

## Department of Biology

The Department of Biology has 55 primary faculty members, located in Building 68 (24), the David H. Koch Institute for Integrative Cancer Research (13), the Whitehead Institute for Biomedical Research (14), the Broad Institute (2), and the Picower Institute for Learning and Memory (2). Joint faculty appointments provide important connections to other departments, including Brain and Cognitive Sciences (BCS) (5), Chemistry (3), Physics (1), Biological Engineering (2), and Civil and Environmental Engineering (1). Including emeritus faculty, the department has four Nobel laureates, 27 members of the National Academy of Sciences, 10 Howard Hughes Medical Institute (HHMI) investigators, and three Howard Hughes early career scientists.

The Department of Biology is recognized as a pioneer in interdisciplinary research and a leader in research, scholarship, and education. Biology at MIT has played a central role in the growth of the molecular life sciences over the past 50 years and continues to be a leader in the fields of molecular cell biology, genomics, and computational biology. Although the Department's research has remained focused on a fundamental understanding of biology, over the years Biology faculty have played a major role in translating basic research into practical applications in clinical medicine, drug development, and industrial microbiology. The 2009–2010 academic year was marked by many notable accomplishments.

### Research

The Department of Biology offers the most brilliant scientists an opportunity to conduct curiosity-driven basic research—something that sets us apart from many other molecular biology departments. We are most fortunate to be imbedded in MIT's highly collaborative academic environment and are already seeing the rewards of collaborations with colleagues in engineering and physical science departments. The following research highlights exemplify achievements that have occurred over the past year.

Jianzhu Chen and his colleagues have engineered, for the first time, strains of mice that produce several types of human immune cells. Though the mice still do not express the full complement of immune cells, the work represents a big advance in generating so-called “humanized” mice. These partially humanized mice have already enabled aspects of the human immune response to pathogens and vaccines to be examined at an unprecedented level of detail.

Matthew Vander Heiden's laboratory is part of a new generation of cancer researchers who are trying to exploit cancer cells' strange metabolism in order “to starve a tumor.” Recent discoveries suggest that cancer cells have reprogrammed the glycolytic pathway to generate the energy they need to grow and divide out of control. Potential drugs that prevent this reprogramming hold promise for keeping a range of cancers in check.

The Tyler Jacks laboratory has found that tumors activate specific deoxyribonucleic acid (DNA) repair pathways to become resistant to the DNA-damaging agent cisplatin, a commonly used anti-cancer agent. Their research has important implications in the

design of new drugs, which should be targeted to stop the repair that is activated in cisplatin-resistant tumors.

Anthony Sinskey's research focuses on the billions of pounds of plastic that pollute the Earth's oceans every year and how we can help keep this problem from getting worse. At a new plant in Iowa, MIT-rooted technology will use bacteria to turn corn into a new bioplastic that biodegrades in soil or the ocean.

Leonard Guarente's laboratory, which has had a long-standing interest in sirtuins, a class of proteins that sense cellular energy stores and adjust gene expression accordingly, has now found a fundamental connection between sirtuins and Alzheimer's disease. Using a mouse model for the disease, they have shown that Alzheimer's plaques are suppressed when SIRT1 is overproduced and become more severe when SIRT1 is absent.

Researchers from the laboratories of Rudolf Jaenisch and Alexander van Oudenaarden have been investigating the fascinating and important process by which adult cells can be reprogrammed to behave like embryonic stem cells by introducing a small set of transcription factors into the adult cells. Based on careful measurements of gene expression, these labs have developed a probabilistic model that can predict the probability of reprogramming as a function of the number of cell divisions.

## Personnel

In January 2010, Matthew Vander Heiden joined the Department of Biology and Koch Institute. Vander Heiden holds MD and PhD degrees from the University of Chicago and did postdoctoral work with Lewis Cantley at Harvard Medical School. He is interested in the connections between the cellular biochemistry of glycolysis and the transformation of normal cells into cancer cells.

Dianne Newman recently left the Department to return to the California Institute of Technology as a professor of biology.

Elaine Glebus, administrative officer, left the department to accept a position at the Tufts University School of Medicine.

Effective July 1, 2009, Michael Yaffe was promoted to full professor and Thomas Schwartz was promoted to associate professor without tenure.

In the coming academic year, Mary Gehring, Piyush Gupta, and Adam Martin will join the department as assistant professors.

## Departmental and Administrative Initiatives

The Department of Biology values diversity and inclusion in both our faculty and student populations. We attract students and faculty from a wide variety of academic backgrounds. We are committed to expanding our efforts in outreach, and the recruitment of underrepresented minorities continues to be a foremost priority. Due to the extraordinary efforts of Dr. Mandana Sassanfar, director of outreach programs, we

have increased the size of our MIT Summer Research Program, and our other outreach initiatives have continued to flourish.

We are very enthusiastic about the recent launch of B<sup>3</sup> (B-cubed), our new two-year post-baccalaureate program based on collaboration between the Biology Department and our local Cambridge-based biotech partners. B<sup>3</sup> has an inaugural class of four students to begin July 1, 2010. Its goal is to provide additional research and academic preparation to talented and motivated individuals from minority groups and economically disadvantaged backgrounds to prepare them for the most competitive PhD programs in the biological and biomedical sciences in the country. The academic portion of the program will take place at MIT, while the research training portion will take place at local biotech companies. The participants will have an academic mentor (an MIT faculty member) and a research mentor (a scientist in the biotech industry).

The Graduate Program in Microbiology includes more than 50 faculty from multiple departments and divisions who study or use microbes in their research. This program integrates educational resources, crosses departmental lines, builds bridges among faculty with shared interests, and fosters collegiality when training students in the study of microbial systems. Six students entered the program in fall 2009 and the Class of 2010 will have six students. In total there will be 20 students in the program.

The MIT Molecular and Cellular Neuroscience (MCN) Program is a cross-departmental educational and research graduate training program that links neuroscientists in a multi-disciplinary approach to the systematic analysis of brain function and neuropsychiatric disease. As part of a campus-wide emphasis on brain research, MIT introduced the MCN program for graduate education in fall 2009. Our goal is to provide a new training program where innovative and cutting-edge neuroscience research is carried out across multiple sub-disciplines, providing critical bridges from the molecular and cellular neuroscience field to neuroengineering, systems neuroscience, genomics, optogenetics, and neurochemistry. Students entering through either the biology or BCS graduate programs will complete their core departmental courses, but if they elect to join the MCN program, they will supplement their didactical training with MCN-specific coursework, as well as cross-departmental electives in the neuroscience area.

Biology has continued to make significant capital investments in updating equipment in the BioMicro Center. Over the past year, next-generation sequencing, robotics, and real-time polymerase chain reaction capacities have expanded and the center is building capacity to support informatic analysis of genomic data for the MIT community. The center has recently been able to meet the exponentially increasing demands for DNA sequencing by recently acquiring two state-of-the-art Illumina sequencers. The new sequencers were purchased through funding from the Moore Foundation, the American Recovery and Reinvestment Act, and the National Institutes of Health (NIH). The Department of Biology, the Koch Institute, the Department of Biological Engineering, and the Center for Environmental Health Sciences jointly support ongoing operations of the BioMicro Center.

We have completed a major upgrade of the X-ray crystallography facilities in Building 68. The major improvement is the implementation of nanoscale crystallization equipment, which greatly increases the number of crystallization conditions that can be screened. The upgrade was made possible through a collaborative effort that included the laboratories of Tania Baker, Catherine Drennan, Amy Keating, Robert Sauer, Thomas Schwartz, and Michael Yaffe.

### **Faculty Honors and Awards**

The following awards and honors were made in AY2010 to our faculty for their excellence in teaching, research, and service.

Angelika Amon and Barbara Imperiali were elected to the National Academy of Sciences.

Catherine Drennan was re-appointed as an HHMI professor. She is the only person in the country who is both an HHMI professor and an HHMI investigator.

Laurie Boyer received the Smith Family Award for Excellence in Biomedical Research.

Leonard Guarente was elected to the French Academy of Sciences. The academy was established in Paris in 1666 under the patronage of Louis XIV to advise the French government on scientific matters. This advisory role has been largely taken over by other bodies, but the academy is still an important representative of French science on the international stage.

Nancy Hopkins received a Gladstone Leadership Award from the Gladstone Institute of the University of California, San Francisco, for the combination of her work in science and her work on behalf of women in science.

Robert Horvitz was elected as a Foreign Member of the Royal Society of London. He was awarded this honor in part for his major discoveries in the fields of developmental biology and cell death. Horvitz spent four years as a postdoctoral researcher in the United Kingdom (UK) and maintains strong links to the UK.

Tyler Jacks was elected to the Institute of Medicine of the National Academies of Science.

Rudolf Jaenisch received the prestigious James R. Killian Jr. Faculty Achievement Award from MIT for 2009–2010. He was also awarded the 2009 Ernst Schering Prize, one of Germany's most prestigious awards for scientists. According to the Ernst Schering Foundation, which confers the prize, Jaenisch was honored for his "groundbreaking work in the field of transgenic animal models and therapeutic cloning." He was inducted into the prestigious Order Pour le Mérite for Sciences and Arts. Nomination to the Order, whose members have included Max Planck, Albert Einstein, and Albert Schweitzer, is conveyed by the president of Germany.

Monty Krieger received an Outstanding Achievement Award for Contributions to Atherosclerosis Research, and also the Tulane University School of Science and Engineering Outstanding Alumnus Award.

Eric Lander was awarded the 2009 Academy Medal for Distinguished Contributions in Biomedical Science from the New York Academy of Medicine. The award recognizes his leadership in the biomedical revolution generated by the new discourse in genetics and in particular the Human Genome Project.

Aviv Regev was a recipient of the Eleanor and Miles Shore 50th Anniversary Fellowship Program for Scholars in Medicine.

David Sabatini received the Paul Marks Prize for Cancer Research in recognition of his discovery of a key pathway regulating cell growth and survival.

Phillip Sharp was awarded the 2010 American Association for Cancer Research Margaret Foti Award for Leadership and Extraordinary Achievements in Cancer Research, and the 2010 American Society for Biochemistry and Molecular Biology Herbert Tabor/*Journal of Biological Chemistry* Lectureship.

JoAnne Stubbe was awarded the National Medal of Science during a White House ceremony. According to the award citation, Stubbe was honored “for uncovering the intricate processes by which cells safely use free radicals, for developing new cancer treatments, and for improving the production of environmentally friendly biodegradable polymers.” She also was awarded the Benjamin Franklin Medal and received the 2010 Welch Foundation Award in Chemistry.

Leona Samson received a 2009 Pioneer Award, the annual NIH grant designed to encourage scientists to explore high-risk projects with the potential to dramatically transform health research.

Graham Walker was named an HHMI professor. In fall 2010, Walker will receive a doctor of science, honoris causa, from the University of Guelph.

Robert Weinberg has been elected a Foreign Associate of the French Academy of Sciences (Institut de France Académie des sciences) in the Academy’s Section of Molecular and Cellular Biology and Genomics. Weinberg was one of 18 scientists worldwide elected for 2010. In June 2009, Weinberg was awarded the Academy’s Grand Medal (Grande Médaille), its highest honor, for his work “that has revolutionized the understanding of the molecular basis of cancer.”

### **Undergraduate Education**

There were 262 undergraduates registered as biology majors during AY2010. Of these students, 37 left biology for another major and 98 declared biology as a major during the academic year, including 44 freshmen who declared biology as their major in spring 2010.

The bachelor of science degree was conferred to 93 students from September 2009 through June 2010. Of them, 58 were in Course 7 and 35 were in Course 7-A.

## Student Awards

We are pleased to note that a number of biology majors received awards in AY2010.

The Barry M. Goldwater Scholarship for students who exhibit an outstanding potential and intend to pursue careers in mathematics, the natural sciences, or engineering was awarded to Vinay Tripuraneni '11 from Fresno, CA.

Vinayak Muralidhar '10 from Chandler, AZ, won a Marshall Scholarship.

Steven Mo '10 from Pearland, TX, received a Rhodes Scholarship.

Charles DeRobertis '10 from Channahon, IL, and Lauren Shields '10 from Bloomfield Hills, MI, both were awarded Fulbright Scholarships.

Gary Eastwick '10 from Delran, NJ, was given a Roy Axford Award for academic achievement by a senior in Nuclear Science and Engineering.

Ryan Flynn '10 from Mount Laurel, NJ, won the Randolph G. Wei Undergraduate Research Opportunities Program Award, presented each spring to the undergraduate who has made the most outstanding contribution in undergraduate research at the interface of the life sciences and engineering.

Mary Jane Tsang Mui Ching '10 from the Northern Mariana Islands won the Roger de Friez Hunneman Prize, which recognizes outstanding scholarship in class and research.

Angela Zhu '10 from Richmond, VA, was given a Service Award for significant contributions in the area of service to the Department of Chemistry.

Elizabeth Iffrig '10 from Philadelphia, PA, was awarded the Frederick D. Greene Teaching Award.

Andrew Musacchio '11 from Acton, MA, won an American Chemical Society Analytical Chemistry Award for achievement by a junior in analytical chemistry.

Amelia Chang '12 from Singapore won the first place S. Klein Prize for Scientific Writing and Jihye Kim '10 from Warren, MI, won second place.

Kamena Kostova '12 from Shipka, Bulgaria, and Xin Qi Cynthia Li '12 from New York, NY, shared third place in the Lufthansa Prize for excellence in German studies.

Adrianna Tam '11 from Arlington, TX, won a Gregory Tucker Memorial Prize in recognition of exceptional ability in performance and overall contribution to the Music and Theater Arts Section.

Joan Chen '12 from Beijing, China, won a third place Robert A. Boit Writing Prize in the essay category.

Alexandra Corella '10 from La Quinta, CA, won a first place Robert A. Boit Writing Prize for poetry.

Two biology majors were awarded Ragnar and Margaret Naess Certificates of Distinction in recognition of exceptional talent and commitment to performance at MIT: Lauren Shields '10 from Bloomfield Hills, MI, won Exceptional Vocal Student and Nora Hickey '11 from McFarland, WI, won Exceptional Wind Player.

In the MIT Symphony Orchestra Concerto Competition, Lauren Shields '10 from Bloomfield Hills, MI, won for soprano; Adrianna Tam '11 from Arlington, TX, for mezzo-soprano; and Stephanie Wu '10 from Fort Washington, FL, for piano.

Tim Lee '11 from Natick, WA, was given the Philip A. Trussell Prize for a male undergraduate student athlete who demonstrates skill, sportsmanship, and levity in the sport of volleyball.

Kathleen Li '10 from Plano, TX, and Jason Scott '10 from Tucson, AZ, were given MIT Impact Awards.

Sumi Sinha '12 from Nashua, NH, was given a Public Service Center (PSC) grant for spring 2010.

Akansh Murthy '13 from Noblesville, IN; Jay Rajan '11 from Cerritos, CA; and Sumi Sinha '12 from Nashua, NH, received grants for Independent Activities Program (IAP) 2010.

Yuri Hanada '10 from Farmingdale, NY, was given a Global Poverty Initiative/PSC Internship for IAP 2010.

Jason Scott '10 won a Distinguished Dedication Award, presented to students who went "above and beyond" their call of duty as student leaders and who showed dedication to their organizations and campus life at MIT.

Ritu Tandon '10 from Nanuet, NY, was awarded a Paul and Priscilla Gray Value-Added Internship for IAP 2010.

Senior Legacy awards were given to Kappa Sigma's Ryan Flynn '10 from Mount Laurel, NJ; Alpha Chi Omega's Minh Huynh-Le '10 from Silver Spring, MD; and Sigma Phi Epsilon's George Pratt '10 from Melrose, MA.

Kappa Alpha Theta's Lauren Shields '10 from Bloomfield Hills, MI, won a David N. Rogers Outstanding Chapter Ideals and Values Award.

The following sixteen biology majors, all Class of 2010, were chosen for Phi Beta Kappa: Jennifer Chu from Fresh Meadows, NY; Ylaine Gerardin from State College, PA; Ezgi Hacısuleyman from Istanbul, Turkey; Timothy Humpton from Jamison, PA; Swetha Kambhampati from Irvine, CA; Grace Lee from Potomac, MD; Cheuk Leung from Ocean

Springs, MS; Leo Luo from Brentwood, TN; Vinayak Muralidhar from Chandler, AZ; Amudha Panneerselvan from Cranston, RI; Lauren Shields from Bloomfield Hills, MI; Yun Song from Savannah, GA; Mary-Jane Tsang Mui Ching from the Northern Mariana Islands; Kevin Warnock from San Dimas, CA; Janelle Whitney from Santa Cruz, CA; and Tiffany Yuh from New Milford, CT.

In addition, the Biology Department presented the following awards and prizes to undergraduate students:

Claire Mazumdar '10 from Waterloo, Ontario, Canada, received the Whitehead Prize for outstanding promise for a career in biological research through academic scholarship as well as contributions to research and the MIT community.

Helen Hou '10 from Beijing, China, received the Merck Prize for outstanding research and academic performance in biophysical or bioinformatics sciences.

Lauren Shields '10 from Bloomfield Hills, MI, and Andrew VanBenschoten '11 from Minnetonka, MN, received the Gene Brown Prize for outstanding academic scholarship and demonstrated excellence as a teaching assistant.

Jenna Caldwell '11 from Indian Spring, AL, received the Susan Hockfield Prize in Life Sciences for a third-year MIT undergraduate student in any area of the life sciences who has demonstrated both exceptional performance and promise for graduate study and research.

Dima Ter-Ovanesyan '10 of Newton, MA, received the Ned Holt Prize for demonstrated excellence in scholarship as well as service to the MIT community.

Ryan Flynn '10 from Mount Laurel, NJ, received the Salvador E. Luria Prize for excellent scholarship and research of publication quality.

Monique Brewster '10 from Lake Katrine, NY; Ollie Osunkunle, Cambridge-MIT Exchange student from Tyne and Wear, England; and Alex Hopkins '10 from Kalamazoo, MI, received the John L. Asinari Award for outstanding research in the field of life sciences.

Thirteen students were invited by their research faculty mentors to speak at the Undergraduate Research Symposium held in January: Jenna Caldwell '11 from Indian Spring, AL; Amelia Chang '12 from Singapore; Ylaine Gerardin '10 from State College, PA; Ezgi Haciosuleyan '10 from Istanbul, Turkey; Alex Hopkins '10 from Kalamazoo, MI; Helen Hou '10 from Beijing, China; Jihye Kim '10 from Warren, MI; Sophia Li '11 from Taipei, Taiwan; Steven Mo '10 from Pearland, TX; Jay Rajan '11 from Cerritos, CA; Stephanie Wu '10 from Fort Washington, FL; Sherry Yan '11 from Groton Long Point, CT; and William Yee '10 from Salem, OR.

## **Graduate Education**

In AY2010, the department awarded a total of 36 PhD degrees and two SM degrees in biology. Five PhD degrees and one SM were awarded in biological oceanography through the MIT/Woods Hole Oceanographic Institute (WHOI) Joint Program in Oceanography and Applied Ocean Science and Engineering. There were 206 graduate students registered in the department in 2009–2010, with another 25 in the MIT/WHOI Joint Program. The incoming class for fall 2010 will consist of 45 students in the biology doctoral program, with an additional eight students in the MIT/WHOI Joint Program.

**Chris A. Kaiser**  
**Department Head**  
**Professor of Biology**

*More information about the Biology Department can be found at <http://mit.edu/biology/www/>.*