Dear Alumni and Friends of the Department,

Welcome to a new academic year! Our department is bursting with excitement with the arrival of 63 first-year graduate students, the largest incoming graduate student class in recent history. We can’t wait to start collaborating with this crop of outstanding and eager young stars!

We are also thrilled with the arrival of four new faculty.

Professor Mei Hong, formerly the John D. Corbett Professor of Chemistry at Iowa State University, joins us as Professor of Chemistry. She is a physical chemist interested in the structure and dynamics of membrane proteins using advanced multidimensional solid-state NMR spectroscopy. Her laboratory is located within the Francis Bitter Magnet Laboratory (FBML), long a premier laboratory for structural biology using novel NMR methods under Professor Bob Griffin’s leadership and a critical resource for MIT faculty. The arrival of Mei guarantees the renewal of this innovative laboratory and a transition of leadership into a new era.

Professor Jeff Van Humbeck, formerly a postdoctoral fellow in the Department of Chemistry at the University of California, Berkeley, joins us as Assistant Professor of Chemistry. Jeff’s novel ideas expand our department’s research into the realm of organic materials and their possible use as catalysts.

Professor Gabriela Schlau-Cohen, currently a postdoctoral fellow at Stanford University, will join the department in January of 2015 as Assistant Professor of Chemistry. Gabriela’s creative proposals expand our department’s research on ultrafast processes down to the single molecule regime.

Professor Alex Shalek, formerly a postdoctoral fellow in the Department of Chemistry at Harvard University, joins us as Assistant Professor of Chemistry with a dual appointment in
Chemformation is published to keep our alumni informed of the department’s activities.

We welcome your news and comments.

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the new Institute of Medical Engineering and Science (IMES) and the Ragon Institute. Alex’s aim is to develop and apply high throughput technologies, largely at the single-cell level, to understand systems-level cellular behaviors, from the “bottom-up,” focusing on dendritic and T cells. His appointment leverages both the biological chemistry expertise in our department as well as the resources of MIT’s interdisciplinary laboratories, IMES, and the Ragon Institute. We are very excited by these new collaborative initiatives.

These collaborations, as well as the recent appointment of Professor Tim Swager as the Director of the MIT Deshpande Center for Technological Innovation, signal the continued importance of the role of chemistry in the extensive initiatives throughout MIT.

Faculty, staff, and students were deeply saddened by the passing of three emeritus faculty this past year: Robert A. Alberty, Irwin Oppenheim, and John S. Waugh. These three remarkable chemists were giants in their fields who established the foundations of many areas in thermodynamics, statistical mechanics, and spectroscopy. They will be sorely missed.

With the combined financial resources of MIT, the Department of Chemistry and most importantly, with your help, I am pleased to announce that the renovation of wet laboratory research space (10,000 sq ft) on the second and third floors of the north leg of Building 2 was completed on budget and on time in January 2014! With the occupancy of the second floor by Professor Mounji Bawendi’s large group, the department can now broaden its research portfolio in the burgeoning area of materials and nanomaterials and help us attract faculty whose materials research will innovate a critical need area such as renewable energy in these state-of-the-art facilities.

To showcase our students’ educational experiences in chemistry, we recently produced a short video that profiles several of our awesome chemistry students and alumni who speak about their education and research, student life, and career paths. To watch the video, go to: http://chemistry.mit.edu/meet-our-students. I am also very proud to tell you that our department’s faculty has won a School of Science Teaching Prize two years in a row: Tim Jamison received the 2012/13 SoS Prize for Undergraduate Education and Rick Danheiser received the 2013/14 SoS Prize for Graduate Education!

Federal cuts in basic science research (20% decrease from 2012 to 2014) continue to plague us, resulting in non-governmental sources of funding becoming more and more essential to the vitality of the department. Therefore, our fundraising priorities continue to be funds for graduate fellowships, especially relevant in light of the increase in numbers of our graduate student body, and for professorships. The Silbey Career Development Professorship Fund is growing but still needs a great deal more support before it will reach a level to support a junior faculty member.

A fundraising priority both for the Institute and the Department of Chemistry is the establishment of the MIT.nano building that will house in its penthouse suite our state-of-the-art chemistry undergraduate teaching labs. Deliberately placed in the center of campus next to the Great Dome on the current site of Building 12, MIT.nano will be a toolbox available to the entire academic and research enterprise—a cutting-edge facility to nurture widespread, cross-disciplinary research and invention. The project is expected to be complete by the end of 2018. Given that the origins of nanotechnology flow down from the fundamental principles of chemical science, it is very fitting that our new undergraduate chemistry teaching labs be the cherry on top of MIT.nano!

In addition, because the department is responsible for partial financing of assistant professor start-up packages, discretionary funds are always needed to attract the best faculty, as well as for assisting current faculty in times of need.

I hope that this Special Edition of Chemformation enables you to share in the past year’s news and successes. Thank you for all you do for the Department of Chemistry! We would not be so successful without your support.

If your travels take you to Cambridge, please do not hesitate to contact me if you would like to visit.
FOUR NEW FACULTY JOIN THE DEPARTMENT

On July 1, 2014, Dr. Mei Hong, formerly the John D. Corbett Professor of Chemistry at Iowa State University, Dr. Jeffrey Van Humbeck, formerly a postdoctoral fellow at the University of California, Berkeley; and Dr. Alex Shalek, a former postdoc in the Park Lab at Harvard University joined the Department of Chemistry. Dr. Gabriela Schlau-Cohen, currently a postdoctoral fellow at Stanford University, will join the department on January 16, 2015.

Dr. Shalek obtained his bachelor’s degree in chemical physics from Columbia University and his PhD in chemical physics from Harvard University.

Dr. Hong received her BA at Mount Holyoke College and her PhD in chemistry from the University of California, Berkeley.

Dr. Van Humbeck received a BSc in chemistry from the University of Calgary and an MA and PhD in organic chemistry from Princeton University.

Dr. Schlau-Cohen received a ScB in chemical sciences from Brown University and a PhD in chemistry from the University of California, Berkeley.

Research in the Shalek group will be directed towards the development and application of new technologies that will facilitate the understanding of how cells collectively perform systems-level functions in healthy and diseased states. With respect to technology development, the group will leverage recent advances in nanotechnology and chemical biology to establish a host of core, cross-disciplinary platforms that will collectively enable them to extensively profile and precisely control cells and their interactions within the context of complex systems. With respect to biological applications, the group will focus on how cellular heterogeneity and cell-to-cell communication drive ensemble-level decision-making in the immune system, with an emphasis on “two-body” interaction (e.g., host cell-virus interactions, innate immune control of adaptive immunity, tumor infiltration by immune cells). The goal is to not only provide broadly applicable experimental tools but also help transform the way in which we think about single cells, cell-cell interactions, diseased cellular states, and therapeutics so as to create a new paradigm for understanding and designing systems-level cellular behaviors in multicellular organisms.

The long-term objective of Dr. Hong’s research is to elucidate the structure, dynamics, and mechanism of membrane proteins and other biological macromolecules using advanced multidimensional solid-state NMR spectroscopy. Phospholipid membranes, and proteins embedded in them, are universal components of cells and play key roles in many cellular functions. The Hong lab is particularly interested in how the structure and dynamics of membrane peptides and proteins underlie their abilities to 1) conduct ions across the lipid bilayer, 2) catalyze fusion of virus envelopes and cell membranes, and 3) disrupt microbial cell membranes during immune defense.

The lab is also studying the structure of the polysaccharide-rich plant cell walls in order to understand how cellulose and matrix polysaccharides form the 3D architecture that both provides mechanical strength to plant cells and allows plant cells to grow.

The Van Humbeck laboratory will develop new methods for controlling catalytic reactions, and the structure of organic materials. Encompassing many individual projects, three overarching research themes will direct its initial endeavors. One area is selective oligomerization. By incorporating catalysts within restrictive supramolecular volumes, size-selective
oligomerization will be pursued in the context of energy applications (i.e. biofuels upgrading) and medicinal chemistry (i.e. polyketide synthesis). In the area of catalysis, the effect of electrostatic elements will also be investigated. The judicious inclusion of charged units into catalyst structures will be investigated with a view to improving both efficiency and selectivity in new reactions. Ion pairing as a means of structural control has been explored to a much greater extent in polymers, with the typical units of charge resulting from proton transfer. As an alternative, the inclusion of inherently charged units that lack protons will be pursued, for both functional and structural organic materials. Additionally, the development of charge-by-electron transfer between redox active centers will be investigated for responsive materials.

Research in the Schlau-Cohen group will use a combination of single-molecule and ultrafast spectroscopies to explore the energetic and structural dynamics of biological systems. There are two major research thrusts. The first is developing new methodology to measure ultrafast dynamics on single proteins, which will be a means to study systems with both sub-nanosecond and second dynamics. The second merges optical spectroscopy with model membrane systems to provide a novel probe of how biological processes extend beyond the nanometer scale of individual proteins.

TING PROMOTED TO FULL PROFESSOR
Professor Alice Y. Ting, currently the Ellen Swallow Richards Associate Professor of Chemistry, has been promoted to Full Professor effective July 1, 2014. Research in the Ting laboratory is focused on the development of new methodology for investigating protein, DNA, and RNA structure and function in the context of complex systems, such as living cells and organisms.

NOLAN PROMOTED TO ASSOCIATE PROFESSOR
Professor Elizabeth M. Nolan’s promotion to Associate Professor without tenure came into effect on July 1, 2014. Research in the Nolan Lab is motivated by the global problems of infectious disease and antibiotic resistance.

The chemistry and biology of small molecules, peptides, and proteins that participate in the human innate immune response and host/pathogen interaction and contribute to microbial pathogenesis are investigated. In many projects, how transition metals, and metal-ion chelators produced by either the host or microbe, contribute to these phenomena are emphasized. The lab’s experimental approach combines the techniques of inorganic and organic chemistries, biological chemistry, and microbiology.

PENTELUTE RECEIVES CD CHAIR
Professor Brad Pentelute has been selected to be the next holder of the Pfizer-Laubach Career Development Professorship beginning July 1, 2014 for a three-year term. The Pfizer-Laubach Chair was established by Pfizer to honor Dr. Gerald D. Laubach, PhD ’50 (under John C. Sheehan) and former president of Pfizer Inc.

SHALEK RECEIVES CD CHAIR
Professor Alex Shalek has been appointed to the Hermann L.F. von Helmholtz Career Development Professorship effective July 1, 2014 for a period of 2 years. The professorship was established in 1973 with a gift from the Becton Dickinson Company, after discussions with Fairleigh Dickinson, Jr., the son of one of the company’s founders. At MIT’s recommendation, the MIT chair was named in honor of Hermann von Helmholtz, a nineteenth-century German physician-physicist whose illustrious career encompassed work in areas such as vision, hearing, conservation of energy, and electricity. Becton Dickinson manufactures and sells a broad range of medical supplies and devices and diagnostic systems for use by health professionals, medical research institutions, industry, and the general public.
ROBERT A. ALBERTY (1922-2014)

Robert A. Alberty, professor emeritus in the Department of Chemistry and former dean of MIT’s School of Science—whose seminal contributions to the thermodynamics and kinetics of biochemical reactions are still at the forefront of chemistry—passed away on Saturday, January 18, 2014 at the age of 92.

A member of the MIT faculty since 1967, Alberty led the School of Science from 1967 to 1982, when he returned to teaching and research in physical chemistry. He became professor emeritus in 1991.

“Bob’s characterization of enzyme kinetics from 1955 to 1965 remains the model for investigations of enzymatic mechanism,” says Sylvia Ceyer, Head of the Department of Chemistry and the J. C. Sheehan Professor of Chemistry. “His work is well-known for its utmost attention to detail and despite being a demanding scientist, he was the quintessential gentleman—always kind and warm-hearted.”

“Alberty’s work placed the kinetic model by Leonor Michaelis and Maud Menten some 30 years earlier on a firm theoretical basis,” Ceyer says, “by describing the interplay between kinetics and equilibrium. He was also the first to recognize the complexity of the many species of adenosine 5’-triphosphate (ATP), and to develop a rigorous, but easily generalizable, thermodynamic treatment to relate them.”

Alberty was widely regarded by MIT colleagues as an accomplished educator at both the undergraduate and graduate level. Many of his students and postdocs went on to pursue outstanding research careers; he was particularly proud of those who became members of the National Academy of Sciences—a status he himself achieved in 1965.

Alberty was the author or co-author of physical chemistry textbooks that are widely used to this day. Physical Chemistry (Wiley), a textbook he co-authored with Farrington Daniels in 1955, was his most esteemed and enduring work. Alberty’s refinements to the book spanned more than 50 years, during which time he and his co-authors—most recently Moungi Bawendi and the late Robert J. Silbey, both professors at MIT—updated the volume to meet current trends and standards. Physical Chemistry is still considered the benchmark textbook in the field, and is used in teaching 5.60 (Thermodynamics and Kinetics) in MIT’s Department of Chemistry.

“I had the pleasure of watching Professor Alberty—Bob to everyone here—in action during the updating of the Physical Chemistry textbook,” says Bawendi, the Lester Wolfe Professor of Chemistry. “Bob was tireless and incredibly organized. He knew the contents of the book to the last detail, [and] rewrote or edited large parts of it, with a clear sense of what he thought should be reorganized to make the text up-to-date. It was an amazing learning experience and a humbling one to watch the two Bobs—Bob Alberty and Bob Silbey—rework the text, especially with Bob Alberty well into his eighties at the time.”

“When I was hired at MIT in 1990, it was in anticipation of Bob’s retirement,” Bawendi adds. “But it never felt that Bob ever actually ‘retired,’ as he was still heavily involved for so many years writing theoretical works and textbooks, and was active in leadership positions of chemical and scientific organizations. I was lucky to have had the chance to work with Bob.”

Alberty’s work on Physical Chemistry led to invitations to participate in and chair national research committees concerned with laboratory safety standards and chemical disposal. A report he authored for the National Research Council in 1981, “Prudent Practices in the Chemical Laboratory,” sold more copies than any of that organization’s previous publications.
Alberty also chaired the committee that wrote a second report in 1983: “Prudent Practices for the Disposal of Chemicals in the Laboratory.”

Alberty was no stranger to senior administrative roles at universities. In 1967, while dean of the Graduate School at the University of Wisconsin at Madison, he was invited to become dean of the School of Science at MIT as well as a faculty member in the Department of Chemistry. His notable achievements as MIT’s dean of science include the development of a joint MIT-Harvard University MD-PhD program and the establishment of the Cancer Research Center, now the Koch Institute for Integrative Cancer Research. He was also the first co-chairman of MIT’s exchange program with Wellesley College and chaired the Institute Committee on Environmental Health and Safety.

“As dean of science, Alberty was always available to his colleagues and always optimistic about finding funding for many endeavors to benefit chemistry and the Institute as a whole,” says Bob Field, the Robert T. Haslam and Bradley Dewey Professor of Chemistry. “He liked nothing better than to convey good news about tenure.”

“I overlapped with the late stage of Bob Alberty’s career, after he returned to being ‘just’ a professor following a stint as dean of science,” says Keith Nelson, a professor of chemistry. “Long past official retirement and into emeritus status, Bob had fewer official responsibilities but just as much scientific curiosity, energy, and enthusiasm as ever. So he took advantage of the opportunity to work with few distractions to consolidate much of the last phase of his theoretical research and to write a unique textbook, *Thermodynamics of Biochemical Reactions*, published in 2005.”

“This topic is not covered in standard courses,” Nelson adds, “largely because the theoretical framework and its applications were developed much more recently than the rest of thermodynamics, and significantly by Bob Alberty. The very next year, Bob published a supplementary text on applications of Mathematica software to problems in biochemical thermodynamics. [He] was not content to inscribe his scientific achievements in textbook form, but also succeeded in bringing his discipline to life for a new generation of students and scientists.”

Alberty spent 30 years as an advisor to the Camille and Henry Dreyfus Foundation and was instrumental in developing many of its programs—including the Henry Dreyfus Teacher-Scholar Awards Program, which supports young chemistry professors who have demonstrated interest and ability in being outstanding teachers as they are considered for tenure.

Born in Winfield, Kansas, Alberty carried out his undergraduate studies at the University of Nebraska, receiving his BS in 1943, followed by an MS from the same university. In 1947, he received his PhD in chemistry from Wisconsin and immediately became an instructor at that institution. He moved up the ranks at Wisconsin, becoming a full professor in 1956. In 1962, he was appointed associate dean of letters and science before being appointed as the dean of the Graduate School in 1963.

Alberty received professional awards and accolades including membership in the National Academy of Sciences, the American Academy of Arts and Sciences, the Institute of Medicine, and the American Chemical Society.

Alberty was predeceased by his wife of 66 years, Lillian; the couple met in high school when he was president of the chemistry club and she was the club’s secretary. They both attended Wisconsin and married the day after their graduation.

Alberty is survived by his three children, Nancy Lou Zant, of Fairfield, Montana; Steven C. Alberty, of Eugene, Oregon; and Catherine Alberty Baxter, of Roseville, Minnesota; by nine grandchildren; and by six great-grandchildren.

by Liz McGrath
IRWIN OPPENHEIM (1929-2014)

Professor emeritus of chemistry Irwin Oppenheim, 84, of Cambridge, passed away on June 3, 2014 from complications following cardiac surgery.

Oppenheim carried out his undergraduate studies in chemistry and physics at Harvard University, graduating summa cum laude in 1949. He attended graduate school at the California Institute of Technology under John Gamble Kirkwood; when Kirkwood left for Yale University, Oppenheim followed him, completing his PhD in physical chemistry in 1956. His thesis research involved some of the first usage of the Wigner functions and expansion in powers of Planck’s constant to develop quantum corrections to classical distribution functions. These distribution functions were then exploited to deduce thermodynamic properties and transport coefficients.

Oppenheim joined MIT’s Department of Chemistry in 1961 as an associate professor—notably, its first theoretical chemist. He was promoted to full professor in 1965.

Oppenheim’s research at MIT concentrated on a molecular description of relaxation phenomena in gases and liquids; he, his students, and collaborators made many important contributions to the field.

“One important contribution is his explanation of the origin of the ‘long time tails’ unexpectedly observed in early molecular dynamics simulations of the correlation function of the viscosity of gases,” says Institute Professor emeritus John M. Deutch, who was Oppenheim’s second PhD student. “He improved our understanding of the microscopic basis of hydrodynamics, Brownian motion, light scattering, [and] magnetic resonance, and this work influenced thinking about these topics throughout the world. He was an expert on chemical thermodynamics and wrote two books on this subject.”

“With his passing, an important index [of] human civilization – ‘global aggregate knowledge of chemical thermodynamics’ — has declined 65 percent,” Deutch adds. “Given all of Irwin’s contributions, I have thought for some time that his work has not received the recognition it should from the scientific community.”

During his lifetime, Oppenheim published 247 publications. In 1996, he assumed emeritus status but remained active in the Department of Chemistry until his death. Oppenheim was an excellent teacher, colleagues say, who taught decades of MIT undergraduate and graduate students introductory physical chemistry and statistical thermodynamics. He was an inspired PhD thesis and postdoctoral advisor to more than 50 individuals, many of whom went on to university positions across the world, and some at MIT. His warm mentoring ensured decades of devotion and friendship from his students.

“Irwin was a master in thermodynamics and statistical mechanics. His theory was marked by rigor and elegance and has influenced a generation of theorists,” says professor of chemistry Jianshu Cao, who in teaching 5.72 (Non-Equilibrium Statistical Mechanics), would invite Oppenheim to present a week of lectures in exchange for a visit to a Chinese restaurant. “Irwin had a free choice of topics for the week but always presented his version of Brownian dynamics theory. These lectures were delivered with precision and clarity, rarely seen in a classroom these days. Except for a few hardcore theory students, it was a challenge to follow his equations that covered the blackboard like wallpaper, but every student left in awe of this grand master and the classic style he exemplified.”
David Chandler ’66, a former undergraduate student of Oppenheim’s who is now the Bruce Mahan Professor of Chemistry at the University of California, Berkeley, says, “Of all the wonderful teachers I learned from at MIT, Irwin Oppenheim influenced me the most. My textbook borrows from his pedagogical style and my research career began on the road he paved for me. I owe much to him, and I will miss him greatly.”

Throughout this career, Oppenheim collaborated with colleagues across the globe—notably from Japan, Israel, and the Netherlands. His Dutch coworkers—Nico van Kampen, Peter Mazur, Ubbo Felderhof, and Dick Bedeaux—often visited MIT, resulting in friendships and collaboration with many members of the department.

“Irwin Oppenheim was an exceptional colleague and friend, an erudite master of the subtleties of thermodynamics and statistical mechanics,” says Jim Kinsey, who served as head of the Department of Chemistry from 1977 to 1982. “His originality and scholarship, along with his jovial enjoyment of good food, good drink, and good company made him a magnet for outstanding visitors from all over the globe.”

“It was always fun to stop by his office and have a moment of revelation,” Cao says, noting Oppenheim’s warm, fun-loving disposition. “Irwin had a high standard for science, but he would always express his opinion with a good sense of humor and a few loud laughs. After lunch, Irwin used to have an afternoon cigar and sometimes asked me to join him. Though not a fan of cigars, I would happily listen to his jokes and wise comments. In recent years, he became less critical about science but still possessed a sharp mind and quick wit. I have fond memories of these light moments and will miss him dearly.”

“Irwin was my ‘academic grandfather,’ and he treated me like family from the moment I walked in the door of MIT almost one year ago,” says Adam Willard, an assistant professor of chemistry. “We talked frequently, sometimes about science—he was truly a master thermodynamicist—but quite often about all those important nonscientific aspects of life. He was a great listener, unusually wise, and had a fantastic sense of humor. His presence here will be sorely missed.”

Irwin Oppenheim was born in Boston in 1929 to James and Rose (Rosenberg) Oppenheim. He was an only child, but grew up in the company of many aunts, uncles, and cousins. He married Bernice Buresh in 1974. In addition to his wife, he is survived by a son, Joshua Buresh-Oppenheim, a daughter-in-law, Rachel Schorr Hirsch, and a granddaughter, Rosalind Iona Hirsch Oppenheim.

Oppenheim was a fellow of the American Academy of Arts and Sciences and the American Physical Society, a member of the Washington Academy of Science, and the recipient of the American Chemical Society’s Joel Henry Hildebrand Award.

“Irwin was a positive part of my life, both professionally and personally, for 65 years,” said [the late] Institute Professor emeritus John Waugh. “I loved and respected him. My world will be smaller, bereft of his wonderful spirit and bonhomie.”
JOHN S. WAUGH (1929-2014)

John S. Waugh, an MIT Institute Professor emeritus and professor emeritus in the Department of Chemistry, died Friday, August 22, at the age of 85. Waugh was an authority in chemical physics, known internationally for his work in magnetic resonance.

Waugh’s pioneering work in nuclear magnetic resonance (NMR) made it possible for scientists to study the molecular structures of proteins involved in Alzheimer’s and Parkinson’s diseases, diabetes, and many other disorders. NMR uses the magnetic properties of atomic nuclei to unravel the structures and dynamics of substances containing those nuclei. In NMR, the magnetic moments of atomic nuclei are stimulated with static and radiofrequency magnetic fields and give rise to signals useful in a variety of applications—from medical imaging to spectroscopy.

“He was an extremely humble giant in the development of solid state nuclear magnetic resonance spectroscopy,” said Sylvia Ceyer, head of MIT’s Department of Chemistry. “His keen wit, razor sharp intellect, and extraordinary sense of humor made him a treasured jewel amongst his colleagues.”

Born in Willimantic, Connecticut, in 1929, Waugh received his bachelor’s degree from Dartmouth College in 1949, graduating summa cum laude with highest distinction in chemistry. He received his PhD in chemistry and physics from Caltech in 1953. He came to MIT as an instructor in chemistry that same year, and became assistant professor in 1955, associate professor in 1958, professor in 1962, and the Arthur Amos Noyes Professor of Chemistry in 1973.

As a grad student in the lab of Caltech chemistry professor Don Yost, Waugh built his first NMR system with a borrowed magnet and some World War II surplus electronics. When he arrived at MIT, NMR was already a valuable tool for the study of molecular structure—but only for liquid samples.

In the 1960s, Waugh developed a way to use NMR to study solids by applying a special sequence of sharp, intense pulses of radiofrequency power. This made NMR useful for analyzing things that don’t dissolve in water, including proteins, nucleic acids (such as DNA), and some drugs. That technique eventually played a role in many of the past half-century’s discoveries in chemistry, physics, biology, and materials science; it is now one of science’s most widely used tools.

In 2011, Waugh told MIT News that he never anticipated the wide impact his work has turned out to have.

“I think that’s the way most [scientists] are,” he said. “You start off doing some limited kind of stuff that makes use of any particular talents or knowledge you happen to have. You don’t think of it as being something that’s going to revolutionize the world. It’s just something interesting to do and might be fun.”

In 1988, Waugh was the recipient of MIT’s James R. Killian Jr. Faculty Achievement Award—an honor bestowed by faculty colleagues in recognition of extraordinary professional accomplishments and service to the Institute.

In 2011, he received the Welch Award, given for basic research that benefits humankind.

“Dr. Waugh discovered how to use NMR to study solids, creating a collection of tools that allows researchers to view the structures and properties of proteins, membranes, viruses and many other critical components of life,” said Ernest H. Cockrell, chair of the Welch Foundation, in presenting Waugh the award. “Ultimately, new applications in fields as diverse as medicine and batteries can trace their way back to the research techniques he initiated.”
Waugh also won the Wolf Prize in Chemistry in 1983. He was a member of the National Academy of Sciences, a fellow of the American Academy of Arts and Sciences, and a former chairman of the Division of Chemical Physics of the American Physical Society. He received Dartmouth’s Haseltine Chemistry Prize in 1949, the Humboldt-Preis in 1972, the Irving Langmuir Chemical Physics Award in 1976, the Pittsburgh Spectroscopy Award in 1978, and Caltech’s Distinguished Alumnus Award in 1987. In 1989 he received an honorary doctorate from Dartmouth.

Waugh is survived by his wife, Susan, of Lincoln, Massachusetts; a daughter, Alice, of Lincoln, Massachusetts; a son, Frederick, of Austin, Texas; and five grandchildren, Sarah and Rebecca of Lincoln, Massachusetts and Jack, Ted, and Sam of Austin, Texas.

A memorial service will take place at MIT in the spring of 2015.
NELSON ELECTED TO THE AMERICAN ACADEMY OF ARTS AND SCIENCES

Professor Keith A. Nelson has been elected to the American Academy of Arts and Sciences.

One of the nation’s most prestigious honorary societies, the Academy is also a leading center for independent policy research. Members contribute to Academy publications and studies of science and technology policy; energy and global security, social policy and American institutions, and the humanities, arts, and education.

“It is a privilege to honor these men and women for their extraordinary individual accomplishments,” said Don Randel, Chair of the Academy’s Board of Directors. “The knowledge and expertise of our members give the Academy a unique capacity — and responsibility — to provide practical policy solutions to the pressing challenges of the day. We look forward to engaging our new members in this work.”

The new class was inducted at a ceremony on October 11, 2014, at the Academy’s headquarters in Cambridge, Massachusetts.

BUCHWALD RECEIVES 2014 PAULING MEDAL

Professor Stephen L. Buchwald, the Camille Dreyfus Professor of Chemistry, has been awarded the 2014 Linus Pauling Medal Award, for “outstanding contributions to chemistry meriting national and international recognition.”

Professor Buchwald was honored at a symposium and banquet held October 11, 2014 at Western Washington University. The Linus Pauling Medal Award has been given annually since 1966 by the ACS Puget Sound, Oregon, and Portland Sections of the American Chemical Society. The award is named after its first winner Nobel laureate Linus Pauling, a native of the Pacific Northwest.

Buchwald’s research combines the elements of organic synthesis, physical organic chemistry, and organometallic chemistry to devise catalytic processes of use in solving problems of fundamental importance.

DANHEISER RECEIVES SCHOOL OF SCIENCE GRADUATE TEACHING AWARD

Professor Rick Danheiser has been awarded the 2014 Teaching Prize for Graduate Education by the School of Science. This prestigious honor is a mark of Professor Danheiser’s dedication to teaching excellence and the School of Science’s appreciation of his efforts.

DINCA AND JOHNSON RECEIVE SLOAN RESEARCH FELLOWSHIPS

Professors Mircea Dincă and Jeremiah Johnson have been selected to receive 2014 Alfred P. Sloan Foundation Research Fellowships. Since 1955, the fellowships have been awarded to early-career scientists and scholars whose achievements and potential identify them as rising stars, the next generation of scientific leaders.

“For more than half a century, the Sloan Foundation has been proud to honor the best young scientific minds and support them during a crucial phase of their careers when early funding and recognition can really make a difference,” said Dr. Paul L. Joskow, President of the Alfred P. Sloan Foundation. “These researchers are pushing the boundaries of scientific knowledge in unprecedented ways.”
SCHROCK RECEIVES PARACELSUS PRIZE

Professor Richard R. Schrock has been honored with the 2014 Paracelsus Prize. The Paracelsus Prize is the highest award given by the Swiss Chemical Society and is awarded biennially to an internationally outstanding scientist for his or her lifetime achievements in chemical research.

Schrock is perhaps best known for his discovery of “high oxidation state carbene” (alkylidene complexes) by alpha hydrogen abstraction in high oxidation state metal alkyl complexes for which he received the Nobel Prize in Chemistry in 2005. In the last several years he has applied alkylidene chemistry toward the controlled polymerization of cyclic olefins via ring-opening-metathesis polymerization (ROMP). He has also achieved the catalytic reduction of dinitrogen by molybdenum complexes at room temperature and pressure with protons and electrons. His most recent focus is on the synthesis and applications of new monoalkoxide pyrrolide (MAP) olefin metathesis catalysts for Z selective olefin metathesis reactions.

NOLAN RECEIVES DREYFUS AWARD

Professor Elizabeth M. Nolan has received a Camille Dreyfus Teacher-Scholar Award for her work in understanding the physiological role of peptides/proteins that bind metals and their function as antibacterial agents. The Camille Dreyfus Teacher-Scholar Awards Program supports the research and teaching careers of talented young faculty in the chemical sciences.

JOHNSON RECEIVES DUPONT YOUNG PROFESSOR AWARD

Professor Jeremiah A. Johnson has been selected to receive a DuPont Young Professor’s Award. The DuPont Young Professor program is designed to help promising young and untenured research faculty who work in areas of interest to DuPont begin their research careers. One of the most sustained corporate programs for academic research, the program has spanned over four decades, providing over $50 million in grants to nearly 700 young professors in nearly 140 institutions in 14 countries since 1968.

Professor Johnson seeks creative, macromolecular solutions to problems at the interface of chemistry, medicine, biology, and materials science.

SWAGER APPOINTED FACULTY DIRECTOR OF DESHPANDE CENTER FOR TECHNOLOGICAL INNOVATION

Timothy M. Swager, the John D. MacArthur Professor of Chemistry, has been named faculty director of the Deshpande Center for Technological Innovation. His appointment, announced at the center’s annual research showcase, IdeaStream, became effective May 1.

“Professor Swager’s background in world class research and technology commercialization, and his leadership within MIT’s Chemistry department will be great assets to the center,” says Deshpande Center founder Desh Deshpande. “Tim’s proven ability to impact the world with his ideas will allow him to play a key role in leading MIT’s innovation agenda.”

Swager will replace Charles Cooney, the Deshpande Center’s faculty director since it was founded in 2002. Under Cooney’s direction, the center has awarded more than $13,000,000 in grants to more than 100 MIT research projects; these projects have lead to the formation of 28 spinout companies that have raised over $500 million in investment capital. “The Deshpande Center is grateful to Charlie for his unwavering commitment to innovation,” says the center’s executive director, Leon Sandler. “He has played an integral role in our success, and the center’s programs have thrived under his leadership.”

Swager has published more than 300 peer-reviewed papers, and has more than 50 issued or pending patents. He has served on a number of corporate and government...
boards, and he is the cofounder of four companies including C2Sense, a Deshpande Center-funded spinout company.

“As a two-time Deshpande grantee, I have benefitted from its transformative role in guiding the entrepreneurial activities of faculty and students,” Swager says. “The Center has had a tremendous impact on the transition of MIT inventions, and I am excited to steward this precious resource. I look forward to examining new models for directing, seeding, and fostering the commercialization of MIT’s research for the benefit of society.”

LIPPAR DELIVERS PRIESTLY ADDRESS

On Tuesday, March 18, 2014 at the 247th American Chemical Society National Meeting in Dallas, Texas, Professor Stephen J. Lippard, Arthur Amos Noyes Professor of Chemistry, was awarded the 2014 Priestley Medal. The Priestley Medal is the highest honor conferred by the American Chemical Society (ACS) and is awarded for distinguished service in the field of chemistry. Professor Lippard has spent his career studying the role of inorganic molecules, especially metal ions and their complexes, in critical processes of biological systems. He has made pioneering contributions in understanding the mechanism of the cancer drug cisplatin and in designing new variants to combat drug resistance and side effects.

To see a video of the address, go to: http://chemistry.mit.edu/2014-priestley-medal-address

DINCĂ RECEIVES COTTRELL SCHOLAR AWARD

Professor Mircea Dincă is one of a dozen outstanding early career teacher-scholars at PhD-granting institutions to be accepted into the Cottrell Scholar program following a rigorous peer-review process. Only about 10 percent of those who submit proposals are successful.

VAN VOORHIS SELECTED BY DREYFUS FOUNDATION

Professor Troy Van Voorhis has been selected to receive a grant from the Camille and Henry Dreyfus Foundation under its Special Grant Program in the Chemical Sciences. The Special Grant Program in the Chemical Sciences provides funding for innovative projects in any area consistent with the Foundation’s broad objective to advance the chemical sciences.

Professor Van Voorhis was selected for his proposal titled, “Expanding the Palette of Problem Authoring Tools For Online Chemistry Education.” This project will develop software tools that will allow instructors to easily create complex open ended problems for use in online chemistry courses.

SHOULDERS RECEIVES RICHARD AND SUSAN SMITH FAMILY FOUNDATION AWARD

Professor Matthew Shoulders has been selected to receive a three-year Smith Family Award for Excellence in Biomedical Research.

For the past 21 years, the Smith Family Foundation has been supporting ground-breaking medical research through the Smith Family Awards Program for Excellence in Biomedical Research. Its mission is to launch the careers of newly independent biomedical researchers with the ultimate goal of achieving medical breakthroughs.
Tuesday, October 22, 2013 was a special day for the Department of Chemistry. It was the day the Chemistry Education Office was named for the late Dean of Science and Professor of Chemistry, Robert J. Silbey. Not by coincidence, it was also the day the first of two A.D. Little Lectures in Physical Chemistry was delivered by theoretical chemist Professor Bruce Berne, Higgins Professor of Chemistry at Columbia University. Bruce Berne is a lifelong friend of the Silbey family. Bob and Bruce attended school together in Brooklyn, New York, and later carried out their graduate studies at the University of Chicago. Bob and Bruce remained the closest of friends right up until Bob’s death in 2011.

Before delivering his lecture titled, “The Role of Water in Molecular Recognition and in the Kinetics of Hydrophobic Assembly,” Professor Berne devoted time to speak about Silbey’s illustrious career. Room 6-120 was filled to capacity with current students and postdocs, along with Silbey’s colleagues, former students and post-docs, friends and family.

Bruce described Bob’s scientific accomplishments in electronic energy transfer in condensed phases, in radiative properties of molecules near surfaces, and in the physical origin of polymer conductivity. He also enjoyed sharing with the audience his enjoyment of Bob’s witty and comedic humor.

At the conclusion of the lecture, the crowd gathered outside the recently refurbished Chemistry Education Office located in 6-205 for a ribbon-cutting ceremony. Presiding over the event were Professor Sylvia T. Ceyer, Head of Chemistry; Professor Susan S. Silbey, the Leon and Anne Goldberg Professor of Sociology and Anthropology at MIT; and Dr. Theresa C. Kavanaugh, former Silbey graduate student and partner at the law offices of Goodwin Procter.

Professor Ceyer described how appropriate it was to dedicate the education office in Bob’s name because of his extraordinary teaching talent, his devotion to his students, and the wonderful relationship he had with his colleagues.
Dr. Kavanaugh, expressing enormous affection for her former advisor, referred to an amusing sign Bob kept in his office which read, “Stop whining,” and his advice to her to act like an adult—“words of wisdom,” she said, “I draw on anytime I feel a whine coming on.”

Professor Silbey, Bob’s wife, declared Bob would not approve of the honor of a dedicated office, but said it was a fitting tribute to a man who was so devoted to science and education. “The honor of the naming of this office is not for Bob,” she said, “it is for all his children—his academic children—and his daughters and grandchildren—who now know his memory will be honored in perpetuity.”

The education office will now formally be referred to as “The Robert J. Silbey Chemistry Education Office.”

by Liz McGrath
Mei Hong joined the Department of Chemistry at MIT in July 2014 as a full professor after spending 15 years at Iowa State University. The move is a homecoming of sorts, as Mei completed her bachelor’s degree at Mount Holyoke College in western Massachusetts and conducted her postdoctoral research at MIT in 1996-1997. In between, she journeyed west to carry out PhD research at the University of California, Berkeley. After sampling both the west coast and the east coast for her education, she started her independent career in the heartland of America before being lured back to MIT.

Trained as a solid-state NMR spectroscopist who designs multidimensional radio-frequency pulse sequences to investigate a wide range of chemical problems, Mei has employed this versatile and powerful spectroscopic technique to answer important biomedical questions. She has always been fascinated by the phospholipid membrane and the proteins embedded in it. How do immune-defense peptides of animals and higher plants make damaging pores in bacterial cell membranes while avoiding any harm to the host cell membrane? How do proteins conduct ions across the hydrophobic barrier of the lipid bilayer? How do viruses use their protein machinery to fuse the virus envelope and the cell membrane to enter cells? Her group has been making detailed inquiries of the inner workings—structure, dynamics, and mechanism of action—of membrane proteins, such as bacterial toxins, antimicrobial peptides, viral channel proteins, and viral fusion proteins.

Two inherent properties of NMR spectroscopy are particularly useful for membrane protein structural biology. One is the ability to report on inter-atomic distances through dipolar couplings between nuclei. Mei and her coworkers have exploited this capability to figure out, for example, where drugs bind inside an ion channel, how antimicrobial peptides assemble into barrels that punch holes in bacterial membranes, and how cationic peptides with charged amino acid residues bind lipid headgroups to neutralize their charges so that they can sneak into cells like Trojan horses to deliver macromolecular cargos.

The second useful feature of solid-state NMR is sensitivity to molecular orientation and its changes during motion. Mei has exploited this orientation dependence of NMR spectra to probe how α-helices and β-sheets are tilted and inserted in the lipid membrane, whether antibacterial peptides kill cells by forming a carpet on the cell surface or a membrane-spanning pore, and how amino acid residues regulate ion conduction by strategic sidechain motions.

To make these biological studies possible, Mei had to develop a number of NMR tools along the way. To be able to study recombinant proteins with extensive $^{13}$C and $^{15}$N labeling, she developed 2D and 3D correlation pulse sequences so that multiple protein signals can be resolved and assigned to individual residues. To detect how deeply a protein inserts into the lipid bilayer, she designed lipid-protein $^1$H-$^{13}$C correlation experiments. To measure how a protein oligomerizes, she developed a $^{19}$F NMR method to count the number of spins within a distance of 15 Å.

Figure 1. (a) The influenza A virus M2 protein is inhibited by drugs. Wild-type M2 is blocked by amantadine, and high-resolution structure of the amantadine-M2 complex has contributed to the design by DeGrado and coworkers of a bulkier drug, WJ352, that blocks the amantadine-resistant S31N mutant. NMR data have pinpointed the binding site of both drugs to be in the pore of the channel. (b) Proton conduction by M2 is mediated by a single histidine residue, His37, in the transmembrane domain. The depicted cycle highlights key dynamic processes that shuttle protons from the cytosol into the virus: microsecond ring reorientation, tautomerization, protonation, and deprotonation. These events have been directly observed in solid-state NMR spectra.
These solid-state NMR techniques are inspired by various biological questions. One of these questions is how the influenza A virus M2 protein works (Fig. 1). This protein forms an acid-activated proton channel that is important for the virus lifecycle. How this small protein conducts protons has implications for understanding larger proton channels in humans. M2 is inhibited by amantadine, and how this drug binds the protein has implications to the design of new generations of antiviral drugs against amantadine-resistant flu strains.

Mei’s lab has also had a long-standing interest in curvature-inducing membrane proteins. Many membrane proteins with completely different functions share the common trait of causing membrane curvature. For example, antimicrobial peptides can form pores in the lipid membrane, and viral fusion proteins generate membrane curvature during its merger of the virus envelope and cell membrane. By studying these systems with a wide variety of NMR techniques, Mei and her coworkers have been gaining detailed insights into the type of membrane curvature and the structure of the protein-lipid assembly at the high-curvature membrane locales.

Due to the public’s increasing interest in plant biomass as an alternative energy source, Mei’s group has also embarked on a new direction of studying polysaccharide-rich plant cell walls. Traditional analytical techniques such as liquid chromatography and mass spectrometry require the use of strong acids and bases to solubilize the cell wall, in doing so damaging the very structure of interest. In contrast, solid-state NMR spectroscopy can be used to probe these biomaterials in their native state. Her group’s findings so far have led to a new model of how cellulose, hemicellulose, and pectins are structured together in the primary plant cell wall (Fig. 2). It has also revealed, for the first time, where a protein called expansin binds in order to loosen the cell wall during plant growth.

Figure 2. Investigating plant cell wall structure using solid-state NMR. (a) A cartoon model of the plant cell wall. (b) 2D 13C correlation spectra such as the one shown here reveal that cellulose are in molecular contact with both pectins and hemicellulose, the two dominant matrix polysaccharides in dicot cell walls. Thus, there is a single polysaccharide network in the wall, instead of two networks as long thought based on chemical extraction data. (c) 1H spin diffusion spectra show that expansin binds cellulose for function. An inactive mutant (WWY) transfers little magnetization to cellulose, while a hyperactive mutant (RKK) shows high magnetization transfer to cellulose. Molecular dynamics simulations suggest the way with which expansin docks the cellulose microfibril.
Dr. Jeffrey Van Humbeck joined the chemistry faculty at MIT in July of 2014, arriving most recently from a post-doctoral position at the University of California, Berkeley, with professor Jeffrey Long, which had focused on the development of new porous organic materials. Prior to Berkeley, Jeff completed a PhD under the supervision of David MacMillan at Princeton University, where he performed detailed mechanistic studies to complement new reaction discovery and development.

Born and raised in Calgary, Alberta, Canada, Jeff was fortunate to have the opportunity to spend meaningful time in three different research groups at his hometown institution, the University of Calgary. With a background in total synthesis (Prof. Brian Keay), organometallic chemistry (Prof. Warren Piers), and mechanistic organic chemistry (Prof. Ted Sorensen), Jeff found himself uniquely positioned when he joined the lab of Professor David MacMillan in the fall of 2006. Recent developments in the MacMillan laboratory had focused on the simultaneous use of two catalysts—one featuring a transition metal center, and the second being a purely organic amine—for new reaction development. However, the precise nature of the interaction between the key catalytic intermediates had not been elucidated, and in some cases, had likely been postulated incorrectly in the published literature. Jeff was able to provide an improved mechanistic understanding for a wide variety of recently discovered reactions, which can now be classified in terms of the number of transition state interactions involving the metallic component (Figure 1).

Upon completing his graduate work in 2011, Jeff moved west to the University of California, Berkeley, joining the research group of Professor Jeffrey Long, who is well known for his expertise in porous inorganic and hybrid materials. With his complementary skill in synthetic organic chemistry, Jeff was able to produce fully organic porous polymers that had superior adsorption and separation performance (as compared to inorganic or hybrid analogs) in processes that featured extremely corrosive environments. In particular, an organic framework featuring a high density of precisely arranges carboxylic acids was shown to have a tremendous affinity for gaseous ammonia, while also showing exceptional stability (Figure 2). The particular spatial arrangement of the functional groups also allows for multiple interactions with dissolved metal ions. Advanced nuclear fuel processing strategies require selective adsorbents that can remove lanthanide and actinide elements—especially americium and curium—from highly acidic and radioactive waste streams. The material shown in Figure 2 has the requisite stability to nitric acid and has also shown the ability to discriminate between metal ions based on their charge/size ratio. For example, Nd(III) and Am(III) are adsorbed in the materials with good preference over other metal ions found in the complex waste mix, include Fe(III), Sr(II), and Cs(I). Additionally, Jeff was also able to design rigid, and fully organic, lithium-ion conducting materials using tetrakis(tetrafluorophenyl)borate nodes as a tetrahedral building unit (Figure 3).
The Van Humbeck group will be focused on using non-covalent interactions to control (i) the outcome of catalytic reactions and (ii) the structure of organic materials.

The techniques of organic synthesis have developed to the point where, with unlimited time and resources, any stable organic molecule of reasonable size can be produced on milligram scale. The current frontier of research, instead, asks the question: Can the desired compound be produced at the scale, and at the cost, that makes it available for society? While determining an acceptable cost and predicting the required scale may be complex questions, it can be said without hesitation that developing new approaches to avoid wasteful operations (e.g. reduction/oxidation, protecting group reactions, etc.), and inventing new reactions that forge numerous bonds in a single transformation would significantly advance the state of the art.

Avoiding wasteful transformations implicitly demands the development of new catalysts that can enforce regioselectivity and chemoselectivity in traditional reactions. The Van Humbeck laboratory is interested in using local electric fields, generated from the inclusion of permanent charges in catalyst structures to achieve these ends.

Numerous high-value compounds, for applications as diverse as gasoline replacement (e.g. 1-hexanol) to medicinal chemistry (e.g. polyketide natural products), could be generated directly in a single step from simple starting materials by an “interrupted” polymerization reaction; a process known as oligomerization. To select for the desired size/length of oligomeric product, rationally designed porous materials will be used to house an active catalyst (Figure 4). The past fifteen years have seen an incredible growth of interest in the development of new porous materials, especially in the area of metal-organic frameworks (MOFs) and structured porous organic polymers. Additionally zeolites are still the dominant porous material in chemical industry. In all these cases, the greatest theoretical understanding and experimental evidence exists for reactions in the gas phase. The reactions shown in Figure 4 will be performed in solution, which also offers an opportunity to greatly expand our fundamental knowledge of how confinement in the polymer environment affects solvation of the reactants, products, and the transition state connecting them.

Materials science has taken advantage of ionic interactions to a much greater degree, with polyelectrolytes an important class of polymers, both industrially and academically. In the overwhelming majority of cases, however, both the position and amount of charge in the polymer structure is fixed, with the noteworthy exception of response to pH. As a generic question, the Van Humbeck lab is interested in exploring the properties of materials where both the amount and position of charge in polymer fragments is dynamic, and ideally, responsive to environmental stimuli.
Alex K. Shalek joined the MIT Chemistry faculty in July 2014 with joint appointments to the Institute for Medical Engineering & Science (IMES) at MIT and the Ragon Institute of MGH, MIT, and Harvard. Dr. Shalek obtained his bachelor’s degree in chemical physics from Columbia University while working in the laboratories of Professors Richard Bersohn and Louis Brus and his PhD in chemical physics from Harvard University under the guidance of Professor Hongkun Park. He then performed his postdoctoral research under the joint supervision of Professors Park and Aviv Regev (Broad Institute & MIT).

Research in the Shalek group is directed towards the development and application of new technologies that will facilitate a better understanding of how cells collectively perform systems-level functions in healthy and diseased states. With respect to technology development, the group is leveraging recent advances in nanotechnology and chemical biology to establish a host of core, cross-disciplinary platforms that will enable them to extensively profile and precisely control cells and their interactions within the context of complex systems. With respect to biological applications, the group is focusing on how cellular heterogeneity and cell-to-cell communication drive ensemble-level decision-making in the immune system, with an emphasis on “two-body” interactions (e.g., host cell-virus interactions, innate immune control of adaptive immunity, tumor infiltration by immune cells). The goal is not only to provide broadly applicable experimental tools, but also to help transform the way in which we think about single cells, cell-cell interactions, diseased cellular states and therapeutics so as to create a new paradigm for understanding, treating, and designing systems-level cellular behaviors in multicellular organisms.

As a graduate student, Alex demonstrated that vertical silicon nanowires (“NWs”) could penetrate the cellular membranes of many different cell types without compromising their health (Figure 1). This intracellular access allowed Alex and his coworkers to pursue novel opportunities to systematically perturb and measure cellular behaviors. For example, by covalently tethering detection substrates to NWs, they were able to use those NWs as biochemical sensors and measure in situ enzymatic activity. Similarly, by fabricating individually electrically addressable NWs, they intracellularly recorded and stimulated neuronal activity in a highly multiplexed fashion.

Moreover, by pre-coating the NWs with biomolecules, Alex and his colleagues were able to use them as cellular scale ‘syringes,’ and efficiently deliver a diverse set of unmodified biochemicals, alone and in combination, directly into almost any living cell. One important advantage of this technique is that it works on even notoriously difficult to transfect primary immune cells. This allowed NW-delivery-based perturbations to be used to systematically study the molecular circuits that drive primary immune cell behaviors in health and disease. As an example, by using NWs to perform the first large-scale RNAi screen in primary naïve mouse T cells, Alex helped experimentally refine a temporal model of the dynamic regulatory network that controls the differentiation of autoimmunity-inducing, pro-inflammatory Th17 T helper cells (Fig. 1). This circuit model showed that the network was composed of two self-reinforcing, yet antagonistically coupled, modules of regulators—one promoting Th17 differentiation and inhibiting the differentiation of other cell types and the other doing the opposite. Through their work, Alex and his coworkers identified 12 novel regulators of Th17 differentiation that may be therapeutically actionable.

Figure 1. Deciphering the molecular network governing Th17 differentiation. Using NW delivery of siRNAs (A), Alex and his colleagues performed a large-scale RNAi screen in naïve T cells (B). This enabled them to discover that the network is comprised of two mutually antagonistic, but self-reinforcing modules.
For Alex, these NW-based studies also highlighted that population-level measurements can mask underlying differences between individual cells. For example, he noticed that some B cells isolated from the same Chronic Lymphocytic Leukemia patient survived knockdown of a given target gene while others did not. This and related findings stimulated his interest in applying single-cell-based approaches to better understand the root causes and functional consequences of cellular differences in gene expression, protein level and phenotypic output.

To date, studies of cellular heterogeneity have typically measured only a few pre-selected RNAs or proteins, limiting their ability to uncover novel factors due to a bias towards pre-characterized genes. For an unbiased view, Alex developed new single-cell genomics approaches and adapted emerging ones. In a first study, single-cell RNA-Seq was used to profile 18 ‘identical’ immune dendritic cells (DCs) after a 4 hour stimulation with a bacterial component. The study revealed extensive bimodality in the DC response at multiple levels, including in the expression of key immune response genes and the splicing of RNA, each of which was independently validated by RNA-FISH of select transcripts. Even with just 18 cells, by explicitly measuring single-cell gene expression, rather than just the population mean, and examining the co-variation between different genes across single cells, Alex and his colleagues were able to decipher two distinct cell states and an interferon-driven antiviral circuit that they subsequently validated.

While this first study showed that single-cell RNA-Seq could, in principle, be used to achieve an unbiased understanding of the extent, basis and function of gene expression variation between ‘identical’ cells, further development required a high-throughput workflow for profiling many cells across different experimental conditions. To address this challenge, Alex and his coworkers collaborated with Fluidigm to realize a microfluidics-based pipeline for capturing and preparing up to 96 single cells for RNA-Seq in parallel and used it to generate libraries from over 1,800 single DCs stimulated with three pathogenic components (Figure 2). This data revealed substantial variation between individual cells exposed to the same stimulus, in both the fraction of cells expressing a given mRNA transcript and the transcript’s levels within expressing cells. It was also determined that distinct gene modules are characterized by different temporal heterogeneity profiles. In particular, a core module of antiviral genes is expressed very early by a rare sub-population of precocious responders and then becomes active in all cells at later points in time. By stimulating cells individually in sealed microfluidic chambers and analyzing DCs from knockout mice, it was shown that these precocious cells propagate and coordinate this response via interferon-mediated paracrine signaling. Surprisingly, ablating cell-to-cell communication dramatically reduces variability in the expression of an early-induced inflammatory gene module, suggesting that paracrine signaling is essential for not only synchronizing the antiviral response, but also repressing and desynchronizing a portion of the inflammatory program. This study highlights the importance of cell-to-cell communication and the cellular microenvironment in controlling heterogeneity; further, it provides new insights into the general strategies that multicellular populations use to establish complex dynamic responses.

Collectively, these observations have convinced Alex that developing a deep understanding of the inter- and intracellular circuits that drive ensemble behaviors in health and disease will require new experimental strategies to resolve the activity of individual cells while precisely controlling the microenvironment and cellular interactions. This recognition is motivating the Shalek group’s current research.
During the 2013-2014 academic year, the Chemistry Education Office focused on enhancing its community building events as well as offering new opportunities for student career development.

Each Chem Café this year featured at least one special faculty guest and everyone enjoyed the opportunity to get together once a month and share in a delicious lunch! We continued the tradition we began last year by hosting our 2nd Annual Halloween Open House, complete with candy and lots of other treats. A new event was also introduced entitled “Cookies, Cocoa, and Chemistry,” which was a study break co-sponsored with Club Chem in December. We invited our majors, as well as students in 5.111 and 5.112, to stop by our Undergraduate Lounge and enjoy cocoa and hand-decorated chemistry themed cookies.

Another new event this year focused on careers in chemistry. Our office hosted a Career Panel during Campus Preview Weekend, an event geared toward both our current majors and prospective MIT undergraduates. The Career Panel featured four recent Course V graduates and provided students with valuable information about diverse career options that students can pursue with a chemistry background.

The real story, as always, is our excellent students. Some highlights of their accomplishments follow.
Chemistry Majors

We continue to consistently attract outstanding undergraduate students to Course V, with a total of 56 majors across the three years. This year, 18 students received SB degrees in Chemistry. In exit surveys, we found that 50% of the Class of 2014 is bound for graduate school, 17% plan to attend medical school, and 33% will seek employment.

The majors are active promoters of chemistry and were on hand to talk with freshmen at the Academic Expo in August and admitted students during Campus Preview Weekend. In addition, six members of Club Chem, along with Professor Brad Pentelute and Karen Shaner, traveled to Washington DC in April to host a booth at the 2014 USA Science and Engineering Festival (USASEF), where the students shared their love of chemistry with hundreds of young students, teachers, and parents across the three-day conference.

Chemistry Teaching Assistants

Our graduate student TAs are some of the best (if not the best) at MIT. This year students gave 78% of our TAs a 6.0 or higher on a 7.0 scale. Of those in this percentile, half received a 6.5 or higher.

Highlights from student evaluations:

“Best recitation leader! Your review sessions and summaries of all the reactions for a single unit were invaluable and the reason our recitation always did so well was because of how clearly you explained all the concepts and worked us through practice problems. I hope you become a full time chemistry teacher someday because you’d be a great lecturer!”

“[She] was incredibly on top of everything, always. She was by far the most organized TA. She would come in early to write up lecture notes on the board before lab, was very helpful during office hours, and made sure to thoroughly explain the experiments to her students. She was not only a wonderful TA in lab, but was also very responsive via email. Great at explaining things, and very committed to her students.”

“He was an excellent TA and helped me understand the material. He genuinely cares for his students and encourages us to put in more effort. I also enjoyed how he always answered students’ questions and focused on each of our problems rather than just completing a set of questions. He has great teaching skills and I learned a lot from recitation!”

UROP

UROP continues to be the capstone experience for our undergraduates. With the vast majority of our majors working in a research group at least once during their degree program, they have the unique opportunity to conduct research alongside faculty, post docs and graduate students. Below is a sample of recent publications by UROP students in chemistry research groups.

UROP Publications 2013-2014


by Jennifer Weisman, PhD
Congratulations Seniors!

Back Row: (L-R) Megan Cherry, Alice Choi, Chyleigh Harmon, Julia Berk, Sumin Kim, Anubhav Sinha, Suan Tuang, Jacob Laux, Katherine Silvestre, Tatiana Berger, Vincent D’Andrea, Erika Ye
Front Row: (L-R) Grace Tuyiringire, Daniel Mokhtari, Alexandra Wrobel, Sasilada Sirirungruang, Arunima Balan, Aileen Johnson
Not Pictured: Sean Karson

2014 Chemistry Undergraduate Student Awards

CRC Freshmen Chemistry Achievement Award
For outstanding academic achievement in chemistry
Minwoo Bae
Tomohiro Soejima

Outstanding Sophomore Achievement Award
For outstanding achievement in academics, research, and service to the Department of Chemistry
Lily Chen
Diptarka Hait

ACS Analytical Chemistry Award
For outstanding achievement by a junior in experimental chemistry
Martin McLaughlin

Strem Prize
For outstanding undergraduate research and in recognition of the best presentation at the 2014 Chemistry UROP Symposium
Alexandra Wrobel

Alpha Chi Sigma Award
For outstanding achievement in scholarship, research, and service to the Department of Chemistry
Daniel Mokhtari
Katherine Silvestre

Research Award
For outstanding contributions in the area of research
Arunima Balan
Tatiana Berger

Frederick D. Greene Teaching Award
For outstanding contributions in the area of teaching
Arunima Balan
Suan Tuang

ACS Inorganic Chemistry Award
For excellence in inorganic chemistry
Alexandra Wrobel
Merck Index Award
For outstanding scholarship
Arunima Balan
Eun Young (Alice) Choi
Sasilada Sirirungruang
Erika Ye

Service Award
For significant contributions in the area of service to the
Department of Chemistry
Suan Tuang
Alexandra Wrobel

Hypercube Scholar Award
For outstanding contribution to the advancement of
computers in teaching
Sean Karson

Special Recognition
Association of MIT Alumnae (AMITA) Senior Academic Award
Arunima Balan

Phi Beta Kappa 2014 Inductees
Arunima Balan
Eun Young (Alice) Choi
Daniel Mokhtari
Katherine Silvestre
Sasilada Sirirungruang

Special Thanks!

We take this opportunity to express our sincere thanks and appreciation to the following chemistry majors for their service this year to the department and the field of chemistry.

Pictured—ClubChem members:
L-R: Kayvon Pedram ('15); Seniors Alice Choi, Arunima Balan, and Daniel Mokhtari; Daniel Zhang ('15); Suan Tuang ('14); and Job Chakarawet ('15)

Tutoring
Arunima Balan
Tatiana Berger
Natalie Burgos
Richard Chang
Lily Chen
Eun Young Choi
Jakob Dahl
Vincent D’Andrea
James Deng
Ahmed Eltahir
Hope Flaxman
Catherine Garrison
Diptarka Hait
Tabitha Miller
Julia Page
Kayvon Pedram
Ilana Porter
Reuben Saunders
Katherine Silvestre
Sasilada Sirirungruang
Rebecca Taylor
Alexandra Wrobel
Daniel Zhang
Kevin Erazo
Diptarka Hait
Hansol Kang
Daniel Mokhtari
Kayvon Pedram
Jennifer Plotkin
Katherine Silvestre
Tomohiro Soejima
Suan Tuang
Daniel Zhang

Service
Lily Chen
Eun Young Choi
Arunima Balan

Nima is a double major in Courses 5 and 8, coming from Niskayuna, New York. After initially declaring chemistry, she discovered that physics was much cooler than she first thought when she took quantum mechanics sophomore fall. Nima has been a member of the Dinca group since her freshman spring, where she has enjoyed working on the synthesis and characterization of MOFs. She has enjoyed her time at MIT, and is now looking forward to moving to California to pursue her PhD in chemistry at UC Berkeley.

Tatiana Berger

Tatiana is from sunny Fort Lauderdale, Florida. Although first declaring course 20, she soon found her real passion in biological and organic chemistry. She has enjoyed learning about peptide chemistry through her work in the Pentelute lab and is very grateful for this experience. Outside of chemistry, she kept busy spiking volleyballs with MIT Women’s Varsity Volleyball team, getting to know her Sigma Kappa sisters, working on international development projects in GPI, and recently (thanks to her course 5 friends), getting roped into training for a marathon. Tatiana is excited to pursue her passion of medicine at Boston University School of Medicine next fall.

Julia Berk

Julia has had an eventful four years at MIT. Having been interested in chemistry since middle school, Julia loved being immersed in Course 5. Through UROPs and other research positions, she investigated the various disciplines within chemistry before settling on inorganic chemistry. Julia first joined the Field group during sophomore year, and then worked during her junior summer in organic synthesis and polymer chemistry at the Université de Pierre et Marie Curie in Paris. She also worked for a short time during senior year in the Cummins group. Julia also completed a minor in music with a focus in presentation.

Aside from her academic career, Julia was very involved on campus. Julia has been part of the MIT Concert Choir since freshman year and spent two years on its executive board. Julia was also very active in her sorority, serving on the executive board for two years and as President for one. In addition, Julia was a founding member of MIT’s newest a cappella group, the Centrifugues. Julia still has some soul-searching left to do but plans to work in industry while exploring long-term career options. She has not ruled out any path, but she is leaning towards teaching, which has been an idea in the back of her mind since she was six years old. No matter what she ends up doing, Julia would like to thank the MIT Chemistry Department for the incredible amount of knowledge that she gained, support that she encountered, and friendships that she formed during her time at MIT.

Megan Cherry

Megan Cherry is from Greensboro, North Carolina. Having varied interests, her road to chemistry was anything but direct, but well worth the journey. After initially declaring 18C, Megan switched to 18 before making the leap to 5 during her junior year. While at MIT, Megan UROP’d in the Sengupta Nanomedicine lab. Here she was able to work on projects relating to metastatic breast cancer. When not in lab or in class, Megan played viola in the MIT Symphony Orchestra, TA’d a computer science course for local high school students, and remained a prominent figure in both dorm and cultural group leadership. She also enjoys traveling (she went to Jamaica twice with the International Development Club), delicious food, and watching (and critiquing) movies. Next year, she is looking forward to pursuing a MSc in Nanoscience at the University of Groningen in the Netherlands.

Alice Eun Young Choi

Alice is from the vibrant city of Seoul, South Korea. She moved to New Jersey in 2004 and found her love for chemistry during her high school chemistry classes. Once at MIT, she declared Course V and never looked back but didn’t give up her other passions—music and biology—as minors. She joined the Stubbe lab as a sophomore, where she worked on incorporating unnatural amino acids into RNR for two years. Outside of class, Alice has spent much of her time doing volunteer work, tutoring,
and exploring new places on the map. Alice also enjoys playing the piano, composing music, cooking Korean food, and spending time with friends. After graduation she plans to work for a year before attending medical school.

**Vincent D. D’Andrea**

Vince is originally from Winchester, Massachusetts. Since chemistry was his worst subject in high school, he dreaded taking organic chemistry his sophomore year as part of his pre-med requirements. But, after noticing that he wouldn’t fail and that he actually enjoyed pushing arrows, he was hooked. After declaring Course 5, Vince pursued a number of research positions in both organic chemistry and biochemistry. As a UROP in Prof. Tim Jamison’s lab, he synthesized epoxide derivatives to study the formation of natural products. He also interned at the Novartis Institutes for Biomedical Research in Cambridge, MA, where he synthesized a ligand to probe protein-protein interactions and their affect on disease mechanisms. Vince loves to teach and has tutored 5.12 and 5.13 over the past two years. This semester, he had the opportunity to TA 5.12, which was an excellent way to culminate his academic career at MIT. Next year, Vince will be taking a gap year at Stanford University to work in a biochemistry laboratory before pursuing a career in medicine. He is an avid Red Sox, Bruins, Celtics, and Patriots fan, and this will be his first experience spending time away from his teams. Wish him luck!

**Chyleigh J. Harmon**

Chyleigh is from Syracuse, New York. While she spends many hours working in the Shoulders Laboratory studying protein misfolding and N-glycosylation, she also has plenty of time for other activities. As a member of the Alpine Ski Team, she has been caught going 50 mph and is thankful that there’s no speed limit on the race course. Additionally, she led the Black Student’s Union as Co-Chair for the past year as well as serving as a Social Chair for the 2014 Class Council since her junior year. She is also receiving a concentration in Spanish. As a member of the Burton Third Bombers, the little extra time she has is spent partying it up! Next semester, Chyleigh will be at Georgetown University for the Special Master’s in Physiology where she will prepare for (hopefully) entry into medical school in 2015.

**Aileen Johnson**

Aileen Johnson is from Chattanooga, Tennessee, where the weather is much much better than here. She has really enjoyed her time at MIT, from her interest in classes to different extracurriculars to becoming a connoisseur of free food. Her first two years, she was a member of the varsity openweight women’s crew team, and, retrospectively, she cannot believe that she woke up at 6 am everyday. She then became involved in a UROP in Cathy Drennan’s lab, where she managed to crystallize a trace contaminant in the stock of protein instead of the protein of interest. Aileen has also really enjoyed her time working with the MIT ambulance, where she frequently saves people from sprained ankles and similar maladies. Next year, she is excited to be attending medical school in Atlanta at Emery! And yes, she has already been informed that there are easier ways to get into medical school than a degree in chemistry from MIT.

**Sumin Kim**

Sumin is originally from South Korea, where she spent the first 12 years of her life. In 2004, she moved to Vermont, home of Ben & Jerry’s ice cream, and then moved to Raleigh, NC, where tea is always served with an absurd amount of sugar. After initially declaring Course 5, she changed her major once before coming back. When not doing chemistry-related activities, Sumin experiments with DJing, music producing, and sound editing, as well as studying molecular gastronomy and cooking lots of delicious things. During her time at MIT, she did MISTI-Switzerland, played violin in MITSO, co-founded and directed the Centrifugues (a cappella group), and participated in Musical Theatre Guild productions as a pianist and sound engineer/designer. She is planning on working for two years before attending graduate school.

**Jacob N. Laux**

Jacob is a course 5 and 15 double major from Dousman (pronounced douse-man), Wisconsin. At MIT, he planned to major in 7, then 5, then 6-7, then 5, then 10, then finally back to 5, to which he added 15 late junior year. Outside of academics, he spent the lion’s share of his free
time playing for the MIT football team, for which he is a record holder, and wrestling for the wrestling team, where he was a two time All-American. Additionally, he enjoys spending time with his fraternity brothers at DKE, playing lawn games, and relaxing on the balcony. Following three summers as a research scientist intern at Promega Corporation and the Medical College of Wisconsin, he will now be a quantitative trader at Old Mission Capital in Chicago.

**Daniel Mokhtari**

Daniel Mokhtari is a chemistry major and music minor from Minnesota—the land of cold and snow—who knew he wanted to study chemistry since coming to MIT. Excited to jump into synthetic organic chemistry right off the bat, Daniel joined the Danheiser lab freshman year and transitioned to working on inorganic chemistry in the Cummins group as a junior. Daniel also loves playing the viola and has had the chance to do so as part of the MIT Symphony Orchestra and MIT Chamber Music Society. Besides music and chemistry, Daniel also really enjoys teaching and traveling and spent the summer after sophomore year in China teaching science and English through MIT CETI. Daniel is looking forward to attending Stanford University in the fall to pursue his passion for medicine.

**Katherine Silvestre**

Katherine’s interest in chemistry was sparked at the age of 12 when her grandfather, a former high school chemistry teacher, taught her about the periodic table of the elements. As a high school student in Providence, Rhode Island, she loved her classes in both chemistry and biology and was fascinated by the interaction of small molecules with biological systems. Katherine declared Course 5, hoping to learn how to synthesize new molecules, with a double major in Course 7A to better understand the biological side of how small molecules work and a minor in public policy thrown in for good measure. She joined the Essigmann lab during her freshman spring and has continued to work there ever since, though her project has moved from NMR spectroscopy studies to synthesis of nucleoside derivatives with the help of the Jamison lab.

The summer after her sophomore year, Katherine interned at the Curie Institute in Paris, France, an experience that taught her much both in and out of the lab. When not in lab, she dances with the ballet and contemporary dance group Movements in Time, serves as the Vice-President of Dormitory Council and on McCormick Hall House Government, and tutors 5.12. After debating for months on what type of “doctor” she wants to be, Katherine is excited to join the chemistry Ph.D program at Harvard and move exactly two Red Line stops further away from home.

**Anubhav Sinha**

Anubhav Sinha is a double major in chemistry and EECS from Beverly, Massachusetts. He was inspired to study both fields after taking 6.01 and 5.112 concurrently during freshman fall. He also completed a minor in biology as well. Outside of class, he enjoyed diverse and meaningful UROP experiences in the labs of Prof. Troy Van Voorhis (Chemistry), Prof. Angela Belcher (DMSE & BE), and Prof. Susan Lindquist (Biology). When not in class or his dorm, Anubhav could often be found on the fourth floor of the student center, where he spent a lot of time involved with the MIT Educational Studies Program and the Undergraduate Association. After graduation, he will stay at MIT to complete his M.Eng. in EECS in the Quantum Photonics Lab, led by Prof. Dirk Englund. In the future, Anubhav hopes to pursue a career in research at the intersection of biophysical chemistry, electrical engineering, and clinical medicine.

**Sasilada Sirirungruang**

Sasilada, or Pi, is a course 5 and 7A double major from Bangkok, Thailand. She came to MIT with a strong interest in chemistry, decided right away on course 5, and started her research experience freshman year. She has worked on various research projects at the interface of chemistry and biology in the Langer Lab, the Dedon Lab, and the Imperiali Lab. Her love for research even extends beyond the Institute as Pi has been spending summers on research fellowships in Thailand, Singapore, and New York City. Outside of class and lab, Pi enjoys spending time with her sisters at Pi Beta Phi sorority, planning
cultural events with Thai Students Association, and tutoring freshman and sophomore chemistry and biology classes with the Office of Minority Education. Upon graduation, Pi is moving across the country to pursue a PhD at the University of California, Berkeley.

Suan Tuang

Tuang was born and raised in Myanmar and immigrated to the United States at the age of 16. After completing 11th and 12th grade in Florida, he moved up north to experience some New England winters. Although he was quite unsure what he wanted to major when he first came to MIT, UROPing with Professor Lippard convinced him Course 5 was it! Outside of classes and research, Tuang is involved in International Development House (iHouse) and MIT ClubChem. He likes to play basketball and soccer in his free time and enjoys singing while playing his guitar on a rainy/snowy/windy/sunny/New England day. Upon graduation, Tuang will head to Harvard Medical School to pursue a combined MD/PhD degree from the Harvard-MIT Health Sciences and Technology (HST) Program.

Grace Tuyiringire

Grace Tuyiringire is from Elkhart, Indiana. She originally started in material science and engineering but joined the chemistry department in her sophomore spring. At MIT, Grace has been involved in a lot of programs that deal with education. She has worked in the Office of Engineering Outreach programs for the past four years as a chemistry teaching assistant, Co-Facilitator for the Engineering Experience at MIT program, middle school mentor, and office assistant. She also served as a TA for 5.111 in ESG. Grace has interned in Washington, DC as a healthcare policy intern. After graduation, Grace wants to continue to pursue her passion of education by working as a policy associate in Indianapolis, Indiana, for a nonprofit known as The Mind Trust. Grace loves to be around friends and enjoys traveling.

Alexandra T. Wrobel

Alexandra (Sasha) is from Forest Hill, Maryland. She started UROPing at the beginning of her sophomore year in Prof. Lippard’s lab and has been there ever since. After her freshman year, she spent the summer in Germany through a MISTI sponsored program. Outside of academics and lab, she has devoted a lot of time to teaching for many ESP (a student club that organizes classes for middle and high school students) programs, including Delve and Junction. Recently, she earned her MIT Pirate’s certificate by completing the archery, pistol, sailing, and fencing PE classes. Next year, she will be staying around Cambridge and starting her PhD in chemistry at Harvard.

Erika Ye

Erika Ye is from the Bay Area, California. Though she declared Course 5 at the start, she has also explored various courses, and ultimately decided to also major in 6-1 (Electrical Engineering). While she is sure she will go to graduate school eventually, she is not sure what field she will go into. Next year she will be pursuing an M.Eng thesis in the 6-1 department and hopes to have more free time to ponder life. She would also like to thank Professor Bawendi for allowing her to play around in his lab and Professor Van Voorhis for being a very lenient and understanding advisor.
I was born in Thailand in a southern coastal province called Surat Thani where sunny beaches and seafood are typical. At the age of ten, my family moved to the capital, Bangkok, and we settled there. I started learning chemistry in high school and found it so interesting that I participated in the International Chemistry Olympiad. I entered MIT with a set goal of becoming a chemist, and the UROP I took early in my freshman year, confirmed that my decision to take the chemistry path was indeed the right one for me.

I started my research experience in the Cummins Lab by exploring the use of cyclic phosphates as ligands for transition metals. It wasn’t long before I developed affection for those six-membered and eight-membered inorganic rings, as well as my good friend 31P NMR spectroscopy.

My research on coordination chemistry of cyclic phosphates progressed slowly until December 2013 when a new finding in the lab, acidic cyclic phosphate, shifted my work direction toward acid-base chemistry. This year, my last, will be spent on making new strong inorganic oxoacids and superacids based on cyclic phosphates, as well as synthesizing metal phosphate complexes via a newly-developed method. The new synthetic route is expected to enable access to new metal phosphate complexes, which are to be tested for catalytic reactivities in oxidative conditions.

Working with inorganic compounds exposed me to the field of X-ray diffraction which inspired me to further my MIT education by taking a second major in Materials Science and Engineering. The latter has enabled me to learn more about solid-state chemistry, and symmetry in the nanoscopic and microscopic world. The two majors require six lab classes, which may sound daunting, but I do enjoy collaborating and conversing with my lab mates, both academically and casually. Great friendships are made when one is waiting for chemical reactions!

Last year, I joined Club Chem, the MIT Undergraduate Chemistry Association. As its Community Outreach Coordinator, my responsibility has been to arrange chemistry demonstrations (aka “Magic Shows”) for elementary school and middle school students in the Boston area as well as several MIT programs. I found I really enjoyed doing the shows and to-date have done four. This year I expect to bring the usual excitement (without explosions) and knowledge to a whole lot more kids in the area.

Outside of chemistry, I have been working for the Thai Students at MIT club for three years, and have organized a Thai cultural event for the MIT community every year. The events are always well-attended and it is a great source of happiness to me seeing hundreds of people having fun.

I also lead the Southeast Asian Service Leadership Network (SEALNet) at MIT. The aim of this club is to promote self-sustainable development in Southeast Asia through organizing summer service projects in needed communities. SEALNet at MIT also introduces the MIT community to cultural experiences by hosting the annual Southeast Asian Cultural Night and periodically Thai Iced Tea fundraising events.

My MIT education has been intensive and enriching. It’s been a wonderful three years! I now look forward to finishing up my undergraduate studies in chemistry, and materials science and engineering, and pursuing graduate studies in the field of inorganic chemistry and inorganic materials. It’s been a great journey!
“That I’ll have my own eureka moment. That’s the dream,” says senior Julia Berk.

The eureka moment is famously attributed to Greek scholar Archimedes. The story goes that one day he stepped into a bath and in a flash of insight suddenly realized that the volume of the displaced water must be equal to the volume of his submerged body.

Often at MIT, these moments occur for students in the Undergraduate Research Inspired Experimental Chemistry Alternatives (URIECA). It’s a lab curriculum in the Department of Chemistry, where undergraduates replicate cutting edge faculty research, experiencing the same process that led MIT faculty to glorious eureka moments.

Berk recently recreated a leading experiment originally done by Professor Christopher Cummins. “Nitrogen is one of the most stable molecules in the world, the second strongest bond in chemistry,” she says, adding that Cummins miraculously found a way to break the triple bond in nitrogen under moderate conditions. “It was a huge discovery, a huge deal. You don’t ever think it can happen, and then all of a sudden, there it is.”

“Discovery is sheer thrill,” she says, and although she didn’t experience the initial discovery herself, reliving his eureka moment was a blast of inspiration. “It opens the door to a whole new world of opportunities. I keep thinking that there might be things never done before that I can do. Maybe I can synthesize a new compound that would be useful in pharmaceuticals. Or maybe I could create a new color I can make into paint.

“When you do something novel, you don’t always know what you can do with it. But,” she adds, “it doesn’t have to become a product. There’s a lot of value in scientific discovery just for discovery. There’s value in knowledge. It’s a way of thinking. It’s just so interesting to study because it’s beautiful, new, unexpected, and interesting.”

By Liz Karagianis, SPECTRUM

5.301 IAP 2014

5.301 Independent Activities Period (IAP) 2014 was a very good experience for all 14 students. Of the 14 students enrolled, 12 completed the course with a passing mark. The course proved to be intensive for all, requiring a major time commitment from each student starting at 10 am in the morning and extending to late afternoons and sometimes, early evenings. The students worked exceedingly well together and gained the confidence needed to take on a UROP appointment in their spring semester as freshmen. Dr. John Dolhun, instructor for the course said. “This was a very celebratory group. The students inspired each other to work hard and be creative.”

The 5.301 students have reported back and these are the groups they joined for UROPs: Anni Zhang (Stephen Buchwald), Nolan Concannon (Yogesh Surendranath), Chen Wang (Yogesh Surendranath), Nagisa Tadjfar (Mircea Dinca), Emma Chant (Mircea Dincă), Samantha Briasco-Stewart (Defer), Zi-Ning Choo (Bradley Pentelute), Lane Gunderman (Adam Willard), Justin Bader (Offered position at MGH pancreatic cancer research), Jareatha Abdul-Raheem (Stephen Lippard), Willie Chen (Unknown), Eli Sadovnik (Robert Griffin).

By John Dolhun
(1) Arthur Pizano and family member
(2) Mingjuan Su, Steve Buchwald, and family member
(3) Stephanie Teo, Sylvia Ceyer, and family members
(4) Mounig Bawendi and Jian Cui
(5) Elizabeth Nolan and Timothy Johnstone
(6) Ta-Chung, Sarah Luppino, and family member
(7) Weslee Glenn and Sylvia Ceyer
(8) Rachel Buckley and Sylvia Ceyer
(9) Keith Nelson, Marcus Gibson, Chunte Peng, and family member
(10) Jeremy Sitser and family members
(11) Erik Townsend, Dick Schrock, and family members
(12) Tengfei Zheng with friends, family, and Elizabeth Nolan
(13) Nathaniel Brandt and family members

September 2013
Joshua Baraban PhD Field
Rachael Buckley PhD Stubbe
Raoul Correa PhD Bawendi
Laura Gerber PhD Schrock
Weslee Glenn PhD O’Connor
Samantha MacMillan PhD Peters
Jessica McCombs SM Johnson
Arturo Pizano PhD Nocera
Stephanie Tumidajski PhD Danheiser
Thomas Willumstad PhD Danheiser
Susan Zultanski PhD Fu

June 2014
Nathaniel Brandt PhD Nelson
Angela Gao SM Johnson
Timothy Johnstone PhD Lippard
Mackenzie Martin SM Hammond
Ta-Chung Ong PhD Griffin
Chunte Peng PhD Tokmakoff
Jeremy Setser PhD Drennan
Mingjuan Su PhD Buchwald
Stephanie Teo PhD Nelson
Erik Townsend PhD Schrock
Darcy Wanger PhD Bawendi
Hyunsuk Yoo PhD Imperiali
Tengfei Zheng PhD Nolan

February 2014
Loren Andreas PhD Griffin
Michael Blair SM Ceyer
Stephanie Cheung SM Imperiali
Jian Cui PhD Bawendi
Daniel Liu PhD Ting
Evgeny Markhasin PhD Griffin
Michael Morrison PhD Imperiali
Andreas, Loren: Griffin Group
Loren is now a postdoc at the ENS Lyon, France, working on protein structure by solid state NMR. His wife and he had a baby in France in April.

Baraban, Josh: Field Group
Josh is a postdoc in Prof. Barney Ellison’s group at CU, Boulder, studying pyrolysis.

Brandt, Nate: Nelson Group
Nate moved to Saint Paul, Minnesota and got married to Lanita in late June. He started a postdoc position in the lab of Renee Frontiera at the University of Minnesota at the end of July.

Buckley, Rachael: Stubbe Group
Rachael is working as an enzymologist at Agios Pharmaceuticals in Cambridge, Massachusetts, focusing on discovery of small molecule therapeutics to treat inborn errors of metabolism.

Correa, Raoul: Bawendi Group
Since graduating in August 2013, Raoul has been working with the Boston Consulting Group in Philadelphia and Los Angeles. He still enjoys reading the scientific output from the chemistry department and Center for Excitonics, and bemoans the day MIT Libraries switches off his VPN access. “PChem seminars,” he says, “likely progress much faster these days without my ridiculous questions to the speaker!”

Cui, Jian: Bawendi Group
Jian has started a postdoc at the Optical Materials Engineering Laboratory under Professor David Norris at ETH Zurich in Zurich, Switzerland. He will be there for the next few years.

Gerber, Laura: Schrock Group
After graduating from MIT, Raoul has been working with the Boston Consulting Group in Philadelphia and Los Angeles. He still enjoys reading the scientific output from the chemistry department and Center for Excitonics, and bemoans the day MIT Libraries switches off his VPN access. “PChem seminars,” he says, “likely progress much faster these days without my ridiculous questions to the speaker!”

Glenn, Weslee: O’Connor Group
Weslee is currently a Ford Foundation Post-Doctoral Research Fellow in Prof. David A. Tirrell’s laboratory at the California Institute of Technology (Caltech). Weslee’s research interests include understanding how plants make the molecules that we humans co-opt as medicines and developing technologies to interrogate the proteomic programming of plant cells under various conditions. He also remains deeply involved in and committed to promoting diversity in STEM fields.

(Wanger) Grinolds, Darcy: Bawendi Group
Darcy is a Reliability Engineer at Google in Mountain View, California. She enjoys using her experimental design and problem-solving skills to make innovative hardware robust!

Markhasin, Evgeny: Griffin Group
Evgeny is presently a postdoc at the Weizmann Institute of Science in Israel.

Ong, Ta-Chung: Griffin Group
Ta-Chung will be moving to ETH Zurich for a postdoc in the lab of Prof. Christophe Copéret where he will be studying heterogeneous catalysis.

Peng, Chunte (Sam): Tokmakoff Group
Sam is moving back to Taiwan to serve in the mandatory military service for a year. After that, he will be joining Professor Steve Chu’s research group as a postdoc at Stanford University at the end of next year.

Pizano, Arturo: Nocera Group
Arturo completed a postdoc with Dan Nocera at Harvard in the summer of 2014 and joined McKinsey and Company as an Associate in Houston, Texas in August.

Setser, Jeremy: Drennan Group
Jeremy is currently a scientist in the Structural Biology Group at Constellation Pharmaceuticals in Cambridge, Massachusetts. Constellation is pursuing the discovery and development of small molecule therapeutics in the area of epigenetics.

Teo, Stephanie: Nelson Group
Stephanie will be starting as a Process Technology Development Engineer at Intel later this year in Portland, Oregon.

Townsend, Erik: Schrock Group
Erik moved to St. Paul, MN where he now works as a Senior Research Chemist in R&D for 3M Company.

Tumidajski, Stephanie: Danheiser Group
Stephanie moved to Illinois and is working as a Chemical Safety Professional at The University of Illinois, Urbana-Champaign.
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<td>- Lemelson-MIT National Collegiate Student Prize Competition, “Use-It” category, Top-5 Finalist</td>
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<td>- Outstanding TA Award</td>
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**NSF GRP** = National Science Foundation Graduate Fellowship Program  
**NDSEG** = National Defense Science and Engineering Graduate Fellowship
## Outstanding TA Award Winners

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>Subject</th>
<th>Advisor</th>
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<td>Salima</td>
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<td>Carr</td>
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<td>5.310</td>
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<td>Ethan</td>
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<td>Pentelute</td>
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<td>Franke</td>
<td>Daniel</td>
<td>5.60 &amp; 5.38</td>
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<td>5.111 &amp; 5.301</td>
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## Department of Chemistry Award for Continued Excellence in Teaching

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Graduate fellowships have become an increasingly critical mechanism to support research innovation and attract the best students. We are constantly striving to strengthen levels of endowed and expendable graduate student support. Over the past few years, we have been most fortunate to receive a number of generous donations from both alumni and industry resulting in several endowed and expendable summer fellowships funds, a few of which have grown to provide more than one annual summer fellowship.

**AMGEN ENDOWED SUMMER GRADUATE FELLOWSHIPS**

Alex Vinogradov, a graduate student in the Pentelute Lab, and Yu-Pu Wang, a graduate student in the Danheiser Lab, were awarded 2014 Amgen Summer Graduate Fellowships. Alex works on completing the synthesis of D- and L-forms of barnase and compares their properties in living systems.

Yu-Pu’s research involves the development of new methods for the synthesis of highly substituted indoles and their application to the synthesis of natural products and polycyclic systems with interesting electronic properties.

**WALTER L. HUGHES MEMORIAL SUMMER GRADUATE FELLOWSHIP**

Christopher Moore, a graduate student in the Shoulders Lab, was selected to receive the Walter L. Hughes Memorial Summer Graduate Fellowship. The expendable fund was established by Dr. Hughes’ daughters and friends of the family in 2010. Dr. Hughes, PhD ‘41, had an illustrious career in biochemistry. Chris is studying Ebola, SARS, and variola smallpox viruses.

**RICHARD R. SCHROCK ENDOWED SUMMER GRADUATE FELLOWSHIP**

When Richard R. Schrock, Frederick G. Keyes Professor of Chemistry won the Nobel Prize in 2005, the department set up an endowed summer fellowship in his honor. The fund, largely supported by Professor Schrock’s graduate students and postdocs, was kicked-off with a generous gift from Mr. Dick Simmons ‘53.

Haritha Chileveru, a graduate student in the Nolan Lab, was selected to be the recipient of the Richard R. Schrock Summer Graduate Fellowship. Haritha’s research involves probing the mechanism of action of an antimicrobial peptide, human defensin 5 using various fluorescence-based techniques.

**MASAMUNE ENDOWED SUMMER GRADUATE FELLOWSHIP**

Andrew DiChiara, a graduate student in the Shoulders Lab, is the recipient of the Masamune Summer Graduate Fellowship. The Masamune Fellowship was established in memory of the late Professor Satoru Masamune.

Andrew is investigating the homeostasis of collagen in primary patient fibroblasts, with the ultimate goal of finding protein chaperones or pathways that are candidates for rational drug design.

**GEORGE H BüCHI ENDOWED SUMMER GRADUATE FELLOWSHIP**

The George H. Büchi endowed summer fellowship was established by Dr. Ping S. Chu, PhD ‘80, as a tribute to his late advisor, George H. Büchi.

Chi Zhang, a graduate student in the Pentelute Lab, was selected to be the recipient of the fellowship this summer. Chi is currently working on using a naturally occurring enzyme family to catalyze an established synthetic transformation.
STREM FAMILY ENDOWED SUMMER GRADUATE FELLOWSHIP

Angela Phillips, a graduate student in the Shoulders Lab, was selected to receive the Strem Family Endowed Summer Graduate Fellowship established by Dr. Michael E. Strem in 2006.

Angela aims to determine how viruses evolve on a molecular level by measuring how manipulating the host’s protein-folding capacity influences viral fitness and evolution.

ANN AND PAUL STEinfeld MEMORIAL ENDOWED SUMMER GRADUATE FELLOWSHIP

Sucheol Shin, a graduate student in the Willard Lab, was selected to receive the Ann and Paul Steinfeld Memorial Endowed Summer Graduate Fellowship. The fellowship was established by Professor Emeritus Jeffrey I. Steinfeld in memory of his parents.

Sucheol’s research involves the development of theoretical framework to interpret the molecular structure of a variety of aqueous interfaces.

RICHARD C. LORD FELLOWSHIP

Jun Jiang, a graduate student in the Field Lab, was selected to receive the Richard C. Lord Summer Graduate Fellowship. The expendable fund was established by Professor Lord’s former students and postdocs with a generous kick-off gift from Gary T. Forrest, ’76.

Jun is currently developing a hydrogen-atom fluorescence detection scheme to study photodissociation as well as the energy level structure of S1 state of acetylene.

KENNETH M. GORDON ENDOWED SUMMER GRADUATE FELLOWSHIP

Phil Hamzik, a graduate student in the Danheiser Lab, was selected to receive the Kenneth M. Gordon Endowed Summer Graduate Fellowship.

Phil’s research focus is on developing metal-free, formal [2+2+2] and [4+2] annulation strategies for the synthesis of highly complex pyridine derivatives.

DANIEL S. KEMP ENDOWED SUMMER GRADUATE FELLOWSHIP

Chet Berman, a graduate student in the Shoulders Lab, was selected to receive the Daniel S. Kemp Endowed Summer Graduate Fellowship. The fellowship was established by a gift from Sally and Dan Harris (Course V, ‘68) in honor of Professor Emeritus Daniel S. Kemp.

Chet is working on creating new technologies for the directed evolution of proteins in human cells.
Whitney Hess is a 4th year graduate student in the Physical Chemistry division in Professor Moungi Bawendi’s group. She held an Eni-MIT Energy Fellowship her first year of graduate studies and is currently a NDSEG Fellow. She is Co-President of Women in Chemistry, is a member of the ChemREFS, and will serve on the MIT Committee on Toxic Chemicals during the 2014-2015 academic year. She obtained joint BS/MS degrees in Chemistry from Idaho State University.

After graduating high school and starting my undergraduate studies at Idaho State University (ISU), chemistry was not really on my radar. It wasn’t until my general chemistry course that I got my first taste of how interesting and exciting chemistry is. My husband and I took general chemistry together as a night course. Our teacher was a sight to behold with her enthusiasm and energy, despite the class and lab being held at night (and 3 hours long, I might add), and it was clear that she cared about her students. While this class inspired my husband’s decision to become a chemist, it wasn’t quite enough to sway me. Now that I am a physical chemist, it’s funny for me to think back on how it was actually organic chemistry (and a very persuasive department head) that really pulled me in. My interactions with faculty at ISU have made a lasting impression on me—with their passion for sharing their knowledge with the next generation of chemists and their capacity for caring. Writing this is making me feel nostalgic and reflective, so Sharlene Jolley, Robert Holman, Lisa Goss, Josh Pak, Jeff Rosentreter, and Andrew Holland—I’m glad you are reading this right now because I want you to know I will be forever grateful for the part you have played in my journey.

During my BS/MS research with Dr. Lisa Goss, part of my project was to develop interactive pedagogical materials for physical chemistry. I absolutely loved my work making new tools for use in the classroom, and Lisa continues to inspire me with her drive to use cutting-edge techniques and tools in her courses. I also had the opportunity to teach a variety of undergraduate chemistry labs. These experiences were my first forays into education, and when I began teaching it just felt right. Perhaps that is what people say when they have found their calling. I am grateful for the opportunities I have had at MIT to be able to teach the brilliant undergraduates in general chemistry, and it has been a privilege to work with Professor Cathy Drennan and Dr. Beth Vogel Taylor. They are both excellent role models as science educators. I am excited to be working with Beth again this semester as one of the problem solving session leaders in Concourse 5.111! I want to give a special thanks to Moungi Bawendi, my advisor, for his support of my gaining more teaching experience.

My research in Professor Moungi Bawendi’s lab focuses on solution processed, hybrid solar cells comprised of polymers and semiconductor quantum dots. It has certainly been a challenge to transition into an area of research completely different from my background, but it is exciting to continue learning new things. In addition to my research responsibilities in the Bawendi lab, I am starting my second year as the lab EHS representative. Last May, I had the unique experience to be EHS representative during our lab move to the beautiful new space in Building 2. I helped organize and facilitate the move, and it was fascinating (albeit a bit stressful) to be involved at that level and see the process and how everything came together. As a chemist, I have always recognized the importance of safety, but my experiences in this role have sparked an interest, and I’m looking forward to continuing in my role as EHS representative as well as serving on the Committee on Toxic Chemicals this year.

Outside of the lab, I am an active member of Women in Chemistry (WIC) and ChemREFS. I am Co-President of WIC with Vinita Lukose, and we have a fantastic group of women on the WIC Advisory Board. In addition to our normal programs, we started a lunch series with the female chemistry faculty and created a Travel Grant Program to support women in the department with funds to attend research or leadership conferences. It is amazing what you can accomplish with a great team! With last year being such a success, I can’t wait to see what we come up with for this year.

I cannot end this piece without mentioning my husband, Jeff, of 8 years. He is my rock. What a wonderful man to move across the country with me so I can attend MIT. His support means everything to me and I am beyond happy he is here by my side. Thank you.
During the 2014 independent activities period (IAP), chemistry graduate students organized the 2nd annual Chemistry Graduate Student Committee (CGSC) Chemistry Career Panel series. IAP is a special four-week term at MIT during which students are encouraged to set their own educational agendas, pursue independent projects, meet with faculty, or pursue many other options not possible during the semester.

Over the course of three weeks, 9 panels, organized by theme, took place on campus, bringing back many MIT course 5 alumni to discuss their academic backgrounds, the thought process that led them to their current positions, how they prepared to get to where they are, and what an average day is like in their current jobs, as well as to answer questions from the audience.

The primary organizers this year were Andrew Horning (Tidor Lab) and Jeremy Setser (Drennan Lab). Response to this series has been extremely positive, and the Chemistry Graduate Student Committee (CGSC), with continuing department support, now plans to continue this series every year!

The organizers would especially like to thank all the faculty members who helped in finding panelists, to Liz McGrath for administrative help and panelist gifts, and to Sylvia Ceyer for helping foster faculty enthusiasm for the series and approving the budget. They would also like to thank their faculty mentor, Professor Brad Pentelute for his help and support.

Alumni from all years and career paths who would like to participate in future panels, help contribute to future career-focused events, or just learn more can contact cgsc-board@mit.edu.

**Biotech/Pharma Panel** - Panel Coordinator(s): Kurt Cox (Ting Lab) and Jeremy Setser (Drennan Lab)
Tim Barder, Vertex Pharmaceuticals, Merck, and Blend Therapeutics
Steve Bellon, Constellation Pharmaceuticals
Sue Bruhn, Promedior
Alumni interested in participating in a career panel should contact: cgsb-board@mit.edu.

**Education and Outreach Panel** - Panel Coordinator(s): Jennifer Scherer (Bawendi Lab)
Anique Olivier-Mason, Lecturer, MIT HHMI Education Laboratory
Dipa Shah, Associate Director for Teaching and Learning, MIT's Teaching & Learning Lab
Shannon Morey, Dir of Education, Science from Scientists and Science Enrichment Coord, East Boston High School
Lynne O'Connell, Director of Intro Chem Labs, Boston College

**Intellectual Property/Law Panel** - Panel Coordinator(s): Timothy Adams (Movassaghi Lab) and Phil Hamzik (Danheiser Lab)
Alexander Akhiezer, Principal, Hamilton Brook Smith Reynolds
Elizabeth Karnas, Technical Specialist, Lathrop & Gage
Jennifer Loebach, Senior Patent Attorney, Takeda Oncology Company
William Neeley, Patent Agent, Goodwin Procter

**Computing Panel** - Panel Coordinator(s): Russ Jensen (Bawendi Lab)
Eric Zimanyi, Senior Software Developer, athenahealth
Woody Sherman, Vice President of Applications Science, Schrödinger Inc.
Bracken King, Founder, Less Annoying CRM

**Materials/Energy/Environment Panel** - Panel Coordinator(s): Jolene Mork (Tisdale Lab)
Johanna Wolfson, Fraunhofer TechBridge
Steve Reece, Sun Catalytix
John Amara, EMD Millipore

**Startup Panel** - Panel Coordinator(s): Gregory Gutierrez (Swager Lab)
Jan Schnorr, Chief Technology Officer, C2Sense
Alyssa Larson, Scientist, Arsia Therapeutics
Craig Breen, Manager, Materials Development at QD Vision Inc.
Kollol Pal, Chief Executive Officer, Mnemosyne Pharmaceuticals

**Academia Panel** - Panel Coordinator(s): Michael Mavros (Van V order Lab)
Shawn Burdette, Assistant Professor of Chemistry, Worcester Polytechnic Institute
Timothy Curran, Professor of Chemistry, Trinity College
Angeliki Rigos, Associate Professor and Chair, Merrimack College
Eranthie Weerapana, Assistant Professor of Chemistry, Boston College

**Science Communication Panel** - Panel Coordinator(s): Kara Manke (Nelson Lab)
Laura Grego, Senior Scientist, Global Security Program, Union of Concerned Scientists
Deborah Douglas, Director of Collections and Curator of Science and Technology, MIT Museum
Bethany Halford, Senior Editor, Chemical and Engineering News
Jenny Rood, Biology Ph.D and Master’s Student, MIT Graduate Program in Science Writing

**Consulting Panel** - Panel Coordinator(s): Nicole Davis (Hammond Lab) and Jingnan Lu (Sinskey Lab)
Daria Feduykina, Life Sciences Specialist, L.E.K. Consulting
Peter Goldman, Consultant, ClearView Healthcare Partners
Michael Kiermaier, Associate, McKinsey & Company
Abigail Oelker, Scientist, Exponent Engineering and Scientific Consulting
Shan Wu, Consultant, Clarion Healthcare
Chemistry Student Seminar Series Fall 2013 - Spring 2014

Chemistry Student Seminars (CSS) are weekly student-organized meetings where graduate students and postdoctoral associates share their research with their peers. CSS is a great way for attendees to have scientific discussions while meeting and catching up with people from the department. The seminars are held in Room 4-163 on Fridays at 10:00 am.

The line-up of the speakers this past academic year was really strong and diverse with representative talks from different areas of chemistry: inorganic, organic, biological, and physical. The attendees were able to enjoy coffee and donuts while listening to the research highlights from graduate students and postdocs from the department. Furthermore, this year we introduced our new CSS-logo customized mugs, which are presented to the seminar speakers every week.

We believe that nothing can speak of the quality and the importance of our seminars better than the feedback that we have been getting from our speakers throughout the year.

Amy Rabideau (Pentelute group): “I like the diverse audience [of the seminar]. Even though we’re all chemists we speak slightly different languages (i.e. biological, organic, inorganic, physical). As a result, the questions that audience members asked me were not necessarily things that I have thought about before.”

Hyangsoo Jeong (Schrock group): “I really like that CSS is a great chance for me to learn what’s going on in other groups in this department. In addition, I enjoyed a lot when new postdocs present their previous work (thesis work) in this semi-formal way.”

Sarah Tasker (Jamison group): “Giving a research talk is an essential part of professional development as a scientist. Speaking at the CSS seminar is a great way to practice these skills in a low-risk environment among your fellow grad students.”

Marcus Gibson (Drennan group): “I had fun preparing and giving the talk, and I very much appreciated the feedback that was given. Plus, the mug is a great addition to my morning routine.”

Weixue Wang (Lippard group) summarized our attitude and enthusiasm for the seminars best when he said that giving a CSS talk simply “Felt good!”

If you are interested in contributing to the development of this student organized seminar series, please contact us at vinograd@mit.edu (Ekaterina Vinogradova) or mk16@mit.edu (Markrete Krikorian)!
The 18th Bruker/MIT Symposium, “Modern Approaches to Crystal Structure Solution,” was held February 21-23, 2014. The meeting was hosted by the MIT Department of Chemistry, organized by Peter Müller, Director of the Departmental X-Ray Diffraction Facility, and sponsored by Bruker-AXS (and for the first time co-sponsored by Oxford Cryosystems).

Solving a crystal structure, as opposed to refining the structure, is the step of assigning more or less accurate phase angles to the measured intensities (that is the squared structure factor amplitudes). Although for most X-ray single-crystal small-molecule structures, the phase problem can be solved reliably and quickly with available software, there is still progress underway and new approaches to solve the phase problem are being actively developed. Protein structures or structures based on data from neutron or electron diffraction experiments can be difficult to solve and even for structures that are solved easily with current software, this progress is welcomed.

The first talk of the symposium by Michael Ruf (Bruker-AXS) introduced what is “New and Exciting at Bruker,” giving insight into the hardware of the new MetalJet, an x-ray source based on a liquid gallium-alloy and other recent developments such as shutterless data collection, which speeds up the experiment and increases data quality at the same time.

Peter Müller from MIT gave a general introduction to “The Crystallographic Phase Problem.” Starting from Bragg’s law, the Ewald construction and the structure factor equation, he explained the nature of the phase problem and introduced various classical methods of solving it (such as Patterson and several direct methods).

Thanks to his popular textbook Fundamentals of Crystallography (3rd edition, Oxford University Press, 2011) and his many seminal contributions to direct methods, Carmelo Giacovazzo from Instituto di Cristallografia, CNR, Bari, Italy is certainly one of the most prominent crystallographers alive. Under the title “SIR2014, Phasing Methods and Results,” he gave some insight into the many different methods that work together in SIR2014 to solve crystal structures of all kinds of molecules. In this context, it should be mentioned that Giacovazzo’s latest book has just appeared: Phasing in Crystallography – A Modern Perspective (Oxford University Press, 2014).

After lunch, Lukáš Palatinus (Institute of Physics, ASCR, Prague, Czech Republic) gave a talk about “Solving Crystal Structures with Charge Flipping.” Palatinus introduced the basic principle of charge flipping, a true dual-space algorithm where in the real-space cycle the sign of all negative electron density is changed (flipped). He explained that for charge flipping no prior knowledge of space group symmetry or the chemical composition are required and not even atomicity is assumed. Besides for typical single-crystal x-ray structures, charge flipping can be used for the solution of complex structures from powder diffraction data or the solution of incommensurately modulated crystals and quasicrystals.

Under the title “Quality Data: Economical and Cutting Edge” Bruce Noll (Bruker-AXS) described details of the top and bottom end of the lineup of Bruker single-crystal diffractometers, from the MetalJet to the D8 QUEST ECO.

The final talk was presented by George Sheldrick (University of Göttingen). Sheldrick is the author of the highly successful SHELX program package, which is used by almost all small molecule crystallographers and many biological crystallographers in the world. In his talk with the title “SHELXT: Integrating Space Group Determination and Structure Solution” he described the many approaches used by his latest program, SHELXT. It turned out that several methods used in SHELXT had originally been introduced by Giacovazzo and Palatinus, yet the specific combination and individual implementations of those methods into one program as well as a number of original innovations makes intrinsic phasing the powerful tool it is.

Coupled to the symposium were three workshops taught by Carmelo Giacovazzo (SIR2014), Lukáš Palatinus (Superflip), and George Sheldrick (SHELXT) and a poster competition.
Joseph Azzarelli, a third-year MIT graduate student in chemistry, works on developing inexpensive, low-power chemical sensors—but the spark that set him on his scientific path has an unlikely source: a presentation on fly-fishing in a bookstore near Kankakee, Illinois.

The speaker let Azzarelli, 9 years old at the time, practice casting a model fly rod in the store, and he was sold. “I was immediately captivated by the whole process,” Azzarelli says. He began saving money to buy a starter rod and learned to cast, fishing for largemouth bass and sunfish in the creeks and ponds around Kankakee.

By the time Azzarelli and his family moved from Illinois to Evergreen, Colorado—a fly-fishing mecca—when he was in the eighth grade, his interest had snowballed into full-blown obsession. He learned to tie flies, studied entomology, and combed through the vast literature on fly-fishing for trout. As a high-school freshman, he got a job at a fly shop in Evergreen called the Blue Quill Angler—“kind of like the MIT of fly-fishing shops,” Azzarelli says.

For Azzarelli, the sport shaped his approach to science. “Fly-fishing led me into this awareness of human impact on the environment, and that, in turn, led me into trying to learn about the science behind our impact,” Azzarelli says. “It really is a driving force for what I do now.”

A finger on the pulse

Today, Azzarelli is a student in the lab of Timothy Swager, the John D. MacArthur Professor of Chemistry at MIT, where he works on developing improved chemical sensors for environmental and agricultural applications. Current sensors often use “high-temperature, metal oxide surfaces at which chemical reactions occur,” Azzarelli says. But maintaining those temperatures—as hot as 400 degrees Celsius—can be a power sink.

Azzarelli’s research aims to develop passive sensors that can be treated as simple circuit components; for example, the presence of the sensed chemical might lead to a change in resistance. Furthermore, a new method of constructing the sensing components—essentially, a pencil lead that can simply be drawn into a circuit—could achieve vast increases in affordability.

Lower cost and higher efficiency could allow the introduction of large numbers of chemical sensors into applications that are currently prohibitive. Azzarelli uses an environmental survey of a watershed as an example: “Right now, you have to contract a third party to come out and take those measurements and conduct a comprehensive study . . . but the problem is that that comprehensive study might happen once a month, or once a year, or once a decade.”

“The idea is to have sensors that are so inexpensive that you could have a lot of them and you could be collecting the data more frequently,” Azzarelli says. “The more continuously you can have your finger on that pulse, the more you can start to make intelligent decisions about activities that may influence those environments.”
“Sign me up”

Unlike his singular obsession with fly-fishing, Azzarelli’s path to MIT has been more convoluted. His interest in graduate school emerged during an internship with Stephen Buchwald, the Camille Dreyfus Professor of Chemistry, after his sophomore year at Montana State University. “I really did like the process of rigorous scientific inquiry,” Azzarelli said.

After graduating from Montana State in 2010, Azzarelli was accepted to graduate school at MIT, but decided to defer for a year to do an internship at Pfizer. “That gave me a taste of the corporate world,” Azzarelli says. “I was fortunate to gain insight into how a large organization like Pfizer operates at the level of an R&D center.”

While Azzarelli was considering both academic and nonacademic careers, he also became fascinated by an entirely different concept: the idea of economic externalities, costs or benefits that are incurred by a party that didn’t choose them, such as air and water pollution. Azzarelli was unsure of his future path when Swager contacted him about a project: using sensors to detect ethylene, a byproduct of fruit ripening, in order to determine fruit ripeness, and therefore reduce food waste.

It was the perfect project, combining Azzarelli’s scientific, economic, and entrepreneurial interests. “It was an incredibly serendipitous meeting, and once we had that conversation, I said, ‘I definitely want to join your lab, and any way I can be involved in that project, please sign me up,’” he says.

The team was awarded an MIT Deshpande Innovation Grant for the project, which has since spun out into a company, C2Sense. Although Azzarelli is not part of the company, entrepreneurship, he says, is likely to be in his future. “To me a technology is not successful by getting into a high-impact paper, it’s not successful by having a lot of people tell you it’s really interesting,” he says. “It’s successful once people are using it and find it valuable.”

Team player

Given his wide array of interests, it’s unsurprising that Azzarelli is enticed by interdisciplinary work—such as a recent collaboration with Karen King, a professor at Harvard Divinity School. King approached the Swager lab with an ancient papyrus that addresses early Christian values on celibacy—a document that has received attention for its suggestion that Jesus had a wife. Azzarelli helped analyze the authenticity of the document using a process known as FT-IR spectroscopy, which revealed that the papyrus is homogeneous “old paper,” and probably does not reflect modern tampering.

At MIT, Azzarelli is the outgoing president of the MIT Science Policy Initiative, a group that focuses on how scientists and engineers can best inform policymakers to help create laws that are most beneficial to society. He was also part of the MIT Strong team, which ran the Boston Marathon in April to raise money for the Sean A. Collier Memorial Fund, which honors the MIT Police officer who was killed in the line of duty last year.

“I think that the Collier Fund is a way to have a remembrance in the right way,” Azzarelli says, “not, ‘Let’s forever be sad about this event,’ but rather, ‘Let’s forever celebrate the people who, like Sean Collier, go above and beyond to make their communities better places.’”

By Zach Wener-Fligner, MIT News Office
The 2013-2014 academic year was a very exciting, busy, and productive year for Women in Chemistry (WIC)! Members of WIC would like to express their heartfelt gratitude for the generous support the organization received from its donors. With this continued support, they were able to carry out many activities that enrich the MIT experience for women in the Department of Chemistry.

WIC kicked off the academic year with its 9th annual First Year Mentorship Program. Each incoming woman graduate student was paired with an older female graduate student. This program assists the incoming women with their transition into the department’s graduate program and with living in the Boston/Cambridge area, and mentors continue to act as resources throughout the academic year. Members continued their fall tradition of apple picking at Shelburne Farm. This was their 4th annual apple picking trip, and it continues to be a great opportunity for the women to get to know each other better while being surrounded by the beautiful Massachusetts autumn foliage. In December, WIC spread their holiday cheer and invited all the chemistry graduate students and post-docs to a Holiday Social. This was the first social WIC has held for both men and women. Together, they ate, drank, and were merry, and this event was so well received that WIC looks forward to holding another Holiday Social this coming December.

WIC continued to hold its Skills to Succeed Dinner during the spring semester. This is an important event for WIC, providing an environment of shared experience and support. At this dinner, attendees discussed challenges they have experienced, strategies they have used to overcome these challenges, and their successes. In April, WIC members had the opportunity to visit the Genzyme Allston Landing Manufacturing Facility, where they learned about the history of Genzyme from Paula O’Donnell who has been in the industry for almost 30 years. The women were fascinated to see biochemistry performed on such large scales. WIC also co-hosted a workshop with the ChemREFS about negotiating in a power imbalance. They were also happy to have had an MIT WIC presence at the Boston Women in Chemistry symposium hosted by Harvard WIC, the Sloan Women in Management Conference, and the GWAMIT Empowerment Conference.

This summer, WIC introduced a new lunch series with the female faculty in the department to help them strengthen their community of women chemists. Each informal lunch features one professor and gives the women an opportunity to get to know her better and hear about her journey. To date, WIC has enjoyed lunches with Professor Cathy Drennan and Professor Liz Nolan, and they are looking forward to interacting with the remaining female faculty in the upcoming months.

Finally, WIC is excited to announce that they have created a WIC Travel Grant Program to support women chemistry graduate students and post-docs with funds to attend research or leadership conferences. Their first travel grants will be awarded in September. With this program they aim to help increase participation of women at research conferences and to increase accessibility of leadership conferences to women in the department. Details of this new program can be found on its website: http://wicscripts.mit.edu/wic/travel-grant/. If you are interested in contributing to the development of this program, please email the WIC Advisory Board at wicadmin@mit.edu. If you are an alumna and interested in participating in WIC’s career or networking events, we would love to plan an event with you! Please email wicadmin@mit.edu or visit our website: http://wicscripts.mit.edu/wic/
Sylvia Ceyer, Head of the Department of Chemistry was pleased to welcome the Chemistry Department Visiting Committee on Tuesday, September 30 and Wednesday, October 1, 2014.

The committee, elected by the corporation, typically includes 17 members: 5 corporation members assigned by the chairman of the corporation, one of whom chairs the committee, 6 presidential nominees nominated by the President of MIT, and 6 alumni nominees. Operating as advisory groups to the Corporation, Visiting Committees afford the Corporation, senior administration, faculty, and students appraisal, advice and insight on each academic department and on certain major activities at the Institute. Meetings provide faculty and students with opportunities to contribute to the governance of MIT, and they encourage stimulating and highly valued reviews. Important changes in departmental and Institute policy have resulted from visiting committee recommendations.

**MOERNER AWARDED 2014 NOBEL PRIZE**

The department was thrilled to learn on October 8, 2014, one week after his visit to the department as a member of the Visiting Committee, that Professor W.E. Moerner, the Harry S. Mosher Professor of Chemistry at Stanford University was awarded the 2014 Nobel Prize in Chemistry for his role in developing single molecule spectroscopy. Moerner shares the recognition, and the $1.1 million prize, with Eric Betzig of Howard Hughes Medical Institute and Stefan W. Hell of the Max Planck Institute for Biophysical Chemistry in Germany.
On July 20-22, 2014, the seventh Future Faculty Workshop for Diverse Leaders of Tomorrow, organized by MIT Department of Chemistry Professors Timothy Swager and Jeremiah Johnson, was held at the Endicott House in Dedham, MA.

The aim of this popular 2-day workshop is to provide mentorship to aspiring underrepresented minority students who have ambitions to become independent academic researchers in the areas of chemistry and chemical engineering as it relates to polymer science, materials science, and supramolecular science.

Eighteen eminent professors from around the country were in attendance to provide mentoring with a student/faculty ratio of less than four. The six previous workshops were held at: MIT (2008), Carnegie Mellon University (2009), UMass Amherst (2010), MIT (2011), UCSB (2012), and GIT (2013).

Led by Professor Swager, the workshop’s impact since its inception in 2008 has increased, and the number of applications has close to doubled.

The workshop is unique in its narrow scientific focus and thus allows for detailed technical engagement as well as future networking within the subfield. MIT’s leadership in this workshop has been critical to its success, and Professor Paula Hammond, Department of Chemical Engineering, and Professor Christine Ortiz, Department of Materials Science and Engineering, have served as mentors with Swager in all seven of the workshops.

This year, MIT Professors Michael Rubner, Department of Materials Science and Engineering, Jeffrey Van Humbeck, Department of Chemistry, and Jeremiah Johnson, Department of Chemistry, also provided mentorship. To date, about 20 participants have successfully competed for faculty positions.

The 2014 workshop was sponsored by the National Science Foundation, MIT’s Center for Materials Science and Engineering, and Harvard’s Materials Research Science and Engineering Center.
ClubChem—the MIT Undergraduate Chemistry Association—was invited to host a booth at the 2014 USA Science and Engineering Festival (USASEF). From April 24-April 28, six members of ClubChem, faculty advisor Professor Brad Pentelute, and Karen Shaner (Chemistry Education Office) traveled to Washington, DC to put on fun chemistry activities and demonstrations for hundreds of kids ages 2-12.

The team loaded into a cargo van and left early Thursday morning for the 9-hour drive to our nation’s capitol. Kept in good spirits by Suan Tuang’s (’14) never-ending playlist of songs, the team arrived at the Walter E. Washington convention center in the late afternoon just in time to load in the equipment. After a much needed night’s rest at the DoubleTree Hilton, the team set up the booth for VIP night and took a sneak peak at some of the other exhibitors, which included the stars of many childhood science memories such as the Magic School Bus, Bill Nye, and Mythbusters, along with Lockheed Martin, Bose, and Dow. The main event began at 9 am Saturday morning as large crowds waiting outside the convention center rushed in to kick off USASEF 2014. Over the next few days, the ClubChem booth was overflowing with as many as 20 kids at a time, along with their families.

The ClubChem booth featured four different chemical demonstrations, as well as two hands-on activities. The on-the-hour magic shows began with the Blue Bottle Experiment, displaying the nature of reduction and oxidation reactions. The crowd was amazed to see an initially blue solution of methylene blue turn colorless upon standing and then turn blue again with shaking. “How did that happen?!” a kid exclaimed in awe. “So, what we have here is methylene blue,” explained Daniel Mokhtari (’14). “It’s what we call a redox indicator that is colorless when reduced and then regains its blue color when oxidized. Glucose is a reducing agent, and that’s why it originally turned the solution colorless. When I start shaking the bottle, the oxygen in the bottle’s headspace dissolves, and oxidizes the methylene blue back to its blue color. As the solution is again left to stand, methylene blue is reduced back to its colorless form by the remaining glucose.”

The second of the four demos utilized freshly extracted red cabbage juice to introduce pH and colorimetric indication. The pigment flavin found in red cabbage gives different colors in different pH solutions (red in acidic, purple in neutral, and blue-green in basic). The team used vinegar, lime juice, baking soda, and tap water to show the kids the range of pHs found in everyday household products. As a finale, the team mixed the acidic red vinegar solution and the basic blue baking soda solution to produce neutral purple bubbles. The next demo showcased the spontaneous crystallization of supersaturated solutions. A heated solution of sodium acetate was cooled after heating. Kids then watched as it
rapidly crystallized once Daniel Zhang ('15) added a seed crystal. For the last demonstration, the team used a pair of 60mL syringe cartridges, HPLC tubing, and a ring stand to set up a flow apparatus that mixed a luminol solution with an oxidant. A velvet sheet covered the center of the display that glowed blue upon the mixing of the solutions.

To provide kids with an opportunity to get hands-on experience with the science, the team set up paper chromatography and fruit battery activity stations. For the paper chromatography activity, the chemical components of wet-erase markers were separated based on their variable retention times on filter paper. Participants drew different patterns inspired by some examples made by Ta Corrales ('15). Everyone then watched as water spread out the colors to create a tie-dye effect. This turned out to be one of the favorite activities for both the kids and parents. Parents and educators were especially happy when they learned that the solvent was just tap water, which meant the experiment could be easily implemented at home or in the classroom. Along with this activity, the team described how chromatography is used to separate compounds every day in chemistry labs. In the fruit battery stations, participants used copper pennies and zinc nails to make batteries out of various fruits. Alice Choi ('14) began by giving each participant a fruit to construct the battery. Then the participants were asked to cut their fruit in half, and repeat, showing them that the voltage output of the fruit (~1V) arises from the interaction of the metals. One volt was not enough to light the LED, but connecting the fruit batteries together in series (up to 8 at a time) did the job. The team used this opportunity to talk about teamwork and community in science.

By the end of the weekend, over 1300 people had visited the ClubChem booth. “Overall, our trip to USASEF 2014 was an incredible experience,” remarked Kayvon Pedram ('15), co-president of ClubChem. “We were inspired by the many amazing individuals we met and came away from DC with a renewed sense for the importance of education in science.” ClubChem hopes that the MIT presence at USASEF will continue to grow in coming years.

There are many individuals without whom this trip would not have been possible, let alone so successful. Scott Ide gave invaluable safety advice. John Dolhun provided extremely helpful feedback on our chemistry demonstrations and activities. We thank Dr. Mariusz Twardowski and Randall Scanga for providing the USASEF team with flame resistant lab coats for use during the trip. Karen Shaner did a lot of useful footwork in planning the trip. Jennifer Weisman supported us strongly from the outset of this project and connected us to many Chemistry Department resources. Brad Pentelute came with us on the trip, worked at the booth, and provided mentorship throughout the whole process. Finally, we thank the Dow Chemical Co. for providing funding for this trip.

Contributed by: Alice Choi, Daniel Mokhtari, Kayvon Pedram, Tachmajal Corrales Sanchez, Suan Tuang, and Dan Zhang
On July 17, A-level students from Lancaster Girls’ Grammar School in Lancashire (LGGS) in the United Kingdom visited the department. LGGS is a leading and highly selective school in the UK and is ranked as one of the top 50 in the country. The school has an outstanding record of A-level results. The aim of the trip was to expose the girls to a variety of opportunities available to them for study in some of the world’s top universities/research centers and to inspire them in their research project writing on their return to the UK. During their day-long visit to MIT, the group also visited the Broad Institute and the Koch Institute for Integrative Cancer Research.

Upon arrival to the department, the 26 students (all in their final A-level year) and 4 of the school’s staff members, were greeted by Jennifer Weisman, Academic Administrator in the chemistry education office. The ensuing agenda for their visit included a talk on “Molecular Electronics for Chemical Sensors” by Timothy Swager, the John D. MacArthur Professor of Chemistry, a tour of several labs, and discussion with a member of the department’s Women in Chemistry group.

“The visit to the Department of Chemistry was a highlight for many of the girls,” said Samantha Ireland, one of the staff members in a follow-up email to the organizers of the girls’ visit. “They were amazed at the different options available to them for study within the department, and the opportunities to be involved with real life, cutting edge research from an early stage in their careers.”

Sally Stott, an A-level student who is applying to the military commented, “Professor Swager, who talked on organic detectors was extremely interesting, and all the speakers talked so passionately about their varying fields of research. It was impossible not to be completely engaged and enthused about chemistry at degree level.”

“The speakers were open to answering questions about their career paths so far and what drives them forward in their research,” said Ireland. “The real passion they have for their subjects shines through; it is this passion along with the search for knowledge that underlies all the research at MIT that has encouraged a number of the girls to apply to MIT for undergraduate study.”

Sarah Ingham, an A-level student applying for engineering at degree level, said: “I found the MIT Department of Chemistry visit useful and inspiring because they talked about using chemistry with technology and, as I want to be an engineer, this gave me an insight into the range of fields I could end up doing in the future.”

“We are very grateful to the Department of Chemistry for the opportunity to meet with researchers and professors who are so eminently respected in their fields,” said Ireland. “It has not only inspired the girls to consider the role of chemistry in their own career paths, but highlighted the place chemistry has in the global and interdisciplinary nature of science and engineering in the Twenty-First Century.”
Dolhun Team Wows Cambridge Science Festival Audiences

On Saturday, April 19, 2014, the Dolhun team once again participated in the Science Carnival component of the Cambridge Science Festival, now in its eighth year.

The team’s spectacular show, “Marvelous Molecules in Play,” sponsored by the MIT Chemistry Department and MIT Boston Alumni Association, took place twice during the day in the Cambridge Public Library Auditorium to packed houses.

The team was made up of (team leader) John Dolhun, Chemistry PhD ‘72, who is an Instructor in the MIT Department of Chemistry Undergraduate Labs; Nathan Sanders who received his PhD in Astrophysics at Harvard University at the end of April; Shannon Morey who has an advanced degree from MIT Chemistry and who has recently accepted a new position at an East Boston High School for fall 2014; William Watkins and Zaid Zayyad who are both seniors at MIT and both former 5.310 students, and Katy Chiang who has advanced degrees in Chemistry and is a Re-Seed Volunteer from Northeastern University.

CO2 bubbles in the palm of their hands

Knock your soxs off reaction

Putting some Easter Peeps under vacuum

Reaction illustrating the expansion of liquid N2 as a gas
When I was 25 years old, I served as a forensics expert for the Innocence Project. The volunteer position was one of several personally transformative experiences I had while working my “day job” as a forensic biologist for the City of New York. On their website, the Innocence Project describes itself as a “national litigation and public policy organization dedicated to exonerating wrongfully convicted individuals through DNA testing and reforming the criminal justice system to prevent future injustice.” That may be what the organization means to most people, but to me, it finally answered a question that had been nagging me throughout my education—how were the topics I studied in STEM courses related to the real world? For years, I had dutifully learned about various concepts that seemed totally disconnected from the world I lived in and cared about. At the Innocence Project, I saw how the bench work I had been doing was not in a vacuum, but rather it directly impacted someone else’s life and was important. That realization sparked a curiosity about the biological foundation of forensics that inspired me to pursue advanced study in graduate school.

Now that I am an instructor at MIT in Professor Drennan’s Education Laboratory, I am involved with several educational projects that emphasize the authentic nature of science and help high school and college students see why they should learn and care about different STEM concepts. Educational research supports our emphasis on motivation—there is a direct correlation between inspiration and persistence in science. I’ll describe two easy ways to implement suggestions from our work that can be done in any classroom.

Provide students with an example of an interesting application of a concept as a way to motivate them to learn about its intricacies. One way this can be done easily is by embedding short videos into your class. [The Drennan Group] has published online a series of videos, “Behind the Scenes at MIT,” that highlight the who and the why of chemistry (see the July-August 2013 announcement in STEM Pals). While all less than three minutes, the videos manage to relate specific textbook chemistry concepts to cutting-edge research in medicine, the environment, or alternative fuels and have been embedded within high school and college classes worldwide. Here at MIT, after a student saw the videos in his introductory chemistry class, he commented, “I saw that there was actually an impact in what they were doing. They were changing the world. That’s important I think, that’s important to me.”

Invite a scientist into your classroom either virtually or in-person. Instead of just talking about why learning a STEM concept is important, having a scientist describe how the concept is critically relevant to her research can be a life-changing moment for your students. For many K-12 students, this might be their first interaction with a working scientist and could be an opportunity to dispel the various myths about what type of person becomes a scientist and what scientists actually do while at work. Many graduate students and post-doctoral fellows are eager to meet K-12 students and don’t have the same time constraints as professors. To get in touch with a scientist, you can contact the outreach or education office at your local college or university. Teachers in the Greater Boston area should consider attending “There’s a Scientist in My Classroom,” a bi-annual teacher-scientist workshop at MIT; at these workshops, we have helped dozens of teachers find a scientist to visit their classrooms. The next events will be in the fall of 2015.

Teaching a STEM subject in today’s world is exciting because science touches so many parts of people’s everyday lives. While those connections may seem obvious to those of us in the STEM fields, it is critical that as educators we remind our students of these connections and the relevance of each lesson—something that can be accomplished by spending less than three minutes of each class on a real-world example. Such efforts to bring the real world into the high school classroom may ignite in some students a passion for science they had not anticipated.

by Anique Olivier-Mason
Graduate Students’ Outreach Program

The MIT Chemistry Outreach Program enjoyed another successful season in the Spring of 2014. Between the months of April and June, nearly 40 graduate student and post-doc volunteers visited 24 middle schools and high schools throughout New England to perform fun and educational chemistry demonstrations for science classes. As a result, over 1000 young students were able to participate in hands-on chemistry experiments introducing them to concepts relating to chemical reactions, acids and bases, polymers, extreme temperature, and light. The goal of the MIT Chemistry Outreach Program, now in its 26th year, is to spark interest in science and medicine-related careers by demonstrating chemistry’s relevance to everyday life. The program proudly focuses on reaching young students in socioeconomically challenged areas and minorities that are underrepresented in the sciences.

If you would like to learn more about the program, or if you would like to request a visit for the 2015 season, please visit the MIT Chemistry Department’s website and click on “Outreach.”

Club Chem

ClubChem is an organization dedicated to the MIT undergraduate chemistry community and friends. ClubChem members hold study breaks, organize dinners with professors, organize UROP lab tours, and plan other events with the goals of bringing together MIT’s chemistry students and interfacing with the rest of the undergraduate community. ClubChem also goes on the road to area elementary schools with a Chemistry Magic Show, a presentation of experiments designed to promote excitement and interest in science.

ClubChem is extremely grateful to Mr. James K. Littwitz, SB ’42, who, on the occasion of his 60th reunion, decided to demonstrate his continuing support for MIT’s Chemistry Department and its students by establishing an endowed fund to promote undergraduate activities. The Littwitz fund has been providing funding for ClubChem for many of the activities described.

Behind the Scenes at MIT

“Behind the Scenes at MIT” is a collection of short videos that feature MIT researchers explaining how a textbook chemistry topic is essential to their research and to an inspiring real-world application. There are currently twelve science videos, which can be searched by chemistry topic (i.e. atomic theory, bonding, acid-base equilibrium) or by research application.

A set of accompanying personal videos, one for each scientist featured, illustrates the journeys to becoming a scientist. Some of these videos highlight challenges that have been overcome, such as dealing with learning disabilities, growing up gay and intellectual in a conservative small town, and having to learn English in order to understand science class.

Our goals in creating these videos were to bring the excitement of MIT research into the chemistry classroom and to illuminate both the why and the who of chemistry. These videos are intended to help motivate students to learn chemistry, inspire students to tackle important scientific problems in their future careers, and expose students to the many faces of chemistry.
The videos can be viewed online or downloaded for use in the classroom. Each science video is under three minutes, and the personal videos are three to five minutes in length. Teachers are welcome to use any or all of our videos in their classrooms. Video creation was funded by the Howard Hughes Medical Institute (HHMI) through an HHMI Professors Grant to Professor Cathy Drennan and is licensed under a Creative Commons Attribution 2.0 Unported License.

Please explore at http://chemvideos.mit.edu/

BRADLEY LECTURE

On April 15, Joel C. Bradley, PhD ’75 (with George Büchi), founder and CEO of Cambridge Isotope Labs, presented a guest lecture “Stable Isotopes—2014. Unique tools in Scientific Research, Trace Analysis and Medical Diagnosis.”

The event was the first 5.310 Distinguished Chemistry Alumni lecture organized by Dr. John Dolhun who is an Instructor in the Chemistry Undergraduate Labs.

Dr. Bradley built and runs one of the world’s top isotope labs, which he started in Cambridge, Massachusetts after receiving his PhD in chemistry.

JUST THE RIGHT CHEMISTRY!

The department recently produced a short video profiling several remarkable chemistry students and alumni. To watch the video, go to: http://chemistry.mit.edu/meet-our-students
Louise Foley, PhD ’70, grew up in Old Forge, a small town in upstate New York. Her mother was an English major and a “closet” scientist, and her father an electrical engineer who spent time at MIT during World War II while he was working on radar for the US Navy in Washington, DC.

Louise had been interested in science since 8th grade and in high school became passionate about chemistry. Her high school did not offer advanced courses so she took alternative classes including mechanical drawing and typing, the former coming in handy during the early days of structure drawing. Without the burden of advanced course work, she found time to enjoy alpine ski racing, and from an early age, was fond of classical music.

After high school, Louise chose to go to the University of Vermont (UVM) where they offered a “Professional Chemistry Program.” There, she was chosen for a NSF Undergraduate Research award for the summer after her sophomore year. “This experience in the lab,” she says, “was critical, as until then, I knew I liked organic chemistry but had no idea what I could do with a degree in it.” She received the same NSF award for her junior and senior academic years and for the following summers. “I simply fell in love with doing organic research,” she says.

Her undergraduate research mentor at UVM, Prof. M. E. Kuehne, enquired as to her future plans, and on learning she wished to pursue a PhD in organic chemistry, suggested she read the papers of several professors she should consider working with, Prof. George Büchi at MIT being one. “I enjoyed reading Büchi’s papers because in addition to discussing his research, he added related information,” Louise says. Her second choice was Prof. Gilbert Stork at Columbia, “but,” she says, “Stork’s papers were interesting but lacked the tidbits of knowledge that George Büchi provided.”

In 1965, after graduating from UVM, Louise arrived at MIT aspiring to be admitted into the PhD program and more expressly into Prof. Buchi’s group. However, Büchi had a reputation for not admitting women into his group so she knew it wouldn’t be easy.

Louise notes that at least until 1965, to be admitted to the PhD program in chemistry at MIT, one had to have taken and passed qualifying exams in the four areas of chemistry. UVM had no inorganic professors and Louise’s analytical chemistry professor had been a poor instructor and, as a result of not reviewing physical chemistry, Louise failed three of the four exams. When she met with Professor Herbert House at MIT, he told her that if he could have averaged her organic score over the other three exams, she would have passed them all with flying colors.

Prof. Büchi, however, told Louise that he had no room in his group for the fall semester but he offered her a place in his group in January with the condition that she pass all the qualifying exams as well as her courses.

“Following my mother’s death,” says Louise, “I found a letter from Prof. Arthur Cope, then department chair, to my parents saying how proud they should be as I had proved a number of professors wrong in their assessment of me by passing all the qualifying exams and my courses. This led me to think they, especially Prof. Büchi, had been betting against my success!”

Büchi and Cope suggested Louise retake the GRE. She did, and received an excellent score, resulting in a NIH Fellowship. “Thus I became the only woman PhD from MIT with George Büchi as mentor,” she says, adding, “George seemed to take pleasure in introducing me to others as his only female PhD or as his first and last female PhD!”

In the fall semester, prior to joining the Büchi group, Louise TA’d for Prof. C. Gardner Swain’s organic chemistry class. Her task was to correct the exams he gave using the key he supplied. In doing this, she noticed he had an incorrect mechanism. “He came down to the Reading Room where I was correcting the papers, visibly upset that I would question him,” Louise says. “When he looked at my mechanism, and the papers I had pulled out to support it, he agreed I was right. Needless to say, he never asked me to correct his exams again!”

Louise’s research topic in the Büchi Lab was a novel approach to quinidine, the quinuclidine portion of quinine. The next to last step in this synthesis was in essence to dehydrate an alcohol. Louise thought this should have been simple but instead of dehydrating, the alcohol underwent a transannular reaction followed by the addition of any available nucleophile. The dehydration
problem was eventually solved with the assistance of another member of Büchi’s group, Terry Barrett, who suggested another method to form the desired olefin. Later Louise was able to find an alternative way that gave her the olefin in a higher yield.

In their later years, students often found themselves on their own, working through any problems that developed. George Büchi watched from a distance and would only step in if the student was trying to find solutions without success. Thus, his students became very knowledgeable and self-sufficient, both important skills for the “real world.”

Once Louise had the precursor to the desired Cope Rearrangement in hand, she discovered that this rearrangement did not occur but a retro Diels-Alder reaction did. Interestingly, had she chosen a different route to the critical compound, the product of the retro Diels-Alder reaction would have been one of the starting materials.

The most challenging aspect of grad school, Louise found, especially in the first two years, was getting her research done while at the same time preparing seminars and, in the second year, preparing a proposal to defend. Despite the demands, she found graduate school enjoyable and stimulating. “It was wonderful to be around really bright people who were interested in the science I loved,” she says, “and the Büchi lab members enjoyed socializing together. We went on ski trips and hiked and Prof. Büchi would join us when he could.”

Besides Büchi, Louise held in high regard Profs. Arthur Cope, Herbert House, and George Whitesides, all of whom were in the department at the time. Although she never took a course with Cope, she had read his papers. Prof. House had just written the first edition of Modern Synthetic Reactions and Louise attended his wonderful course on that topic. She also enjoyed a course that Prof. Whitesides taught that introduced students to writing programs on computers to analyze NMR spectra. This was back in the days when programs were printed on slippery 3”x6” cards. Handling them was very difficult, she remembers, as if the stack was held too tight, it exploded into hundreds of flying cards in no particular order! “Prof. Whitesides was a night owl, like me,” she remembers. “During the hot summer nights, I’d see him walking the hallways of the main building with less and less clothes on. The undershirt stage was the point I’d leave and go home, as who knew what might come off next!”

Louise received her PhD in February of 1970 and began looking for an academic position. At the time, there was a dearth of female faculty in universities. However, she was unable to get an interview, even using her MIT proposal, which she’d been told was excellent. She turned her attention to securing an industrial job but again found reluctance on the part of employers to hire female PhDs. Finally, she was granted three interviews. The first was with a major pharmaceutical company where she was met by a gentleman who stated: “Five years ago we hired a woman PhD and she has worked out well; we think it might be time to hire another one.” To which Louise replied, “If that is the only reason I am here, you can take me back to the airport.”

At the second pharmaceutical company, she was met by a fellow who said, “We have never interviewed a woman before so is there anything special we should do?” To which Louise responded, “If I ask to use a rest room, please direct me to a Lady’s Room.” The third interview was with Hoffmann-La Roche where she discovered two women PhDs were already employed in the chemistry department. That interview had commenced, as had the others, with the question: Do you have a boyfriend? “In those days that question was allowed,” says Louise, adding, “if the answer was in the affirmative, you would not be considered for the position.” She notes also that having a boyfriend at that time also meant you would not get a postdoc position. “Happily, how things have changed!” she remarks.

At Roche, Louise’s pharmaceutical research encompassed chemistry and biology. During her career, she worked with amino acids, carbohydrates, nucleotides, nucleosides, novel purines, new derivatives of Vitamin C, synthesis of novel retinoids and Vitamin A isomers, and synthesis of numerous heterocycles. “Working in just one area of organic chemistry,” she says, “would never have been as much fun.”

Working at Roche also had other advantages. As the first person to be allowed by Roche to hold a faculty appointment, Louise began teaching a basic organic course on Saturday mornings and three evenings a week at Fordham University in the Bronx, NY. The small class was comprised of older students who wanted to go to medical school but lacked organic chemistry. Finally, this
gave Louise the opportunity to satisfy her desire to teach! In 1981, after 10 years of pharmaceutical research, Louise’s interest in biology had reached a point where she wanted to learn more. So, taking a leave of absence from Roche, she returned to MIT as a Visiting Scientist to study cell biology and immunology, while still doing organic research. Changing gears and studying a totally new area was an exhilarating experience for Louise.

Back at MIT, Louise was once again kept busy. Prof. K. Barry Sharpless was going on sabbatical and asked her to teach his section of the second semester of the organic course, the carbonyl section of the course. Louise agreed and while teaching it began to feel there had to be a better way to present the somewhat disjointed topic. A few years later she came up with “Carbonyl Chemistry Unified” (which she copyrighted).

Prof. Büchi, delighted to have Louise back at MIT, provided her with lab space and chemicals as long as she led his weekly group seminar (which he attended) and also taught his Natural Product course when he was out of town. She and George realized they both had an interest in the synthesis of the same marine natural product—dibromophakellin. Through a biomimetic synthesis that Louise suggested, it worked out beautifully.

When Louise returned to Roche in 1988 (after an intervening teaching post at UNH), it was to take up the chemistry part of a new oncology program. “It was a wonderful choice,” she says, “the biology of cancer at that time was rapidly developing and my cell biology background made keeping up with that, as well as with organic chemistry, a full time but fun job.”

Retired now, Louise still loves classical music, reading history—both world and US—and of course keeps up with the science journals.

“I played many tricks on Prof. Büchi,” Louise says, reflecting again on her graduate student experience at MIT. “He had a great sense of humor and always found a way to get back at me or us.” By “us” she is referring to Jimmy Powell or the aforementioned Hugh “Terry” Barrett whom she often enlisted as co-conspirators.

One of Prof. Büchi’s best “get backs” to the tricks was when it came time for her Thesis Defense. “It was scheduled for 2pm and about 1:45pm Prof. Büchi came to the lab and asked me if I was ready,” Louise recalls. “I responded that I only get dressed up once a year and this is it.” On arriving at the assigned room, they found it empty so they sat and waited. After a while, Prof. Büchi got up saying he was going to find the others and departed. Louise sat alone for a while and then Prof. Glenn Berchtold came in and sat down for a while. Then he departed saying he was going to find the others. Prof. Daniel Kemp came in and went through the same routine. This went on for over a half an hour. Louise concluded they were all in the Men’s Room across the hall from the lecture room, having a good laugh and drawing straws to decide who should go sit with her next.

When Jimmy Powell, Terry Barrett and Louise were finishing up their degrees, Prof. Büchi treated the three to lunch and told them he had never enjoyed having any graduate students in his group as much as he enjoyed having them. Tricks and all they had succeeded!

George Büchi,” Louise says, “was an intimidating person, not because of anything he said or did, but because of his stature in the department and in the field of organic chemistry. Many group members worried they would do something wrong and be thrown out of the group. “A number of years after his death,” Louise says, “I woke up from a nightmare in which he had thrown me out of his group. I immediately called his wife, Anne, to complain. Her quick response of, it’s about time!, has had me laughing ever since.”

Over the years, Louise became very close to Anne and George Büchi, joining them some weekends at their New Hampshire home and every few years skiing in Switzerland. They were wonderful friends and became almost a second set of parents. Louise still treasures her friendship with Anne.

Louise is a loyal supporter of the department. “MIT, the Chemistry Department, and George Büchi were very good to me,” she says, adding, “they provided me access to a career that I loved. I am happy to, in some way, repay that gift.”

By Liz McGrath
Dr. Gary Forrest received his PhD in Chemistry in 1976. His thesis carried out under the advisement of Professor Richard C. Lord was titled: “Cyclic phosphates, dinucleotide coenzymes, and lipids: infra-red and Raman spectroscopic investigation of the relationship between molecular structure and biological function.”

Liz McGrath, Communications and Development Coordinator in the Department of Chemistry, contacted Dr. Forrest to learn about his experiences as a graduate student at MIT and the decisions behind his career path. The following interview ensued.

Liz: Where did you grow up?

Gary: I was born in Buffalo, NY and grew up in nearby Kenmore, NY.

Liz: Were any members of your family scientists?

Gary: My father was an aeronautical engineer and worked on the design of the X-1. My mother was a kindergarten teacher.

Liz: Why did you choose to do biological studies at Cornell for your undergraduate studies?

Gary: When I enrolled at Cornell my intention was pre-dental. I had come from a high-powered high school and at Cornell was placed in sophomore chemistry and calculus classes along with Cornell’s first crop of 6 year BA/PhD students. Quickly, I discovered I liked chemistry lab work and biochemistry became my focus.

Liz: At what point in time did you know you would continue your studies to do a PhD in physical chemistry? Were you familiar with your advisor Richard Lord’s research before coming to MIT—was he the motivator?

Gary: My boss at UW Hospital went on sabbatical to England and during that time a post doc and I ran the lab. That experience was way more fun than being a lab tech! So I looked into PhD programs. What I liked about MIT was the open program structure that emphasized research over course work. When I arrived at the Institute, I talked with different professors. Prof. Lord was heading to retirement, but he was interested in the type of biological problems I wanted to explore (membranes and cellular energy production) and I, in turn, was interested in spectroscopy — having enjoyed courses in the latter at UW.

Liz: Would you describe the optics research you carried out in the Lord Lab?

human cells in tissue culture—a skill I learned working summers at Roswell Park Memorial Institute in Buffalo.

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Gary: Under Prof. Lord I used primarily Raman spectroscopy to explore how the shape of molecules in membranes and energy production related to their function. With our age difference, Prof Lord was like having a second father! On his 65th birthday, I made sure he got treated to lunch in Boston at Locke Ober, his favorite restaurant.

The second summer I was at MIT, Lord ran out of funding so I interviewed with Philip Morris on campus and wound up working in their Richmond, VA, R&D center doing industrial IR spectroscopy. When I graduated the following year, they offered me a great job and over $200k in funding to set up a tunable diode laser lab to explore combustion products in cigarette smoke. So everything turned out great. During my last summer, I also got to work with Prof Lord and Prof. Dana Mayo at Bowdoin College helping out with the Infra Red and Raman courses.

Liz: What were the most challenging aspects of grad school? Did you enjoy student life at MIT?

Gary: I found graduate school life very isolating, mostly from a lack of on-campus housing—I rented a place in Melrose. I only remember taking two courses—biological chemistry and welding. I am a pure lab/research person so lack of a social structure really didn’t bother me and I was in and out in 3 years. My goal was to advance my knowledge and skills and get back to work.

Liz: Besides Lord, were there other chemistry professors that you held in high esteem for their teaching attributes and/or research?

Gary: Without question—Professor Khorana! He was a Nobel Prize winner and had a brilliant research mind.

Liz: Do you think the graduate student experience today is very different from the ‘70s? For example, do you think students nowadays approach their science with a moral obligation to improve life on earth?

Gary: From my limited personal contact with current students, and reading newsletters from MIT, Cornell and UW, I don’t think so. I see the same desire to learn and push the frontiers of science that I saw in my time at MIT.

Liz: Did you know when you graduated whether you would go into academia or industry? What was the influencing factor in your decision?

Gary: No question—industry. I liked teaching at UW, but at heart I am an experimentalist who thrives on solving problems.

Liz: What career path did you take before you started your own San Francisco based company SensorPhysics in 1985?

Gary: After four years at Phillip Morris, I was selected for a sabbatical at Stanford University in Mechanical Engineering. My task was to demonstrate to students the signal processing techniques for tunable diode lasers that I had developed using a precursor of the first PCs—a DEC MINC (The Digital Equipment Modular Instrumentation Computer).

When I returned to Phillip Morris 8 months later, I was interested in transferring to manufacturing but management wanted me to stay in the lab. So I spent a couple of years working on business ideas of my own in the biochem area and eventually had to “get a real job.” I was hired by the Laser Analytics Division of Spectra Physics in Bedford, MA to sell tunable laser diode systems. Despite no experience in sales, I found it was easy because I understood how the equipment was going to be used. I managed to sell a whole year’s quota in just the first quarter. With success in sales comes “competition,” and I was pushed out after 18 months and quickly hired at Burleigh Instruments to manage sales, service, and marketing. With that company, I travelled nearly 50% of the time and had record sales, but never really liked managing people. My boss (who had my position previously) told me to improve my management skills—and I told him if he could do better, and have record sales like I had, he could have my job back! That got me fired.

I interviewed for jobs for a month and finally concluded the best position was one that no one could fire me from. So I used my marketing contacts at Laser Focus World magazine to get a “job”—at $400 a month—writing short articles about laser and optics companies.
Soon after, I packed up and moved to the San Francisco Bay area which, at that time, was the heart of the laser industry built around Spectra Physics and Coherent. Slowly, there, I built up a consulting business, brokered laser diodes for NASA from Fujitsu, and revitalized the annual Laser Focus Marketplace seminar. I also did FDA laser registration for companies large and small.

On one trip to China on behalf of a client, I found a laser power meter with the unusual combination of high sensitivity and good thermal stability. That detector became the basis for SensorPhysics. I expanded my test equipment business over the years to include spatial beam profiling using UV sensitive films for excimer lasers, and low cost video cards for lasers in general. Eventually I phased out my consulting and focused on SensorPhysics.

Liz: What were your reasons for retiring to Hawaii?

Gary: By 2002 I had taken SensorPhysics as far as I thought I could so I sold the company to a former electronics designer who had done work for me. He continued the business in Colorado. I was living in Florida at the time as my mother had died two years previously and I was helping out my dad. However, I never really liked the humidity of Florida. Two years later, after a golfing vacation on Maui, I found the climate suited me and I was attracted to the rural areas on Maui. Ironically, Maui was also the site of one of my color center laser installations from my days at Burleigh Instruments.

Liz: Now that you have retired, do you still stay involved with chemistry at any level? Are you still involved with your company?

Gary: For several years I stayed in contact with SensorPhysics to make sure the transition for customers was smooth. And I stay current reading newsletters and technical reports—often laughing at how the press gets technology mixed up! My chemistry today is limited to treating metal and wood projects, but this year I am setting up a little 445nm laser CNC engraving system. What I apply daily is the problem solving training I got at MIT and the subsequent years of lab and sales experience.

Liz: I discovered in researching you that you produce the most beautiful one-of-a-kind clocks and lamps that combine koa and other hardwoods with stained glass, simple carvings oil penciled or 23k gold filled, and abalone or koa inserts. This work is obviously much more than a hobby. When did you discover this wonderful talent?

Gary: As I moved around the country from place to place, I always remodeled my houses, and of course I had my MIT welding course to fall back on.

My dad had been an apprentice boat builder before college and my uncle built and repaired wood boats so “sawdust was in my veins”. In caring for my dad in Hawaii, I needed a hobby I could work on an hour at a time.

Initially I developed a technique to print photographs on thin mulberry paper and that led to making frames that let the light shine from the back as well as the front of the picture—applied optics! Pretty soon I had a complete wood shop. My items are sold locally at four Maui Hands stores. This year I am working with George Kahumoku—a local Grammy award winning guitar player—to fine tune little electronic music boxes I make out of bamboo and Hawaiian koa. My share of the proceeds will go to support local youth music programs.

Liz: You have been a very loyal supporter of the chemistry department for many years. Why do you feel strongly about supporting the department?

Gary: I feel strongly about supporting education in general. My dad and I set up endowed scholarships at Buffalo State (for elementary school teachers) and Indiana Institute of Technology (in engineering).

When I retired in 2002, I set up a small UROP summer scholarship fund to recognize Professor Lord in the hope that other of his students would contribute.

In 2014, I am funding engineering scholarships in my Dad’s memory for local Maui Boy Scouts pursuing or enrolled in engineering programs. The funding is for the duration of their studies. That will be expanded to include scholarships in science education at the Maui Boys and Girls Club. My goal is to show kids as they are growing up that science and engineering are worth the effort in school and non-need based financial help is available without a lot of paper work.
Dr. Gerald (Gerry) Laubach received his PhD in Chemistry in 1950 under Professor John C. Sheehan. He spent his career thereafter at Pfizer Inc., rising to the position of president of the company in 1972. To mark the occasion of his retirement in 1991, Pfizer established a career development chair in his name at MIT. To date, 10 junior faculty members have benefitted from the Pfizer Inc.-Gerald Laubach Career Development Professorship, and chemistry professor Brad Pentelute is the current holder.

In addition to being a member of the Institute of Medicine and the National Academy of Engineering, Gerry Laubach is a Fellow of the American Academy of Arts and Sciences, the New York Academy of Medicine, and an Honorary Fellow of the American Institute of Chemists.

In 1985, he was the recipient of the International Palladium Medal awarded by the American Section of the Société de Chemie Industrielle and the Mayor’s Award in Science and Technology (bestowed by Hizzoner, Mayor Ed Koch).

His public service included membership in The President’s Commission on Industrial Competitiveness during the Reagan Administration, and the National Science Board’s Commission on Precollege Education in Mathematics, Science, and Technology.

Former board service with academic institutions includes: Brooklyn Polytech, Connecticut College, Carnegie Science, and The New York Academy of Sciences. He was awarded honorary degrees by Connecticut College, Hofstra University, and the Mt. Sinai School of Medicine of the City University of New York.

Former board service in business and industrial firms, in addition to Pfizer, includes: Cigna, Loctite and Millipore Corporations and the biotech firms include Affymax, DNA Plant Technology, BioTechnology General, and GenProbe.

The reminiscences and commentary that follow are in response to questions posed by Liz McGrath, Communications and Development Coordinator in the Department of Chemistry.

In 1947, when I arrived at MIT for graduate studies in chemistry, the Department of Chemistry was very much in transition.

Arthur C. Cope had just been hired from Columbia University as the new chair of the department, evidently with a mandate to make extensive changes. Cope had been active in the WW2 science effort and had chemistry contacts throughout the US, so he began his term by recruiting a large cadre of new faculty: Jack Roberts from Caltech, John Sheehan from Merck, and Charles D. Coryell from Clinton Laboratories, to name just a few.

An extensive faculty from an earlier era, however, was still in place. Among them was Prof. Avery Ashdown, a bit slowed by severe arthritis but nonetheless magisterially presiding over graduate housing in Ashdown House, and Prof. Nicolas (Nicky) Milas, rarely without his trademark
cigar, who wrestled with the oily complexity of Vitamin A chemistry in the basement, and who, it was widely held, initiated his multi-litre Grignard reactions by pressing the glowing tip of his cigar onto the reaction flask.

I was lucky enough to be among a generation of graduate students that occupied one of the several new chemistry laboratories. This particular corps of graduate students also reflected transition. The great majority of them were resuming careers interrupted by the war; they were older, often married, and more serious about getting on with their studies than students just out of college.

This age—one might say generational—difference was evident in two very young MIT undergraduates who spent a great deal of time hanging around the Sheehan Lab. Lab members referred to them as the “Bobsey twins.” It turned out the two were sizing up the lab for grad school and both did end up joining the Sheehan group. One of these “twins” was Barry Bloom who joined Pfizer in 1952 after a post-doc with Bill Johnson at Wisconsin. Barry subsequently became my successor as a Director, and Vice President for Research at Pfizer, retiring in 1993.

The other “twin” was E.J. Corey who was recruited to the University of Illinois by Roger Adams, and then, in 1959, went on to Harvard University where he was awarded a Nobel Prize in 1990 for his development of the theory and methodology of organic synthesis, specifically retrosynthetic analysis. EJ also became an early consultant to Pfizer Research and celebrated a 50th anniversary as such a few years ago.

As a newly minted professor with six or eight brand new lab spaces to fill, John Sheehan probably did a good deal of networking to glean graduate students from around the country. Prof. Marvin Carmack, then at Penn, who was an acquaintance of Sheehan’s from grad school, was the middleman that led to my appointment to a Research Assistantship in Sheehan’s group.

Bristol Laboratories, a newly founded pharmaceutical company, funded my research and I was charged to discover a non-steroidal androgen, e.g., a synthetic male sex hormone. In retrospect, this was a considerable challenge for a green grad student, and a professor whose principal experience and interest was penicillin! However, Sheehan and I contrived a rationale that led to the synthesis of a family of complex cyclohexanones. They were fun to make, but alas, not hormones.

By amusing coincidence, one of the compounds synthesized in this research turned up in a collection of surplus chemicals Pfizer obtained from MIT for use in a program of in-vitro screening for bioactivity. After three, maybe four decades, I remember that the crystals looked pretty good but were still not bioactive.

Naïve and unsuccessful though it was, this little project was medicinal chemistry—and medicinal chemistry had been my primary interest from the beginning.

I recall a number of years ago, in a social discussion among pharmaceutical research types, my surprise to learn that the career choices of several of us had been powerfully influenced by “The Microbe Hunters,” an exploration by author Paul de Kruif of the history of research on infectious disease, antibacterials, and antibiotics. Fortuitously, and appropriately, my first laboratory job (after school, 11th grade) was doing bacteriology to screen coal tar chemicals for bioactivity (among other lab chores) in a sponsored program at the University of Delaware.

The penicillin team was the main event in the Sheehan laboratory, and I was pleased to be a part of it for the second part of my thesis. Prof. Sheehan has well summarized this piece of the penicillin story in his book, The Enchanted Ring.

One of Sheehan’s best, and often repeated sayings, was: “to synthesize penicillin is like placing an anvil on a house of cards.” In the end, a method developed for other purposes proved to be the tool to do that delicate trick.

What Prof. Sheehan doesn’t do in his book is describe his approach to the guidance of a research group. I suspect none of us in his lab fully appreciated his light touch and the opportunity it provided us to develop originality and independence.

In the late ‘40s—and I imagine, nowadays as well—grad students were expected to spend long hours in the laboratory. But Boston was, and still is, an exciting place for students. I confess to having had the luxury of a season ticket to Sunday matinees at the Symphony, to membership in an amateur Gilbert and Sullivan group.
at Harvard, and to occasional getaways for skiing and mountaineering.

I recall one memorable escapade on, I believe, Memorial Day weekend in 1949 or ’50. E.J. Corey, Charlie Robinson (another Sheehan student, now retired from Wyeth Laboratories), and I set out by train to North Conway for a three-day traverse of Mt. Washington, walking on snow most of the way. Finally, in our bedraggled state, we were retrieved at Pinkham Notch by friends who had driven up from Boston. Among these friends was Winifred Taylor who was an English major from Tufts, a part-time assistant in Nicky Milas’s lab, and my future wife.

There were occasional fun activities inside the department itself. One memorable occasion, we grad students performed a radically modified version of the Broadway show *Finian’s Rainbow*, written and produced by Victor Frank (PhD with Sheehan, then to DuPont). The show was, of course, a faculty roast: “How are things in Glocca Morra?” turned into “How are things with Cope and Sheehan?” A good time was had by all!

Immediately after I completed my PhD, Pfizer offered me a position in medicinal chemistry. I jumped at this ground-floor opportunity. Pfizer, for 100 years up until 1950, had been supplying mostly fermentation-derived chemicals, including penicillin, to the pharmaceutical and food industries, but had just made the transition to becoming a pharmaceutical company.

My first assignment was to try to develop a chemical synthesis of cortisone from ergosterol, a natural sterol produced in small quantities, as a by-product in the manufacture of citric acid by fermentation. Cortisone, a hormone produced by the adrenal gland, had been found by Mayo scientists E.C. Kendall and Phillip Hench, to produce miraculous benefits in patients with rheumatoid arthritis. Industrial-scale production, however, was thought to require a more readily available natural steroid as a starting material—and a means to insert an oxy substituent at the inaccessible 11-position of that steroid.

Carl Djerassi, in his autobiography, describes the horse race of competing research groups seeking to solve this problem, and how all were discomfited by Upjohn biochemists who discovered a way to introduce the 11-oxygen by fermentation. But an even more important development was the growing recognition that prolonged administration of cortisone—and the ever more potent analogs that were being discovered—induced unacceptable side-effects. Thus, corticosteroids became limited to specialized medical niches. But these drugs, despite their limitations, did demonstrate that it was possible to discover a dramatically effective medicine for an intractable, non-infectious disease, and perhaps there could be others?

Corticosteroid research at Pfizer, and doubtless at many other laboratories, was thus redeployed to explore that possibility.

One of the first new medicines to emerge from the Pfizer program was a convenient, long-acting oral drug for the treatment of diabetes. Other drugs from the program—for use in psychotherapy, hypertension, inflammatory diseases—followed. New antibiotics were discovered. Structural modification of older antibiotics—notably penicillin and tetracycline—yielded important new medicines. Collaborations with European firms and independent research laboratories contributed to a growing portfolio of Pfizer pharmaceuticals.
Growth, and change, in Pfizer R&D from the ‘60’s onward was continuous and multifaceted. Newly recruited staff included a number of MIT chemists. The old laboratories in Brooklyn became crowded and new research centers were built in Connecticut and overseas in England and France. Organization was realigned to better foster the close interaction of chemists, pharmacologists and clinicians in project teams. The “D” in R&D, grew bigger, more sophisticated, more precise—in response to the increasingly stringent standards for proof of the safety and efficacy of new drugs.

Indeed, every dimension of a pharmaceutical firm—manufacture, marketing, demonstrating new medical applications of established drugs—became increasingly reliant upon science. Perhaps that had something to do with my appointment as head of Pfizer’s US pharmaceutical operations in 1969, and as president of the company in 1972.

Retirement from Pfizer in 1991 coincided with a unique and timely opportunity to contemplate the status of pharmaceutical R&D. I was appointed to the chair of a new committee that IOM had established to broadly survey technological innovation in medicine.

Several busy and rewarding years followed. Ultimately, the National Academy Press published five volumes, recording proceedings of conferences organized by the committee, and an overall summary was published in the NAS “Issues in Science and Technology” in 1995.

The outlook for pharmaceutical innovation that was intimated in these publications has been largely confirmed by subsequent events.

The growing understanding of biological processes in molecular terms has certainly provided the medicinal chemist with many new targets for drug discovery. However, the research based pharmaceutical industry has simultaneously undergone truly disruptive change. Legislation, enacted in 1984, mandated that after a drug patent expires, the safety and efficacy data generated by the innovator to gain approval to market that drug in the USA—the innovator’s most valuable intellectual property—may be relied upon by other manufacturers to seek approval of generic copies. The loss of revenues, as patents have expired on older medicines, has led to massive consolidation of the industry. Long established firms have disappeared in mergers. Laboratories have closed.

Our policies toward medical innovation are contradictory. As a nation, we generously fund basic research to create biomedical knowledge, but, at the same time, we have eroded the capacity for applied research and development to translate that knowledge into useful medicines.

Harry Rudel, MD (on left) who carried out the clinical pharmacology on Pfizer’s earliest drug candidates, talks with Gerry Laubach.
The department also welcomed the following named speakers during the fall of 2013 and spring of 2014

- Organic Chemistry Merck-Pfister Lectures: Makoto Fujita, University of Tokyo
- Sigma-Aldrich Lecture in Organic Chemistry Seminar: Sarah Reisman, Caltech
- Merck-Banyu Lecture in Organic Chemistry: Mamoru Tobisu, Osaka University
- A.D. Little Lectures in Physical Chemistry: Bruce Berne, Columbia University
- Buchi Lectures in Organic Chemistry: Phil Baran, Scripps
- Novartis Lectures in Organic Chemistry: Viresh Rawal, University of Chicago & Sejal Patel, Novartis
- Bristol-Myers Squibb Lectures in Organic Chemistry: Jeff Johnson, UNC & David Kronenthal, BMS
- Davison Lectures in Inorganic Chemistry: Chi-Ming Che, University of Hong Kong
- Pfizer-MIT Lecture in Organic Chemistry: Melanie Sanford, University of Michigan

Carlos Bustamante, Howard Hughes Medical Institute Investigator and Professor of Molecular and Cell Biology, Physics, and Chemistry at the University of California, Berkeley, visited the department from April 22-23, 2014 inclusive to deliver the “T.Y. Shen Lectures in Biological Chemistry.”

Professor Bustamante’s first lecture was titled, “Division of Labor and Coordination Among the Subunits of a Viral Ring ATPase.” The title of his second lecture was “Mechanisms of Cellular Proteostatis: Insights from single molecule approaches.”

The T.Y. Shen Lectures in Biological Chemistry are made possible by Dr. T.Y. Shen who received his PhD from the University of Manchester in 1950 and did postdoctoral work at Ohio State University many years at Merck, Sharp and Dohme Research Laboratories as the Executive Director of Synthetic Chemistry. He was involved in the development of analgesics, immuno-suppressants, and anti-inflammatory drugs. He is best known for his contributions to the development of Indomethacin, a non-steroidal anti-inflammatory drug. For his contributions at Merck, he received the Director’s Scientific Award in the field of medicinal chemistry in 1975. Shen retired from Merck in 1986 and held the Merck endowed chair in Chemistry at the University of Virginia where he is now Emeritus. The Shen family endowed the lectureships in 2001.

The Shen family also recently endowed an Amy Lin Shen Summer Graduate Fellowship named in honor of T.Y.’s wife, Amy, who carried out graduate studies in physical chemistry at MIT under Professor George Scatchard.
Naming Opportunities

Endowed Professorship $4,000,000
Endowed Career Development Professorship $2,500,000
Endowed Graduate Fellowship—annual tuition and stipend $1,000,000
Expendable Graduate Fellowship tuition and stipend for five years $350,000
Endowed Summer Graduate Student Support $250,000
Expendable Graduate Fellowship—tuition and stipend for one year $70,000

Gifts in all amounts to the Department of Chemistry are deeply appreciated. Your donations provide critical support by way of graduate fellowships, supplies, and important seeding for new programs. If you would like to make a gift or pledge over the telephone, please contact the MIT Alumni Association at 1-800-MIT-1865 or go to MIT’s secure on-line giving site: http://web.mit.edu/giving/. The chemistry department website also has direct links to the funds: http://chemistry.mit.edu/giving-alumni/ways-give

Robert J. Silbey Career Development Professorship Fund ........................................... 3246750
- Gifts of alumni/ae, faculty, staff, friends, and family in memory of Professor Robert J. Silbey to support a career development professorship

Chemistry Undergraduate Lab Renovation Fund ......................................................... 3704250
- Gifts towards a comprehensive renovation of the Department of Chemistry Undergrad Labs

Chemistry Renovations ................................................................................................... 2735912
- Gifts to renovate research space in the Department of Chemistry

Graduate Fellowships in Chemistry ............................................................................... 2735295
- Gifts to support graduate fellowships in the Department of Chemistry

Chemistry Department Discretionary Fund ................................................................. 3912200
- Gifts to provide support to one-time and near-term goals of the Department of Chemistry

Richard R. Schrock Fellowship Fund ............................................................................. 3312001
- Gifts to support a graduate fellowship named for Richard R. Schrock, Nobel Laureate and Frederick G. Keyes Professor of Chemistry

Stephen J. Lippard Fellowship Fund .............................................................................. 3304020
- Gifts to support a graduate fellowship named for Stephen J. Lippard, Arthur Amos Noyes Professor of Chemistry

Satoru Masamune Memorial Fellowship Fund .............................................................. 3305900
- Gifts to support a graduate fellowship named in memory of the late Professor Satoru Masamune

Michael S. Feld Memorial Fellowship Fund ................................................................. 3298340
- Gifts to support a graduate fellowship named in memory of the late Professor Michael S. Feld
Thanks to the generosity of two long-standing and thoughtful supporters, the Department of Chemistry hosted a springtime celebration on May 18, 2014.

Over sixty alumni, friends, and faculty gathered in the Winter Garden of MIT’s Media Lab. Guests enjoyed not only spectacular views of the Charles River and Back Bay, but also conversation and presentations focused on the department’s educational and research accomplishments, as well as its future plans, goals, and special projects.

After opening remarks and a warm welcome from Sylvia Ceyer, Department Head and the J. C. Sheehan Professor of Chemistry, John Essigmann, William R. (1956) and Betsy Leitch Professor of Chemistry and Biological Engineering gave a presentation entitled “Our Chemistry Labs Don’t Stink Anymore” explaining why we can expect an improvement in the atmosphere in which our undergraduates will study chemistry due to the exciting and long overdue relocation of our undergraduate laboratories to the top floor MIT’s new state-of-the-art nano building.

This major capital project is a focal point for MIT’s planned campaign, and the department intends to take full advantage of the project’s high internal and external profile for the benefit of our efforts to raise funds for our department’s undergraduate laboratories.

A major feature of the new facility is the fact that the design of the new laboratories offers a perfect example of form following function, for they are inspired by URIECA, our innovative undergraduate curriculum, which later in the evening was the focus of Brad Pentelute’s presentation, “Flowing into URIECA moments at MIT.”

To conclude the evening’s presentations, Susan Solomon, Ellen Swallow Richards Professor of Atmospheric Chemistry and Climate Science, and a well-known scientist whose research takes place at the intersection of basic science and public policy, spoke about “The World’s Chemistry in our Hands,” a compelling subject as significant and large as our planet itself.
Department Head, Prof. Sylvia Ceyer welcomes our guests.

Professor John Essigmann speaks on how our labs no longer stink.

Professor Brad Pentelute speaks about flowing URIECA moments.

Professor Susan Solomon explains why the world’s chemistry is in our hands.

Judith Selwyn, PhD ’71, John Dolhun, PhD ’72, and Katy Dolhun

Ybet Villacorta, PhD ’87 and Professor Dick Schrock

Professor Matt Shoulders and Mr. Stanley Solomon, ’52

Tim Oyer, PhD ’91 and Joanne Oyer

Mark Findeis, PhD ’81, Dr. Cady Coleman, ’83 and Dr. Maureen Rezendes
We gratefully acknowledge gifts and pledges to the Chemistry Department from the following chemistry alumni, friends, corporations and foundations during the 2013 calendar year.

Names emboldened indicate a giving level of $1,000 or more (whether unrestricted or committed to a particular department) to MIT that qualifies for membership in the William Barton Rogers Society for either, or both Fiscal Years ‘13 and ‘14. Benefits include: invitations to special events, commemorative MIT calendar, acknowledgement of membership at events, recognition in the Annual Report. Membership details at: https://giving.mit.edu/wbrs/membership.html.

Names with an * indicate membership in the Katharine Dexter McCormick (1904) Society. In the long history of giving to MIT, planned gifts and bequests have been the largest source of gifts to MIT’s endowment. To honor those donors who continue this practice, in 1994, MIT established the Katharine Dexter McCormick (1904) Society (KDMS). Membership details at: https://giving.mit.edu/ways/planning/kdms/

Names with an # indicate membership in the 1861 Circle. The 1861 Circle is an esteemed community of MIT alumni, parents, students, and friends who give to the Institute year in and year out. Membership begins in the year of one’s fifth consecutive annual gift and continues with ongoing annual support. http://giving.mit.edu/1861circle/how.html

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Richard R Kurtz#  CM ’71
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Araba A K Lamouse-Smith  CH ‘00
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Edward J Lanpher**  ‘49 CM
Amelia M Lapena#  ‘94 CM
Gerald D Laubach#  CM ‘50
Michael D Lawlor#  CM ’97
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Catherine Leatherdale#  CM ‘00
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Katherine L Lee#  CM ‘96
Eliza-Beth W Lerch#  ‘02 CM
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Michael D Lewis#  ‘78 CM
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Stephen J Lippard#  CM ‘65
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James H Loehlin#  CM ‘60
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Brian Woody H Sherman  CM ‘04
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Robert P Short#  CM ‘89
Jennifer Z. Sieczkiewicz#  CM ‘01
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Nathan R Tzodikov  CM ‘77
Barbara C Ucko
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**Foundations and Corporations**

3M Community Affairs
American Chemical Society
Amerin Inc
Arsia Therapeutics, Inc
Boehringer Ingelheim Pharmaceu
Bristol-Myers Squibb Company
Chicago Community Trust
Corning Incorporated Foundation
Dainippon Sumitomo Pharma Co, Ltd
Dow Chemical Company
Camille and Henry Dreyfus Fdn
Edward Mallinckrodt, Jr. Foundation
Medical Foundation Inc
Nippon Shokubai Co., Ltd.
Novartis Institutes Biomed Rsrch
Organic Syntheses Inc
Pfizer Inc
Alfred P Sloan Foundation
Lee L. and Judith E. Selwyn Foundation
Sontag Foundation Inc.
Howard Hughes Medical Institute
Graham, Roger  
SB  
Advisor: Professor C. Gardner Swain  
PhD Chicago 1953 (Westheimer). Rohm and Haas Co. 1953-1996 (basic and applied polymer research, patent agent). Retired 1996; active in various senior activities in Moorestown, NJ.

Kessel, David  
SB  
Advisor: Professor John Sheehan  
Still (somehow) supported by the NIH for studies mainly involving photobiology. The advantage of that early training in organic chemistry is that I can carry out simple synthetic reactions without activating any alarm systems.

Drake, Kenneth  
PhD  
Advisor: Professor George Büchi  
I visited the Institute in September 2013 and hardly recognized my old stomping ground. The outside of the main building was of course the same, but there were all sorts of changes in the interior. Like many other grad students, I earned my tuition and room and board by acting as a teaching assistant for the early undergraduates. As I recall, lectures were given to about 210 students. Then the group was divided into 7 x 30-member problem sections, and I had one of these classes. My particular classroom was on the first floor of the main building, facing the inner courtyard. It was near the end of the second semester, about May and about half of the period, I had gone over a few problems and answered all the questions the students had. There were big windows facing the courtyard. It was a beautiful day, and the courtyard outside looked so inviting. One of the students said, “Hey Mr. Drake, let’s go outside.” Why not? I thought. So out we went through one of the windows. I sat them under a tree and expounded to them on my concepts of chemistry in particular, and life in general. 58 years later, everything is different, but the tree is still there. So I took a picture of “my tree” as a remembrance of some good times past.

MacLachlan, Alexander  
PhD  
Advisor: Professor C. Gardner Swain  
My wife Elizabeth (also a 1957 PhD from MIT) and I are enjoying retirement. I retain a strong interest in science and do occasional service for the National Research Council.

Spiro, Thomas  
PhD  
Advisor: Professor David Hume  
A few years ago I relocated from Princeton to the U. of Washington. Great chemistry department, close to grandchildren. The lab moved too, and we are enjoying research, in the midst of the great Northwest.

Loveland, Walter  
SB  
Advisor: Professor Glen Gordon  
Walter Loveland was awarded the 2014 ACS Award in Nuclear and Radiochemistry, the Glenn T. Seaborg Award.

Durst, Richard  
PhD  
Advisor: Professor David Hume  
It’s been just one year since my family and I moved to Regensburg, Germany, and we have settled in reasonably well. My wife is a professor at the University of Regensburg and the kids are doing very well in the German schools. My only problem s the language. While I can speak some German, the Bayerisch dialect that they speak here in Bavaria is unique. Learning a new language at my age is difficult enough without throwing in this mostly unintelligible dialect. Oh well, if I got through MIT, I’ll also survive this ordeal. BTW, I recently also joined the MIT Club of Germany, and I am looking forward to future meetings and making new, English-speaking friends. Auf Wiedersehen.
Model, Frank
SB
Advisor: Professor Walter Thorson
Although reporting being done with chemistry [since retirement] in previous posts, I can now report being “reborn.” I am now consulting on a project involving eco-coal being led by an MIT classmate from Course 8. Good to be back in the saddle.

‘64
Meriwether, John
SB
Advisor: Professor Isadore Amdur
Enjoyed MIT 50th reunion but very sad and sorry that IO passed away just three days prior to our reunion. Enjoyed meeting Prof. Carl Garland whom I did not know when I was a student. It appears that MIT is about to change big time re building repairs. I hope this goes forward smoothly.

Young, William
SB
Advisor: Professor Fred Greene
In 2007, Bill retired from his 34-year career as a Chemical Analyst on Wall Street. He still does consulting work in his field, although this constitutes a relatively small percentage of his time. As VP of his MIT undergraduate class (which just celebrated its 50th Reunion), he has spent considerable effort tracking down “lost” classmates and creating the Course V webpage: http://1964.alumclass.mit.edu/s/1314/clubs-classes-interior.aspx?sid=1314&gid=55&pgid=10777. If the link doesn’t work and you would like to visit the site containing selected choice comments about the Chem Department’s faculty in the early 1960s—professors who were in the department as early as the 1920s and as late as 2014—simply conduct a search for “MIT Class of 1964 Course V Chemistry.” Separately, he is on a campaign for noise reduction in movie theaters for the sake of maintaining auditory health and is seeking others to join him in this effort. At his urging, legislation to limit sound levels was introduced—but did not pass—in the most recent session of Connecticut’s General Assembly. Bill and his wife Linda have two kids and six grandchildren, all of whom live in the San Francisco Bay Area.

‘65
Smith, David
PhD
Advisor: Professor Clark Stephenson
I regret to inform you of my husband’s passing on June 1, 2014 Renee G. Smith.

Wade, Charles
PhD
Advisor: Professor John Waugh
The end of June marked the end of my first year of retirement. It has been wonderful, though a busy one as I helped educate my two grandkids (JAVA, Sketchup, Geometry and a variety of hands on activities), helped with fundraising for non-profit 501(c)(3) organizations, and made significant progress on reading that stack of books I’d created over the years.

‘66
Desiderio, Dominic
PhD
Advisor: Professor Klaus Biemann
Dominic M. Desiderio, Professor in the Department of Neurology and Director of the Charles B. Stout Neuroscience Mass Spectrometry Laboratory, University of Tennessee Health Science Center, Memphis, TN, presented two invited lectures in China in October, 2013. One lecture was at the 15th Beijing Conference and Exhibition on Instrumental Analysis (BCEIA) in Beijing, and the other at East China Institute of Technology (ECIT) in Nanchang, Jiangxi Province. Dr. Desiderio is a member of the MIT Cardinal and Gray Society (graduated 50 years ago), and members led the procession at the graduation ceremony on June 6, 2014.

‘67
Sitrin, Robert
SB
Advisor: Professor Daniel Kemp
I retired from Merck in 2011 and worked as an independent consultant in Vaccines Development. I recently took on a part time position with PATH and nonprofit which develops vaccines for the third world.
‘68
Friedman, Emil M.
SB
Advisor: Professor Richard C. Lord
I’m far from the first MIT grad who’s career took lots of unexpected turns. At graduation I thought I’d be a spectroscopist. Grad school & a post-doc led me to polymers, liquid crystals, and polymer liquid crystals. Goodyear led me to emulsion polymers, structural property relationships, chemical reactor engineering and then statistics. Statistics eventually led me to non-clinical biostatistics in the pharmaceutical industry. Somewhere along the way I also got involved with the statistics of promotional games, including a generalization of the birthday problem that we learned about in high school.

‘69
(Platzblatt) Pepperberg, Irene M
SB
Advisor: Professor Jeffrey Steinfeld
Moved my lab (research on Grey parrot cognition) from Brandeis to Harvard last summer, and added a new baby Grey to the flock in September. Although I still do not have a ‘regular’ job, my teaching and research are now in the same place, and my students and I are doing many interesting studies and publishing regularly.

‘70
Marks, Tobin
PhD
Advisor: Professor Al Cotton
2013 Alan MacDiarmid Medal, University of Pennsylvania
2014 Sir Geoffrey Wilkinson Medal, Royal Society of Chemistry

Rebek, Jr., Julius
PhD
Advisor: Professor Daniel Kemp
I have opened a new laboratory in the Chemistry Department at Fudan University in Shanghai under China’s Global Experts Program.

Ronald Sheinson
PhD
Advisor: Professor Kerry Bowers

‘71
Gall, Martin
PhD
Advisor: Professor Herbert House
It’s nice to be back in Massachusetts again. Allyson and I moved to Scituate, MA this past January, after retiring from our respective positions (I as Global Clinical Trial Head for Novartis, she as Director of the NJ chapter of the American Jewish Committee). I was saddened to read of the passing of my thesis advisor, Prof. Herbert House, who had moved to Georgia Tech after I graduated from MIT. I’m delighted to learn of the important energy and other chemistry projects being carried out at MIT and enjoyed the annual Science Fair held at the Institute this past spring.

‘72
Drummond, David
SB
Busy managing isoSolutions and our nuclear medicine business in Latin America, Canada and China. Having too much fun to think about retirement!

Scott, James
SB
Advisor: K. Barry Sharpless
Going on 30+ years now from internship to staff at Mass General Hospital - I think I may have been Barry’s first undergraduate lab guy and have now achieved the rare status of having forgotten more chemistry than I may have known. Great memories though.

‘76
Frye, R. Bruce
PhD
Advisor: Professor Sidney Hecht
Enjoying volunteering in science classes in the local Delaware schools to promote STEM in general and chemistry in particular. I call myself “Dr. Frye, ANOTHER Science Guy” (I hope Bill Nye is not offended).
‘77
Melzer, Jim
SM
Advisor: Professor Jeffrey I. Steinfeld
I was recently promoted to Technical Fellow at Rockwell Collins, in Carlsbad, California, where I design and develop head- and helmet-mounted displays. My research interests are in visual perception, image processing, nanoplasmonic metamaterials and invertebrate vision.

‘79
Peterson, Christine
SB
Advisor: Professor Christopher Walsh
Currently organizing a workshop on solving environmental problems (e.g., ocean acidification) via atomically-precise nanotechnology pathways. Also collaborating with SENS Foundation on their first U.S. conference on rejuvenation biotechnology.

‘80
Rios-Mercadillo, Victor
PhD
Advisor: Professor George Whitesides
Chief Scientist at Green Seal Corporation Queretaro, Qro. México.

‘81
Orvig, Chris
PhD
Advisor: Professor Alan Davison
Chris Orvig was this year honored by his institution, the University of British Columbia, Vancouver, with its highest award for research, the Jacob Biely Research Prize.

‘82
Mitchell, Miguel
SB
After 12 years at Salisbury University, I tried my hand at starting a fine chemical manufacturing company...just before sequestration. Oops! Well, timing is everything. I did complete one contract. Now I’m happily employed by Late Nite Labs in NYC, at-home working as Science Content Editor for a virtual learning lab environment.

Palmer, Chip
SB
Advisor: Professor Richard Schrock
After many years at DuPont, I’ve moved to Ethox Chemicals, a medium sized specialty chemicals company with a strong entrepreneurial environment. I’m in charge of R&D and marketing there and recently was promoted to Vice President. I get to work on many new product developments, evaluating new technologies, intellectual property management, and marketing our new products. We’re promoting our new reactive surfactants to make paint with both better performance and a better environmental profile. I really enjoy my work with all of its challenges!

Sard, Howard
PhD
Advisor: Professor Rick Danheiser
I am a co-founder and Vice President at Organix, Inc., a contract research and development company that has provided outsourcing in all areas of synthetic organic chemistry since 1986.

‘83
Liang, Bryan
SB
Advisor: Professor Rick Danheiser
Hello! Well, I finally made something of myself—35 years after leaving high school early w/o graduating, and post-MIT BS and three terminal degrees [MD, PhD, JD], I was awarded my high school diploma this past June! This was part of my being named to the school’s Wall of Fame for Professional, Civic, and Humanitarian Service—they couldn’t induct me initially because it is an award only for “graduates.” So the School Board voted to award me a HS Diploma and then announce the induction! They also put all the degrees after my name—bet they hadn’t used that much ink for a name in a long time! Hope all’s well in Course V! Best, Bryan [HS Dipl. (Hon.), MD, PhD, JD]

Spencer, Mark
PhD
Advisor: Professor Jeffrey Steinfeld
Water Analytics is now in its fifth year. We recently released our first major new product—a web based controller for our industrial water quality sensors. By MIT standards it may be “so yesterday” but, in the water treatment arena, it’s the first of its kind at its price point. An even more advanced controller is due out in 6 months.
Grayce, Christopher
SB
The world of online educational technology seems to have taken off, and business for the product I designed (ALEKS for chemistry) is really booming. We’ve just acquired the general chemistry business at our third University of Texas and University of California campuses, and Penn, Baylor, Rice, UNC Chapel Hill, are joining Emory, Ohio State, Washington and many others as customers this fall. As a former professor it’s awe-inspiring to have nearly 100,000 students a year, so to speak, but the work is intense.

McManus, Michael
PhD
Advisor: Professor Glenn Berchtold
Working as senior vice president at Knome, Inc.

Thoman, Jay
PhD
Advisor: Professor Jeffrey Steinfeld

Duncan, (Noel) Audra
SB
Advisor: Professor Stephen Lippard
I am presently a Professor of Surgery, Vascular Surgeon at the Mayo Clinic, Rochester, MN.

Boyd, James
PhD
Advisor: Professor Daniel Kemp
I am VP of Chemistry at Artificial Cell Technologies, Inc., a small biotech company in New Haven, CT. We are developing a peptide film technology for applications in vaccine science and were recently awarded a Phase 2 SBIR grant for development of our microparticle-based malaria vaccine. If things go well we will begin testing in humans in 2-3 years. (and yes, Prof. Bob Langer is on our SAB).

Kuo, Erica
SB
Life since graduating from MIT certainly has been an adventure:
Berkeley grad school, Stanford law school, married, moved to NY, traveled all over the world, baby, partner at Goodwin Procter, retired from Goodwin Procter, moved to Hong Kong, traveled around Asia, learned Chinese (finally!), moved back to NY, and recently opened my own boutique patent law firm, Haner & Kuo, PLLC (www.hanerkuo.com). What lies ahead? Can’t wait to find out!

Oyer, Timothy
PhD
Advisor: Professor Mark Wrighton
I am President of Wolf Greenfield, a Boston IP law firm, and live in the city with my wife and two sons. In my job, I have the great privilege of interacting regularly with MIT students, profs., administrators, and alums, as well as companies spun out of MIT. Few days pass when I am not reminded one way or another how fortunate I am to have had such a strong and positive impact made on my life by MIT.

Wright, David
PhD
Advisor: Professor William Orme-Johnson
I have been at Vanderbilt University for the last 13 years in the Department of Chemistry. This past spring, I was named the Stevenson Professor of Chemistry. On July 1, I took the reins as the Chairman of the department.
Freundlich, Joel PhD
Advisor: Professor Richard Schrock
Joel Freundlich (Ph.D. Chemistry 1996) is an associate professor at Rutgers University. His group is using an array of computational, chemical, and biological tools to study Mycobacterium tuberculosis—the causative agent of tuberculosis. His research is funded by the NIH. He resides in Princeton, NJ and would love to hear from other chemistry alumni!

Spencer, Darryl PhD
Advisor: Professor Mario Molina
Started a new job last year in Philadelphia as VP, Technology for the Life Science Solution division of Elsevier. Our software tools and information content supports pharmaceutical R&D.

Sturla, Shana PhD
Advisor: Professor Stephen Buchwald
I was pleased to receive the 2014 ACS Chemical Research In Toxicology Young Investigator Award (http://www.acschemtox.org/inside/Pages/newsletter.aspx?AID=123&thread=). I am a Professor of Toxicology at the ETH Zurich, and enjoy life in Switzerland with Kristopher McNeill (Professor of Environmental Chemistry at ETH, and former MIT postdoc) and our 1-year-old son, Bosco.

Bartlett, Bart PhD
Advisor: Professor Daniel Nocera
Bart M. Bartlett was promoted to Associate Professor with tenure at the University of Michigan Department of Chemistry in May 2014.

Bachmann, Julien PhD
Advisor: Professor Daniel Nocera
Julien is an associate professor of inorganic chemistry at the University of Erlangen in Germany.

Radhakrishnan, Mala PhD
Advisor: Professor Bruce Tidor
I am a wife, a Mom of two, and a chemistry professor at Wellesley College. I also published a humorous book of chemistry poetry, Atomic Romances, Molecular Dances, which course 5-ers would likely enjoy!

D’Ascoli Etheridge, Jenn SB
Advisor: Professor John Essigmann
In May I graduated from Wharton with my MBA in Health Care Management, in June I married my wonderful husband Will Etheridge (Course 3 ’07), and in July I started working at Genentech in the Market Analysis & Strategy within the Patient Insights group. It’s been a busy year!

Redfern, Roseanna SB
Advisor: Professor JoAnne Stubbe
I have been working as a chemist for Sherwin-Williams since 2009. I am currently the Category Manager for Extenders, which are industrial minerals used in coatings. I am hoping to start graduate classes part time in the fall to eventually get my MS; my course load will include analytical chemistry, inorganic chemistry, geology, and polymer science.

Sinnett, Sarah SB
Advisor: Professor JoAnne Stubbe
I graduated from UNC-Chapel Hill in 2014 with a Ph.D. in Neurobiology! I am enjoying my new job as a postdoctoral researcher at UNC’s Gene Therapy Center.

Tantama, Mathew PhD
Advisor: Professor Stuart Licht
I have joined the Department of Chemistry at Purdue
University as an Assistant Professor. My research group develops optical biosensors to study metabolic and oxidative stress in neurodegeneration associated with Parkinson’s disease.

‘09
Cui, Shanying
SB
Shanying is wrapping up her PhD at Harvard in Applied Physics this year, after spending the past few years studying how surface chemistry affects the optical properties of nitrogen-vacancies in diamonds. She and Michael Miller (‘09, VI and XXI-M) are moving to LA in the fall, where she will start her job as a research scientist in the materials group at HRL. She welcomes old (and new!) friends to visit her on the west coast!

Kelly, Amy
PhD
Advisor: Professor Roger Summons
Research geochemist at Shell in Houston and Adjunct Professor at the University of Houston in the Department of Earth and Atmospheric Sciences.

Litwin, Tamara
SB
I received my PhD from the University of Cambridge (the other Cambridge!) in July through a collaborative NIH-Cambridge funded doctoral program. My thesis research focused on topology simplification by topoisomerase enzymes and on topology-dependent protein-DNA binding. I am staying for a short postdoc at the National Heart, Lung, and Blood Institute in Bethesda, MD and looking for future opportunities.

‘12
Lessing, Joshua
PhD
Professor Andrei Tokmakoff
I am the first employee at Professor George M. Whitesides’ latest startup company—Soft Robotics Inc. As the Senior Scientist at SRI, I am responsible for the design and fabrication of a fundamentally new class of chemically inspired robotic actuators. Unlike typical robotic actuators that achieve their function by combining motors and hard linkages, our actuators rely on the pressurization of devices consisting of patterns of materials of varied stiffness and elasticity. This new approach to robotics allows for the creation of actuators that are inexpensive, easy to fabricate, softer to the touch, and capable of conforming to surfaces of varied shape. These attributes make soft actuators more appropriate for applications in disposable search and rescue robotics, interactions with living tissues, and performing unstructured tasks like gripping.

Marshak, Michael
PhD
Advisor: Professor Daniel Nocera
After graduation, I left everything behind to hike the Pacific Crest Trail, walking 2,668 miles from Mexico to Canada. Upon my return, I began a postdoctoral fellowship at Harvard where I currently study organic flow batteries for grid-scale energy storage as part of a collaborative project between professors Michael Aziz, Roy Gordon, and Alán Aspuru-Guzik.

‘14
Cui, Jian
PhD
Advisor: Professor Moungi Bawendi
After graduating, I began a postdoc in the Optical Materials Engineering Laboratory at ETH Zurich in Zurich, Switzerland.

Greenland, Nancy Yerkes
PhD
Advisor: Professor Sarah O’Connor
I got my MD from Stanford in June, and will be starting residency in pathology at UCSF in July

Silberstein, Katie
SB
Advisor: Professor Moungi Bawendi
Katie will be concluding her PhD work this spring, in the Abruna lab at Cornell University.