative ways.

Research Highlights

The following are selected research achievements of MIT faculty and staff over the last five decades.

1967 Joel Moses, William A. Martin, and others develop MACSYMA, a computer program that manipulates algebraic quantities and performs symbolic integration and differentiation.

1968 Radar-based lunar studies are performed by Lincoln Laboratory. The use of radar to map the surface of the moon becomes possible when the radar beam is made small enough to discriminate between two points on the surface that would contribute echoes at the same range and Doppler shift. Altitude data is added to the two-dimensional radar reflectivity data by the use of interferometry. In addition, from the strength of radar reflections, it is estimated that the lunar surface has weight-bearing properties similar to that of terrestrial sand.

1969 Ioannis V. Yannas begins to develop artificial skin—a material used successfully to treat burn victims.

1970 David Baltimore reports the discovery of reverse transcriptase, an enzyme that catalyzes the conversion of RNA to DNA. The advance, which led to a Nobel Prize for Baltimore in 1975, provided a new means for studying the structure and function of genes.

1972 Lincoln Laboratory's Moving Target Detector (MTD) achieved a new performance level for the detection of aircraft in the presence of radar clutter, such as ground, weather, and birds. It employed an antenna with two fan beams to provide coverage from the immediate vicinity of an airport to a distance of 60 nautical miles. The MTD became the world-recognized standard for Airport Surveillance Radar.

1973 Jerome Friedman and Henry Kendall, with Stanford colleague Richard Taylor, complete a series of experiments confirming the theory that protons and neutrons are made up of minute particles called quarks. The three receive the 1990 Nobel Prize in Physics for their work.

1974 Samuel C. C. Ting, Ulrich Becker, and Min Chen discover the "J" particle. The discovery, which earns Ting the 1976 Nobel Prize in Physics, points to the existence of one of the six postulated types of quarks.

1975 The Lincoln Laboratory Experimental Test System (ETS) becomes operational. The ETS is used for deep-space surveillance, daylight satellite tracking, searching the geostationary belt, and making astronomical measurements.

1975–1977 Barbara Liskov and her students design the CLU programming language, an object-oriented language that helps form the underpinnings for languages like Java and C++. As a result of this work and other accomplishments, Liskov later wins the Turing Award, considered the Nobel Prize in computing.

1975–1982 Joel Moses develops the first extensive computerized program (MACSYMA) able to manipulate algebraic quantities and perform symbolic integration and differentiation.

1976 H. Gobind Khorana and his research team complete chemical synthesis of the first human-manufactured gene fully functional in a living cell. The culmination of 12 years of work, it establishes the foundation for the biotechnology industry. Khorana won the 1968 Nobel Prize in Physiology/Medicine for other genetics work.

1977 Phillip Sharp discovers the split gene structure of higher organisms, changing the view of how genes arose during evolution. For this work, Sharp shared the 1993 Nobel Prize in Physiology/Medicine.

1977 Ronald Rivest, Adi Shamir, and Leonard Adleman invent the first workable public key cryptographic system. The new code, which is based on the use of very large prime numbers, allows secret communication between any pair of users. Still unbroken, the code is in widespread use today.

1979 The high frame rate required for airborne laser radar demands an array of photomixers, and Lincoln Laboratory begins a design study in binary optics for a solution. A hologram is proposed to generate an array of beams with the amplitude and phase distributions necessary to ensure efficient photomixing.

1979 Robert Weinberg reports isolating and identifying the first human oncogene—an altered gene that causes the uncontrolled cell growth that leads to cancer.

1981 Alan Guth publishes the first satisfactory model, called cosmic inflation, of the universe's development in the first 10–32 seconds after the Big Bang.

1982 Alan Davison discovers a new class of technetium compounds that leads to the development of the first diagnostic technetium drug for imaging the human heart.

1982 Lincoln Laboratory utilizes a new generation of digital signal processing chips to develop a compact linear predictive coding (LPC) vocoder small and inexpensive enough for wide distribution. A vocoder analyzes and synthesizes speech using parameters that can be encrypted and transmitted at a much lower bit rate than the original speech waveform. The LPC vocoder is important in the U.S. development of secure voice systems.

1985 Susumu Tonegawa describes the structure of the gene for the receptors—"anchor molecules"—on the white blood cells called T lymphocytes, the immune system's master cells. In 1987, Tonegawa receives the Nobel Prize in Physiology/Medicine for similar work on the immune system's B cells.

1985 The Terminal Doppler Weather Radar (TDWR) program is initiated at Lincoln Laboratory to develop an automated system for detecting weather hazards in the airport terminal area and to help pilots avoid them. A successful TDWR prototype led to the procurement of 47 TDWRs from Raytheon in the 1990s, and there has not been a major U.S. wind-shear-related accident since 1994.

1986 Stephen Benton creates the first free-standing hologram. In 1985, Benton began generating synthetic holograms from 3-D digital databases, initially creating a 3-D image of a green car floating in front of the Boston skyline.

1986 H. Robert Horvitz identifies the first two genes found to be responsible for the process of cell death, which is critical both for normal body development and for protection against autoimmune diseases, cancer, and other disorders. Going on to make many more pioneering discoveries about the genetics of cell death, Horvitz shares the 2002 Nobel Prize in Physiology/Medicine for his work.

1988 Project Daedalus sets distance and endurance records for human-powered aircraft in a flight over the Aegean Sea.

1988 Sallie Chisholm and associates report the discovery of a form of ocean plankton that may be the most abundant single species on earth.

1989 The Airport Surveillance Radar (ASR)-9, developed at Lincoln Laboratory, provides air traffic control (ATC) personnel with a display free of clutter and a telephone bandwidth data stream for transmitting information to ATC facilities. The technology was later transferred to Westinghouse Corporation, which deployed the ASR-9 at 137 sites in the United States for the Federal Aviation Administration.

1990 Julius Rebek, Jr. and associates create the first self-replicating synthetic molecule.

1990 Building on the discovery of the metathesis—the process of cutting carbon-carbon double bonds in half and constructing new ones—Richard Schrock devises a catalyst that greatly speeds up the reaction, consumes less energy, and produces less waste. A process based on his discovery is now in widespread use for efficient and more environmentally friendly production of important pharmaceuticals, fuels, synthetic fibers, and many other products. Schrock shares the 2005 Nobel Prize in Chemistry for his breakthrough.

1991 Cleveland heart doctors begin clinical trials of a laser catheter system for microsurgery on the arteries that is largely the work of Michael Feld and his MIT associates.

1992 The Lincoln Laboratory Microelectronics Laboratory becomes operational. It is a 70,000 sq ft state-of-the-art semiconductor research and fabrication facility supporting a wide range of programs: flight-quality gigapixel charge-coupled device (CCD) imager focal planes, photon-counting avalanche photodiode arrays, and niobium-based superconducting circuits, to name a few. The Microelectronics Laboratory also supports advanced packaging with a precision multichip module technology and an advanced three-dimensional circuit stacking technology.

1993 H. Robert Horvitz, together with scientists at Massachusetts General Hospital, discover an association between a gene mutation and the inherited form of amyotrophic lateral sclerosis (Lou Gehrig's disease).

1993 David Housman joins colleagues at other institutions in announcing a successful end to the long search for the genetic defect linked with Huntington's disease.

1993 Alexander Rich and postdoctoral fellow Shuguang Zhang report the discovery of a small protein fragment that spontaneously forms into membranes. This research will lead to advances in drug development, biomedical research, and the understanding of Alzheimer's and other diseases.

1993 The Traffic Alert and Collision Avoidance System (TCAS) is deployed. TCAS reduces midair collisions by sensing nearby aircraft and issuing an advisory to the pilot. Lincoln Laboratory developed the surveillance technology used by TCAS and built and flight-tested the TCAS prototype. Now mandated on all large transport aircraft, TCAS has been in operation for over a decade and has been credited with preventing several catastrophic accidents.

1994 MIT engineers develop a robot that can "learn" exercises from a physical therapist, guide a patient through them, and—for the first time—record biomedical data on the patient's condition and progress.

1995 The Advanced Land Imager (ALI) is developed at Lincoln Laboratory to validate new technologies that (1) could be utilized in future land-observing satellites and (2) would reduce mass, size, and power consumption while improving instrument sensitivity and image resolution.

1995 Scientists at the Whitehead Institute for Biomedical Research and MIT create a map of the human genome and begin the final phase of the Human Genome Project. This powerful map contains more than 15,000 distinct markers and covers virtually all of the human genome.

1996 A group of scientists at MIT's Center for Learning and Memory, led by Matthew Wilson and Nobel laureate Susumu Tonegawa, use new genetic and multiple-cell monitoring technologies to demonstrate how animals form memory about new environments.

1997 MIT physicists create the first atom laser, a device that is analogous to an optical laser but emits atoms instead of light. The resulting beam can be focused to a pinpoint or made to travel long distances with minimal spreading.

1998 MIT biologists, led by Leonard Guarente, identify a mechanism of aging in yeast cells that suggests researchers may one day be able to intervene in, and possibly inhibit, the aging process in certain human cells.

1998 Lincoln Near Earth Asteroid Research (LINEAR) is developed by Lincoln Laboratory to detect and catalogue near-Earth asteroids (NEAs) that may threaten Earth. Applying technology originally developed for the surveillance of Earth-orbiting satellites, LINEAR uses two ground-based electro-optical deep-space surveillance telescopes.

1998 An interdisciplinary team of MIT researchers, led by Yoel Fink and Edwin L. Thomas, invent the "perfect mirror," which offers radical new ways of directing and manipulating light. Potential applications range from a flexible light guide that can illuminate specific internal organs during surgery to new devices for optical communications.

1999 Michael Cima, Robert Langer, and graduate student John Santini report the first microchip that can store and release chemicals on demand. Among its potential applications is a "pharmacy" that could be swallowed or implanted under the skin and programmed to deliver precise drug dosages at specific times.

1999 Alexander Rich leads a team of researchers in the discovery that left-handed DNA (also known as Z-DNA) is critical for the creation of important brain chemicals. Having first produced Z-DNA synthetically in 1979, Rich succeeds in identifying it in nature in 1981. He also discovers its first biological role and receives the National Medal of Science for this pioneering work in 1995.

2000 Scientists at the Whitehead Institute/MIT Center for Genome Research and their collaborators announce the completion of the Human Genome Project. Providing about a third of all the sequences assembled, the Center was the single largest contributor to this international enterprise.

2000 Researchers develop a device that uses ultrasound to extract a number of important molecules noninvasively and painlessly through the skin. They expect that the first application will be a portable device for noninvasive glucose monitoring for diabetics.

2000 Researchers from the MIT Sloan School of Management launch the Social and Economic Explorations of Information Technology (SeeIT) Project, the first empirical study of the effects of information technology (IT) on organizational and work practices. Examining IT's relationship to changes in these models, SeeIT provides practical data for understanding and evaluating IT's business and economic effects, which will enable us to take full advantage of its opportunities and better control its risks.

2001 In a step toward creating energy from sunlight as plants do, Daniel Nocera and a team of researchers invent a compound that, with the help of a catalyst and energy from light, produces hydrogen.

2002 MIT researchers create the first acrobatic robotic bird—a small, highly agile helicopter for military use in mountain and urban combat.

2002–2005 Scientists at MIT, the Whitehead Institute for Biomedical Research, and the Broad Institute complete the genomes of the mouse, the dog, and four strains of phytoplankton, photosynthetic organisms that are critical for the regulation of atmospheric carbon dioxide. They also identify the genes required to create a zebrafish embryo. In collaboration with scientists from other institutions, they map the genomes of chimpanzees, humans' closest genetic relative, and the smallest known vertebrate, the puffer fish.

2003 Enhanced Regional Situation Awareness (ERSA) system is developed by Lincoln Laboratory for the U.S. Air Force to provide improved defense of the airspace surrounding the National Capital Region (NCR). ERSA capabilities have improved airspace surveillance, threat assessment and decision support, distribution of a common air picture to multiple agencies, and new ways to respond to aircraft violating the NCR airspace.

2003 MIT scientists cool a sodium gas to the lowest temperature ever recorded—a half-a-billionth of a degree above absolute zero. Studying these ultra-low temperature gases will provide valuable insights into the basic physics of matter; and by facilitating the development of better atomic clocks and sensors for gravity and rotation, they also could lead to vast improvements in precision measurements.

2004 MIT's Levitated Dipole Experiment, a collaboration among scientists at MIT and Columbia, generates a strong dipole magnetic field that enables them to experiment with plasma fusion, the source of energy that powers the sun and stars, with the goal of producing it on Earth. Because the hydrogen that fuels plasma fusion is practically limitless and the energy it produces is clean and doesn't contribute to global warming, fusion power will be of enormous benefit to humankind and to earth systems in general.

2004 A team, led by neuroscientist Mark Bear, illuminates the molecular mechanisms underlying Fragile X Syndrome and shows that it might be possible to develop drugs that treat the symptoms of this leading known inherited cause of mental retardation, whose effects range from mild learning disabilities to severe autism.

2004 Shuguang Zhang, Marc A. Baldo, and recent graduate Patrick Kiley, first figure out how to stabilize spinach proteins—which, like all plants, produce energy when exposed to light—so they can survive without water and salt. Then, they devise a way to attach them to a piece of glass coated with a thin layer of gold. The resulting spinach-based solar cell, the world's first solid-state photosynthetic solar cell, has the potential to power laptops and cell phones with sunlight.

2005 MIT physicists, led by Nobel laureate Wolfgang Ketterle, create a new type of matter, a gas of atoms that shows high-temperature superfluidity.

2005 Vladimir Bulovic and Tim Swager develop lasing sensors based on a semiconducting polymer that is able to detect the presence of TNT vapor subparts per billion concentrations.

2006 MIT launches the MIT Energy Initiative (MITEI) to address world energy problems. Led by Ernest J. Moniz and Robert C. Armstrong, MITEI coordinates energy research, education, campus energy management, and outreach activities across the Institute.

2007 Rudolf Jaenisch, of the Whitehead Institute for Biomedical Research, conducts the first proof-of-principle experiment of the therapeutic potential of induced pluripotent stem cells (iPS cells), using iPS cells reprogrammed from mouse skin cells to cure a mouse model of human sickle-cell anemia. Jaenisch would then use a similar approach to treat a model of Parkinson's disease in rats.

2007 Marin Soljačić and his colleagues develop a new form of wireless power transmission they call WITricity. It is based on a strongly coupled magnetic resonance and can be used to transfer power over distances of a few meters with high efficiency. The technique could be used commercially to wirelessly power laptops, cell phones, and other devices.

2007 David H. Koch '62, SM '63 gives MIT $100 million to create the David H. Koch Institute for Integrative Cancer Research. The Koch Institute opens in 2011. It brings together molecular geneticists, cell biologists, and engineers in a unique multi-disciplinary approach to cancer research.

2007 Tim Jamison discovers that cascades of epoxide-opening reactions that were long thought to be impossible can very rapidly assemble the Red Tide marine toxins when they are induced by water. Such processes may be emulating how these toxins are made in nature and may lead to a better understanding of what causes devastating Red Tide phenomena. These methods also open up an environmentally green synthesis of new classes of complex highly biologically active compounds.

2007 MIT mathematicians form part of a group of 18 mathematicians from the U.S. and Europe that maps one of the most complicated structures ever studied: the exceptional Lie group E8. The "answer" to the calculation, if written, would cover an area the size of Manhattan. The resulting atlas has applications in the fields of string theory and geometry.

2008 Mriganka Sur's laboratory discovers that astrocytes, star-shaped cells in the brain that are as numerous as neurons, form the basis for functioning brain imaging. Using ultra high-resolution imaging in the intact brain, they demonstrate that astrocytes regulate blood flow to active brain regions by linking neurons to brain capillaries.

2008 A team, led by Marc A. Baldo, designs a solar concentrator that focuses light at the edges of a solar power cell. The technology can increase the efficiency of solar panels by up to 50 percent, substantially reducing the cost of generating solar electricity.

2008 Daniel Nocera creates a chemical catalyst that hurdles one of the obstacles to widespread use of solar power—the difficulty of storing energy from the sun. The catalyst, which is cheap and easy to make, uses the energy from sunlight to separate the hydrogen and oxygen molecules in water. The hydrogen can then be burned, or used to power an electric fuel cell.

2009 Lincoln Laboratory, building on its expertise in sensors and architectures, develops and demonstrates the Lincoln Distributed Disaster Response System, which enables information from airborne platforms, distributed weather stations, GPS-enabled devices, and other sources to be shared by responders at the emergency command centers and by those equipped with ruggedized laptops at the front lines. The system design initially focuses on fighting a large-scale fire but is also applicable for any large-scale disaster response.

2009 A team of MIT researchers, led by Angela Belcher, reports that it is able to genetically engineer viruses to produce both the positively and negatively charged ends of a lithium-ion battery. The battery has the same energy capacity as those being considered for use in hybrid cars, but is produced using a cheaper, less environmentally hazardous process. MIT President Susan Hockfield presents a prototype battery to President Barack Obama at a press briefing at the White House.

2009 Researchers at MIT's Picower Institute for Learning and Memory show for the first time that multiple interacting genetic risk factors may influence the severity of autism symptoms. The finding could lead to therapies and diagnostic tools that target the interacting genes.

2009 Gerbrand Ceder and graduate student Byoungwoo Kang develop a new way to manufacture the material used in lithium ion batteries that allows ultrafast charging and discharging. The new method creates a surface structure that allows lithium ions to move rapidly around the outside of the battery. Batteries built using the new method could take seconds, rather than the now standard hours, to charge.

2009 Li-Huei Tsai's laboratory describes mechanisms that underlie Alzheimer's disease and propose that inhibition of histone deacetylases is therapeutic for degenerative disorders of learning and memory. Her laboratory also discovers the mechanisms of action of the gene Disrupted-in-Schizophrenia 1 and demonstrates why drugs such as lithium are effective in certain instances of schizophrenia. This research opens up pathways to discovering novel classes of drugs for devastating neuropsychiatric conditions.

2010 A new approach to desalination is being developed by researchers at MIT and in Korea that could lead to small, portable desalination units that could be powered by solar cells or batteries and could deliver enough fresh water to supply the needs of a family or small village. As an added bonus, the system would remove many contaminants, viruses, and bacteria at the same time.

2010 Yang Shao-Horn, with some of her students, and visiting professor Hubert Gasteiger, reports that lithium-oxygen (also known as lithium-air) batteries with electrodes with either gold or platinum as a catalyst have a higher efficiency than simple carbon electrodes. Lithium-air batteries are lighter than the conventional lithium-ion batteries.

2010 A team at Media Lab, including Ramesh Raskar, visiting professor Manuel Oliveira, student Vitor Pamplona, and postdoctoral research associate Ankit Mohan, create a new system to determine a prescription for eyeglasses. In its simplest form, the test can be carried out using a small, plastic device clipped onto the front of a cellphone's screen.

2010 MIT releases *The Future of Natural Gas* report. The two-year study, managed by the MIT Energy Initiative, examines the scale of U.S. natural gas reserves and the potential of this fuel to reduce greenhouse-gas emissions. While the report emphasizes the great potential for natural gas as a transitional fuel to help curb greenhouse gases and dependence on oil, it also stresses that it is important as a matter of national policy not to favor any one fuel or energy source in a way that puts others at a disadvantage.

2010 Michael Strano and his team of graduate students and researchers create a set of self-assembling molecules that can turn sunlight into electricity; the molecules can be repeatedly broken down and reassembled quickly just by adding or removing an additional solution.

2011 Elazer Edelman, HST graduate student Joseph Franses, and former MIT postdoctoral fellows Aaron Baker and Vipul Chitalia show that cells lining blood vessels secrete molecules that suppress tumor growth and prevent cancer cells from invading other tissues, a finding that could lead to a new cancer treatment.

2011 The Alpha Magnetic Spectrometer (AMS)—an instrument designed to use the unique environment of space to search for antimatter and dark matter and to measure cosmic rays—is delivered to the International Space Station. The AMS experiment, led by Samuel C. C. Ting, is designed to study high-energy particles; such study could lead to new theories about the formation and evolution of the universe.

2011 A team, including Karen Gleason, Vladimir Bulović, and graduate student Miles Barr, develops materials that make it possible to produce photovoltaic cells on paper or fabric, nearly as simply as printing a document. The technique represents a major departure from the systems typically used to create solar cells, which require exposing the substrates to potentially damaging conditions, either in the form of liquids or high temperatures.

2011 By combining a physical interface with computer-vision algorithms, researchers in MIT's Department of Brain and Cognitive Sciences create a simple, portable imaging system that can achieve resolutions previously possible only with large and expensive lab equipment. The device could allow manufacturers to inspect products too large to fit under a microscope and could also have applications in medicine, forensics, and biometrics. Moreover, because the design uses multiple cameras, it can produce 3-D models of an object, which can be manipulated on a computer screen for examination from multiple angles.

2011 Researchers, led by Daniel Nocera, have produced an "artificial leaf"—a silicon solar cell with different catalytic materials bonded onto its two sides. The artificial leaf can turn the energy of sunlight directly into a chemical fuel that can be stored and used later as an energy source.

2011 Lincoln Laboratory researchers, led by technical staff member Gregory Charvat, build a new radar technology system that can see through walls up to 60 feet away, creating an instantaneous picture of the activity on the other side. The system also creates a real-time video of movement behind the wall at the rate of 10.8 frames per second.

2012 NASA's Gravity Recovery And Interior Laboratory (GRAIL) twin spacecraft successfully enters lunar orbit. By precisely measuring changes in distance between the twin orbiting spacecraft, scientists will construct a detailed gravitational model of the moon that will be used to answer fundamental questions about the moon's evolution and its internal composition. GRAIL's principal investigator is Maria Zuber.

2012 Researchers, including Jeffrey Grossman, discover that building cubes or towers of solar cells—to extend the cells upward in three-dimensional configurations—generates two to 20 times the power produced by fixed flat panels with the same base area.

2012 Researchers, led by Ian Hunter, have engineered a device that delivers a tiny, high-pressure jet of medicine through the skin without the use of a hypodermic needle. The device can be programmed to deliver a range of doses to various depths—an improvement over similar jet-injection systems that are now commercially available.

2012 A clinical trial of an Alzheimer's disease treatment developed at MIT finds that a nutrient cocktail can improve memory in patients with early Alzheimer's. Richard Wurtman invented the supplement mixture, known as Souvenaid, which appears to stimulate growth of new synapses.

2012 Researchers, including Young Lee and PhD graduate Tianheng Han, have followed up on earlier theoretical predictions and demonstrated experimentally the existence of a fundamentally new magnetic state called a quantum spin liquid (QSL), adding to the two previously known states of magnetism. The QSL is a solid crystal, but its magnetic state is described as liquid: Unlike the other two kinds of magnetism, the magnetic orientations of the individual particles within it fluctuate constantly, resembling the constant motion of molecules within a true liquid.

2013 A new steelmaking process developed by MIT researchers, Donald Sadoway, Antoine Allanore, and former postdoc Lan Yin, produces no emissions other than pure oxygen and carries nice side benefits: The resulting steel should be of higher purity, and eventually, once the process is scaled up, cheaper.

2013 A research team, led by Yuriy Román, has devised a cheaper way to synthesize a key biofuel component, which could make its industrial production much more cost-effective. The compound, known as gamma-valerolactone (GVL), has more energy than ethanol and could be used on its own or as an additive to other fuels. GVL could also be useful as a "green" solvent or a building block for creating renewable polymers from sustainable materials.

2013 A system being developed by Dina Katabi and her graduate student Fadel Adib, could give us the ability to see people through walls using low-cost Wi-Fi technology. The system, called "Wi-Vi," is based on a concept similar to radar and sonar imaging. But in contrast to radar and sonar, it transmits a low-power Wi-Fi signal and uses its reflections to track moving humans.

2013 Hydrophobic materials—water-shedding surfaces—have a theoretical limit on the time it takes for a water droplet to bounce away from such a surface. Researchers, led by Kripa Varanasi, have found a way to burst through that perceived barrier, reducing the contact time by at least 40 percent. This research could aid ice prevention, wing efficiency, and more.

2014 Platinum-group metals can be considered unsustainable resources that are needed catalysts to enable renewable energy technologies. Graduate student Sean Hunt, postdoc Tarit Nimmandwudipong, and Yuriy Román have devised a process of synthesizing renewable alternative catalysts.

2014 Engineers at MIT and Lawrence Livermore National Laboratory (LLNL) have devised a way to translate that airy, yet remarkably strong, structure style of the Eiffel Tower down to the microscale—designing a system that could be fabricated from a variety of materials, such as metals or polymers, and that may set new records for stiffness for a given weight. Nicholas Fang; former postdoc Howon Lee, visiting research fellow Qi "Kevin" Ge; LLNL's Christopher Spadaccini and Xiaoyu "Rayne" Zheng are among the researchers involved in the project.

2014 Researchers at MIT, including Gang Chen and postdoc Hadi Ghasemi, have developed a new material structure—a layer of graphite flakes and an underlying carbon foam—that generates steam by soaking up the sun. The material is able to convert 85 percent of incoming solar energy into steam—a significant improvement over recent approaches to solar-powered steam generation. The setup loses very little heat in the process, and can produce steam at relatively low solar intensity.

2014 Bryan Hsu PhD '14 and Paula Hammond, working with Myoung-Hwan Park of Shamyook University in South Korea and Samantha Hagerman '14, have developed a new drug-delivery system method that could enable pain medication and other drugs to be released directly to specific parts of the body. The method uses biodegradable, nanoscale "thin films" laden with drug molecules that are absorbed into the body in steady doses over a period of up to 14 months.

2014 Researchers at MIT, inlcuding John Foster, the University of Colorado, including Daniel Baker, and elsewhere have found there's a hard limit to how close ultrarelativistic electrons can get to the Earth. The team found that no matter where these electrons are circling around the planet's equator, they can get no further than about 11,000 kilometers from the Earth's surface—despite their intense energy. See page 62 for more information.

2015 Natalie Artzi and Elazer Edelman, working with other researchers, found that a tissue adhesive they had previously developed worked much differently in cancerous colon tissue than in colon tissue inflamed with colitis. The finding suggests that for this sealant or any other kind of biomaterial designed to work inside the human body, scientists must take into account the environment in which the material will be used, instead of using a "one-size fits all" approach. See page 60 for more information.

2015 Kimberly Hamad-Schifferli and Lee Gehrke are among the researchers that have devised a new diagnostic test that is a simple paper strip similar to a pregnancy test, that can rapidly diagnose Ebola, as well as other viral hemorrhagic fevers such as yellow fever and dengue fever. Unlike most existing paper diagnostics, which test for only one disease, the new MIT strips are color-coded so they can be used to distinguish among several diseases. See page 60 for more information.

2015 Research conducted by Polina Anikeeva, graduate student Ritchie Chen, postdoc Gabriela Romero, graduate student Michael Christiansen, and undergraduate Alan Mohr has developed a method to stimulate brain tissue using external magnetic fields and injected magnetic nanoparticles—a technique allowing direct stimulation of neurons, which could be an effective treatment for a variety of neurological diseases, without the need for implants or external connections. See page 56 for more information.

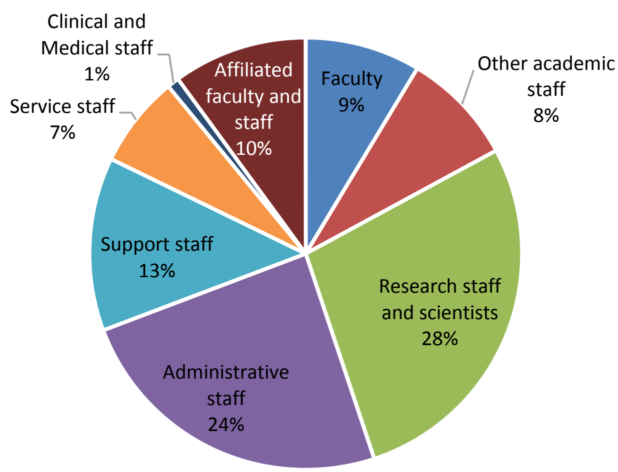
Faculty and Staff

MIT employs 11,843 persons on campus. In addition to the faculty, there are research, library, and administrative staff, and many others who, directly or indirectly, support the teaching and research goals of the Institute.

Faculty and Staff, 2014–2015

Employee Type	Count
Faculty	1,021
Other academic and instructional staff	1,003
Research staff and research scientists (includes postdoctoral positions)	3,289
Administrative staff	2,886
Support staff	1,538
Service staff	812
Clinical and Medical staff	104
Affiliated faculty, scientists, and scholars	1,190
Total campus faculty and staff	**11,843**

Faculty and Staff, 2014–2015



Each year, MIT employs about 1,160 graduate students as teaching assistants and 3,600 graduate students as research assistants.

MIT Lincoln Laboratory employs about 3,480 people, primarily at Hanscom Air Force Base in Lexington, Massachusetts. See page 84 for additional Lincoln Laboratory staffing information.

Faculty

The MIT faculty instruct undergraduate and graduate students, and engage in research and service.

Faculty Profile, 2014–2015

	Count	Percent of Total
Professors	662	65
Associate professors	190	19
Assistant professors	169	16
Total	**1,021**	**100**
Male	796	78
Female	225	22

See page 40 for a chart of faculty and students from 1865–2015.

Seventy-six percent of faculty are tenured.

Faculty may hold dual appointments where they are appointed equally to two departments. Thirty faculty members have dual appointments.

Faculty by School, 2014–2015

School	Count	Percentage
Architecture and Planning	78	8
Engineering	378	37
Humanities, Arts, and Social Sciences	167	16
Science	274	27
Management	113	11
Other	11	1
Total	**1,021**	**100**

Sixty-four percent of the faculty are in science and engineering fields.

Twenty percent of faculty are members of a minority group; seven percent of faculty identify with an underrepresented minority group.

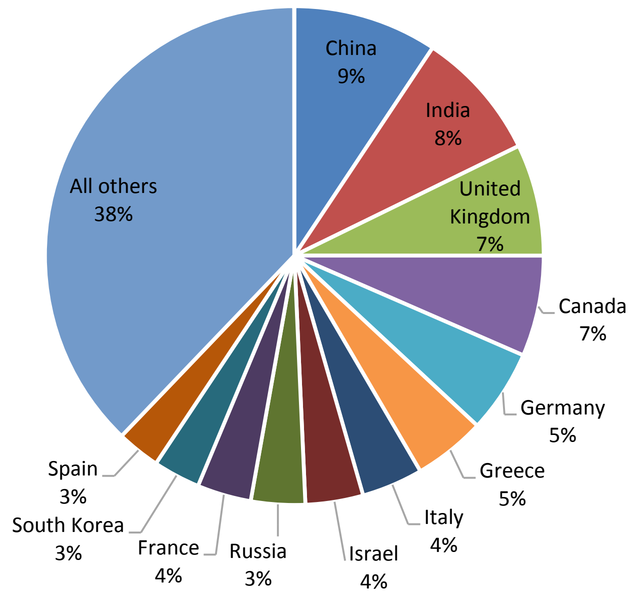
Faculty by U.S. Minority Group, 2014–2015

Ethnicity	Female Count	Male Count
Asian	29	103
Hispanic or Latino	4	35
African American	8	25
American Indian or Alaskan Native	1	1

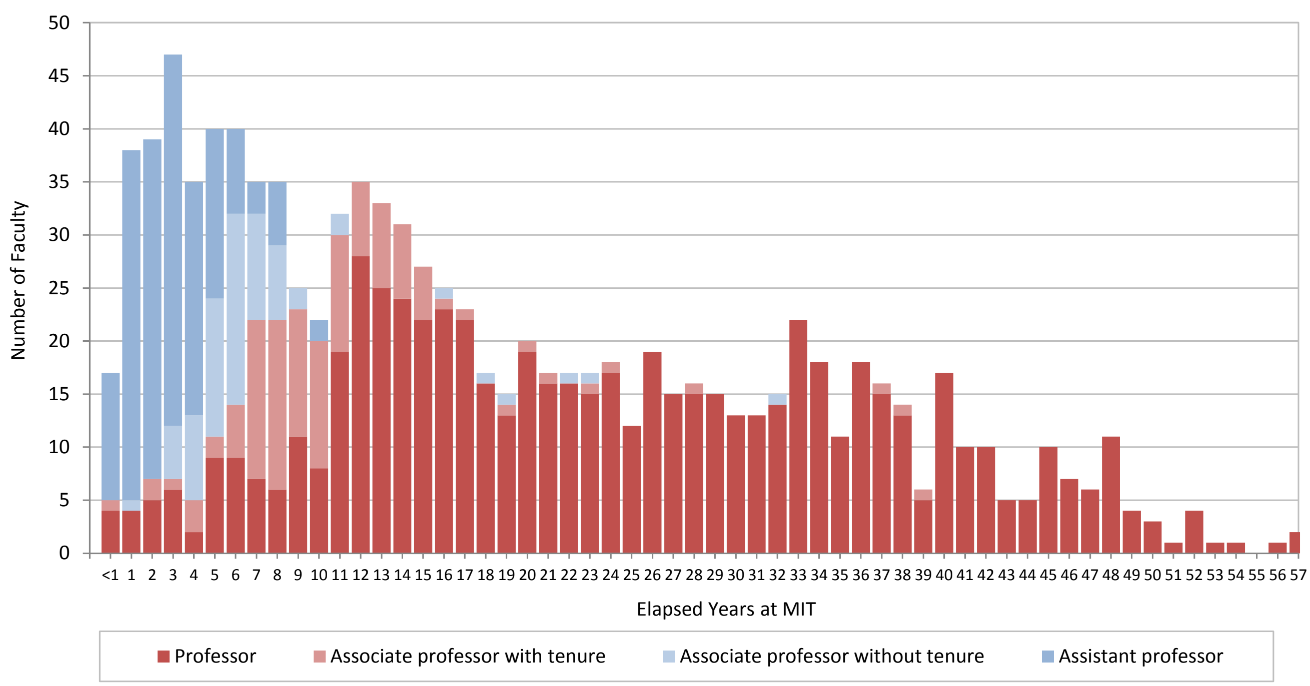
Ethnicity is self-identified, and faculty members may identify with more than one group.

Forty-two percent of current faculty are internationally born. Over seventy countries are represented by these faculty members.

Country of Origin of Internationally Born Faculty, 2014–2015



Elapsed Years at MIT of Faculty, 2014–2015 (Excludes time as student)



Researchers

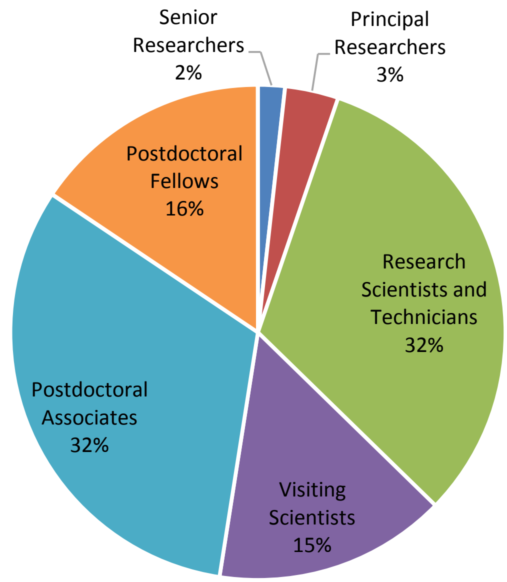
MIT campus research staff and scientists total 3,289. These researchers work with MIT faculty and students on projects funded by government, nonprofits and foundations, and industry.

Campus Research Staff and Scientists, 2014–2015

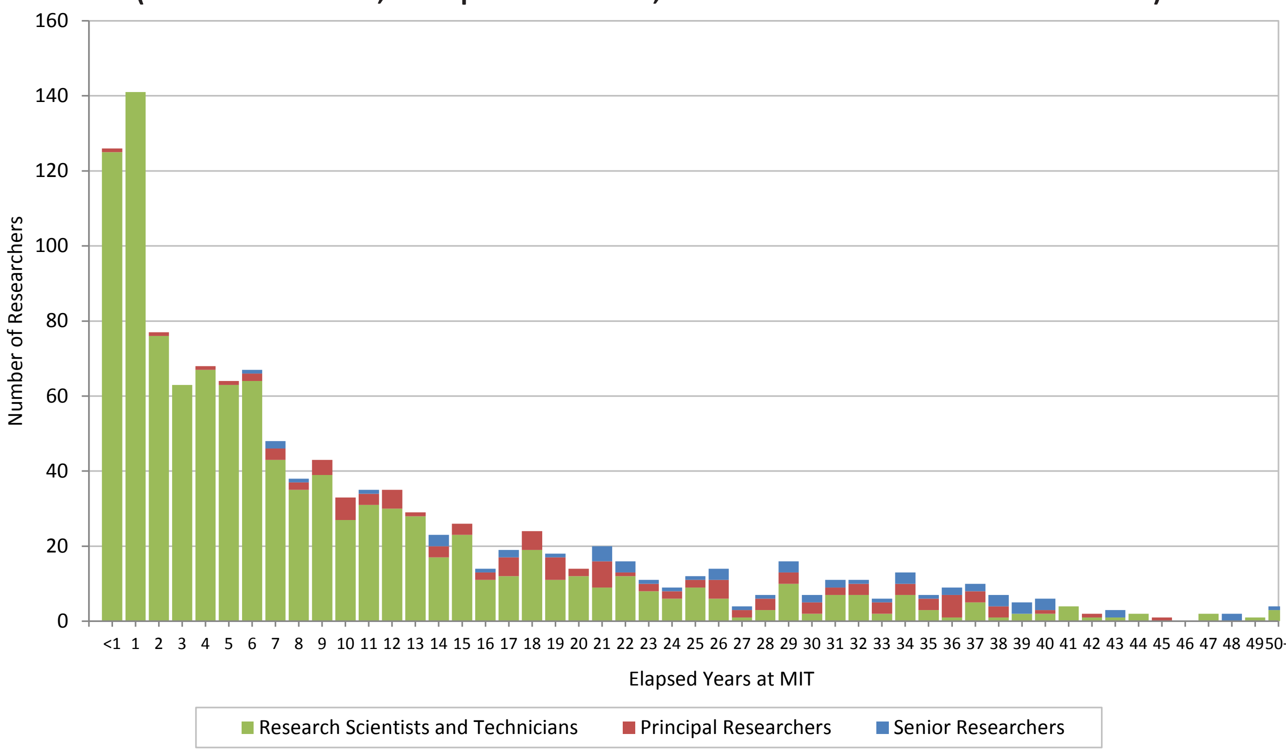
Employee Type	Count
Senior Researchers	58
Principal Researchers	115
Research Scientists and Technicians	1,054
Visiting Scientists	499
Postdoctoral Associates	1,050
Postdoctoral Fellows	513
Total	**3,289**

In fall 2014, approximately 2,600 graduate students were research assistants.

Campus Research Staff and Scientists, 2014–2015



Elapsed Years at MIT of Campus Research Staff and Scientists, 2014–2015 (Senior Researchers, Principal Researchers, and Research Scientists and Technicians)



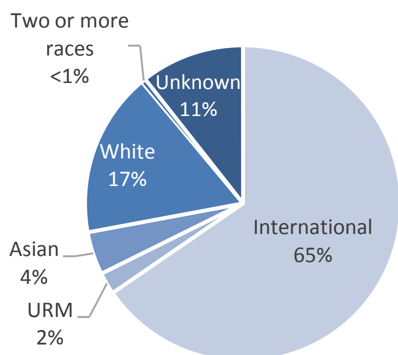
Postdoctoral Scholars

As of October 31, 2014, MIT hosts 1,565 postdoctoral associates and fellows—415 females and 1,150 males. These individuals work with faculty in academic departments, laboratories, and centers.

U.S. Citizen and Permanent Resident Postdoctoral Scholars by Ethnicity, 2014–2015

Ethnicity	Count
Hispanic or Latino	27
African American	8
American Indian or Alaskan Native	0
Total underrepresented minorities (URM)	**35**
White	264
Asian	69
Two or more races	7
Unknown	166
Total	**541**

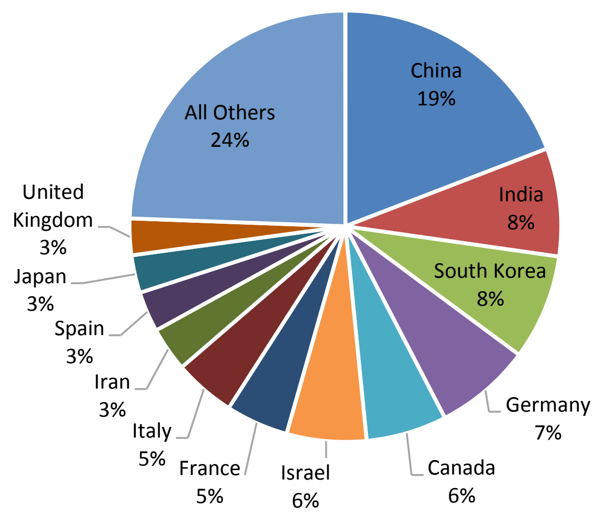
Ethnicity of Postdoctoral Scholars, 2014–2015



International Postdoctoral Scholars Top Countries of Citizenship, 2014–2015

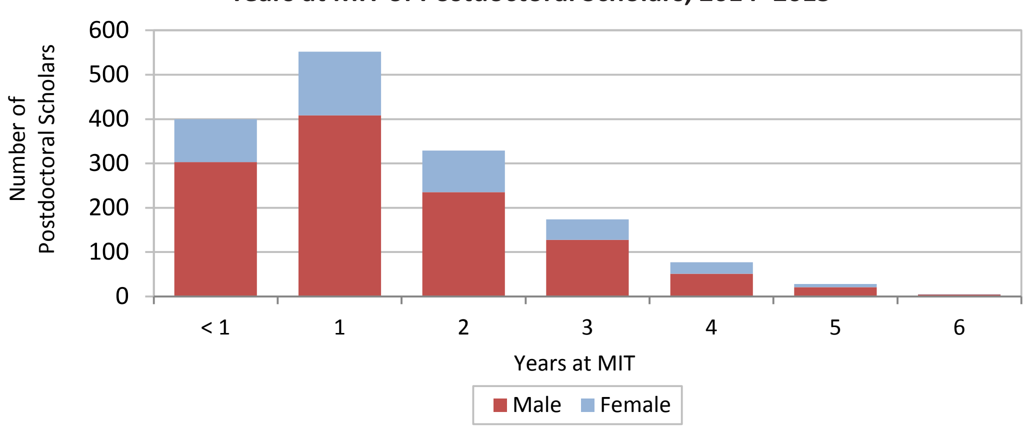
Country of Citizenship	Count
China	196
India	83
South Korea	81
Germany	74
Canada	62
Israel	61
France	48
Italy	47
Iran	34
Spain	31

Country of Citizenship of International Postdoctoral Scholars, 2014–2015



Postdoctoral scholars come from 76 foreign countries.

Years at MIT of Postdoctoral Scholars, 2014–2015



Awards and Honors of Current Faculty and Staff

Nobel Prize

Nine current faculty members at MIT have received the Nobel Prize. They are:

H. Robert Horvitz	Nobel Prize in Physiology or Medicine (shared)
Wolfgang Ketterle	Nobel Prize in Physics (shared)
Robert C. Merton	Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel (shared)
Richard R. Schrock	Nobel Prize in Chemistry (shared)
Phillip A. Sharp	Nobel Prize in Physiology or Medicine (shared)
Susan Solomon	Nobel Peace Prize (co-chair of Working Group One recognized under Intergovernmental Panel on Climate Change (IPCC), shared)
Samuel C. C. Ting	Nobel Prize in Physics (shared)
Susumu Tonegawa	Nobel Prize in Physiology or Medicine
Frank Wilczek	Nobel Prize in Physics (shared)

Number of recipients of selected awards and honors current faculty and staff have received

Recipients	Award Name and Agency
152	American Academy of Arts and Sciences Member
99	American Association for the Advancement of Science Fellow
12	American Philosophical Society Member
88	American Physical Society Fellow
22	American Society of Mechanical Engineers Fellow
29	Association for Computing Machinery Fellow
4	John Bates Clark Medal, American Economic Association
3	Dirac Medal, Abdus Salam International Centre for Theoretical Physics
9	Fulbright Scholar, Council for International Exchange of Scholars (CIES)
7	Gairdner Award, Gairdner Foundation
67	Guggenheim Fellow, John Simon Guggenheim Memorial Foundation
18	HHMI Investigator, Howard Hughes Medical Institute (HHMI)
55	Institute of Electrical and Electronics Engineers, Inc. Fellow
32	Institute of Medicine Member, National Academies
1	Japan Prize, Science and Technology Foundation of Japan
3	Kavli Prize, Norwegian Academy of Science and Letters
1	Kyoto Prize, Inamori Foundation of Japan
23	MacArthur Fellow, John D. and Catherine T. MacArthur Foundation
2	Millennium Technology Prize, Millennium Prize Foundation
68	National Academy of Engineering Member, National Academies
80	National Academy of Sciences Member, National Academies
11	National Medal of Science, National Science & Technology Medals Foundation
1	National Medal of Technology and Innovation, National Science & Technology Medals Foundation
2	Rolf Nevanlinna Prize, International Mathematical Union (IMU)
29	Presidential Early Career Awards for Scientists and Engineers (PECASE)
3	Pulitzer Prize, Pulitzer Board
2	Queen Elizabeth Prize for Engineering, The Queen Elizabeth Prize for Engineering Foundation
4	Royal Academy of Engineering Fellow, Royal Academy of Engineering
5	A. M. Turing Award, Association for Computing Machinery
1	Von Hippel Award, Materials Research Society
2	John von Neumann Medal, Institute of Electrical and Electronics Engineers, Inc.
4	Alan T. Waterman Award, National Science Foundation
3	Wolf Prize, Wolf Foundation

Award Highlights


Michael Stonebraker
Photo: Erica Ferrone Photography

Michael Stonebraker
2015 A.M. Turing Award
Michael Stonebraker, a researcher at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) who has revolutionized the field of database management systems (DBMSs) and founded multiple successful database companies, has won the Association for Computing Machinery's (ACM) A.M. Turing Award, often referred to as "the Nobel Prize of computing." This year marks the first time that the Turing Award comes with a Google-funded $1 million prize.
http://newsoffice.mit.edu/2015/michael-stonebraker-wins-turing-award-0325

Alan Guth
2014 Kavli Prize in Astrophysics
Alan Guth shares the 2014 Kavli Prize in Astrophysics with Andrei Linde of Stanford University and Alexei Starobinsky of the Landau Institute for Theoretical Physics in Russia. Together, they are cited by the Kavli Foundation "for pioneering the theory of cosmic inflation." Guth proposed the theory of cosmic inflation in 1980. The theory describes a period of extremely rapid exponential expansion within the first infinitesimal fraction of a second of the universe's existence. At the end of inflation, approximately 14 billion years ago, the universe was in an extremely hot, dense, and small state, at the beginning of the more leisurely phase of expansion described by the conventional "Big Bang" theory. The conventional theory explains what happened after the bang. The theory of cosmological inflation describes the mechanism that propelled the expansion of the universe in the first place. Supported by three decades of development, including contributions from Linde, Andreas Albrecht, and Paul Steinhardt, Guth's theory is now widely accepted by physicists.
http://newsoffice.mit.edu/2014/alan-guth-shares-1-million-kavli-prize-astrophysics


Robert Langer
Photo: M. Scott Brauer

Robert Langer
2014 Kyoto Prize
Robert Langer, the David H. Koch Institute Professor at MIT, is one of three individuals who have been awarded the 2014 Kyoto Prize, Japan's highest private award for global achievement, created by Japanese philanthropist Kazuo Inamori. Langer was cited as "a founder of the field of tissue engineering and creator of revolutionary drug delivery system (DDS) technologies." His citation notes that "tissue engineering is indispensable for the implementation of regenerative medicine. Langer's technique applies biodegradable polymer technologies to construct 'scaffolds' for cell growth, contributing to the regeneration of tissues and organs. He has also developed DDS technologies for the controlled release of proteins, nucleic acids, and other macromolecular drugs. He holds more than 800 patents and is actively involved in promoting the practical application of his discoveries as a leader in the interdisciplinary advancement of medicine and engineering."
http://newsoffice.mit.edu/2014/robert-langer-receives-kyoto-prize