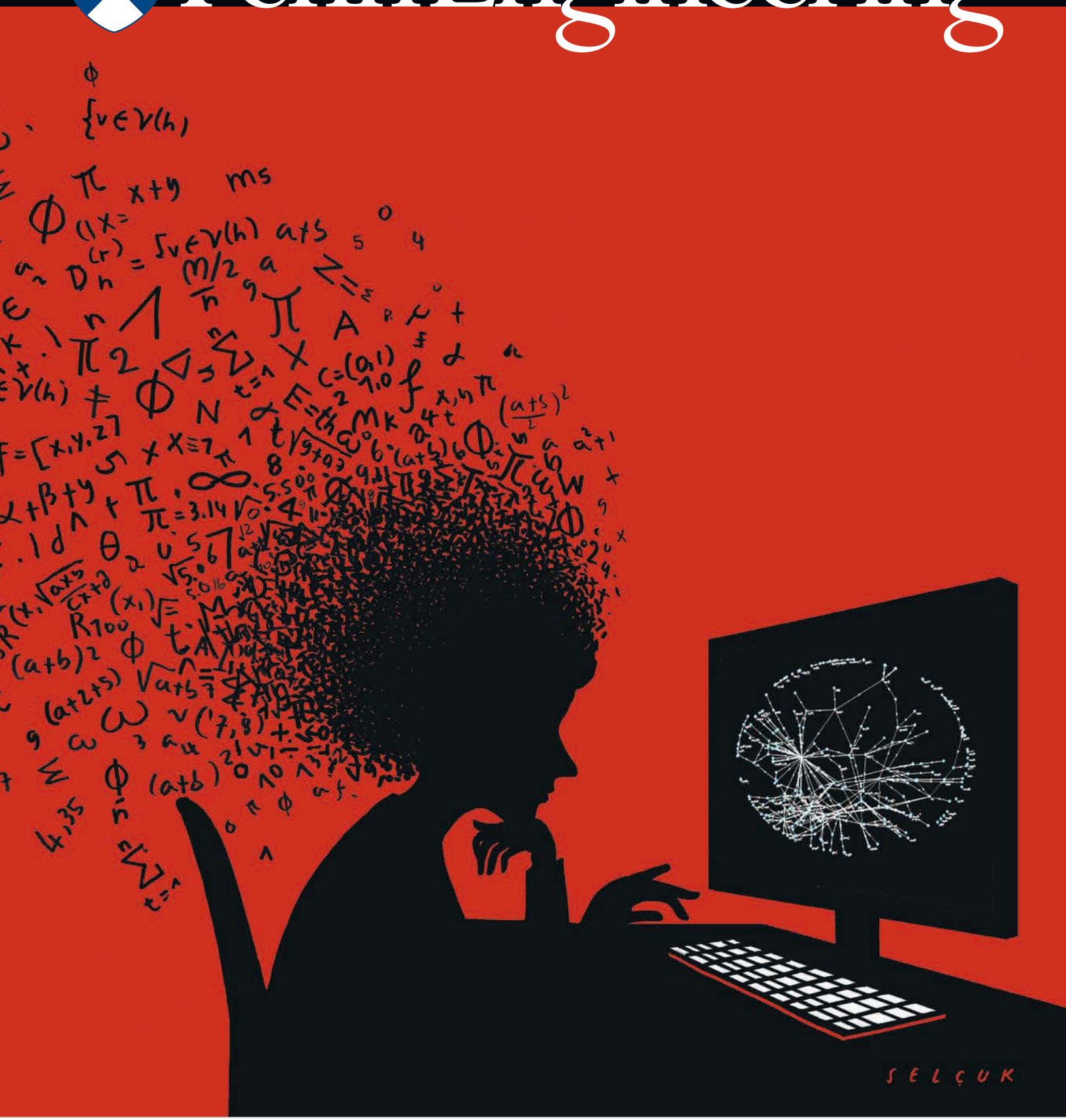
Penn Engineering



UNIVERSITY OF PENNSYLVANIA

SPRING 2014

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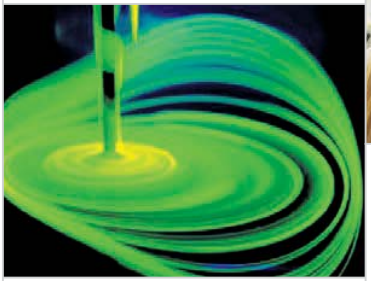
University of Pennsylvania
School of Engineering and Applied Science

"Interdisciplinary study is a hallmark of a Penn education. Penn's strongest differentiating trait is University-wide interschool curricula."



cover

Network Science allows engineers to unveil universal patterns in real-world networks, from the Internet to biological systems. Both theoretical and computational models can be used to analyze and ultimately control the structure of these complex networks.

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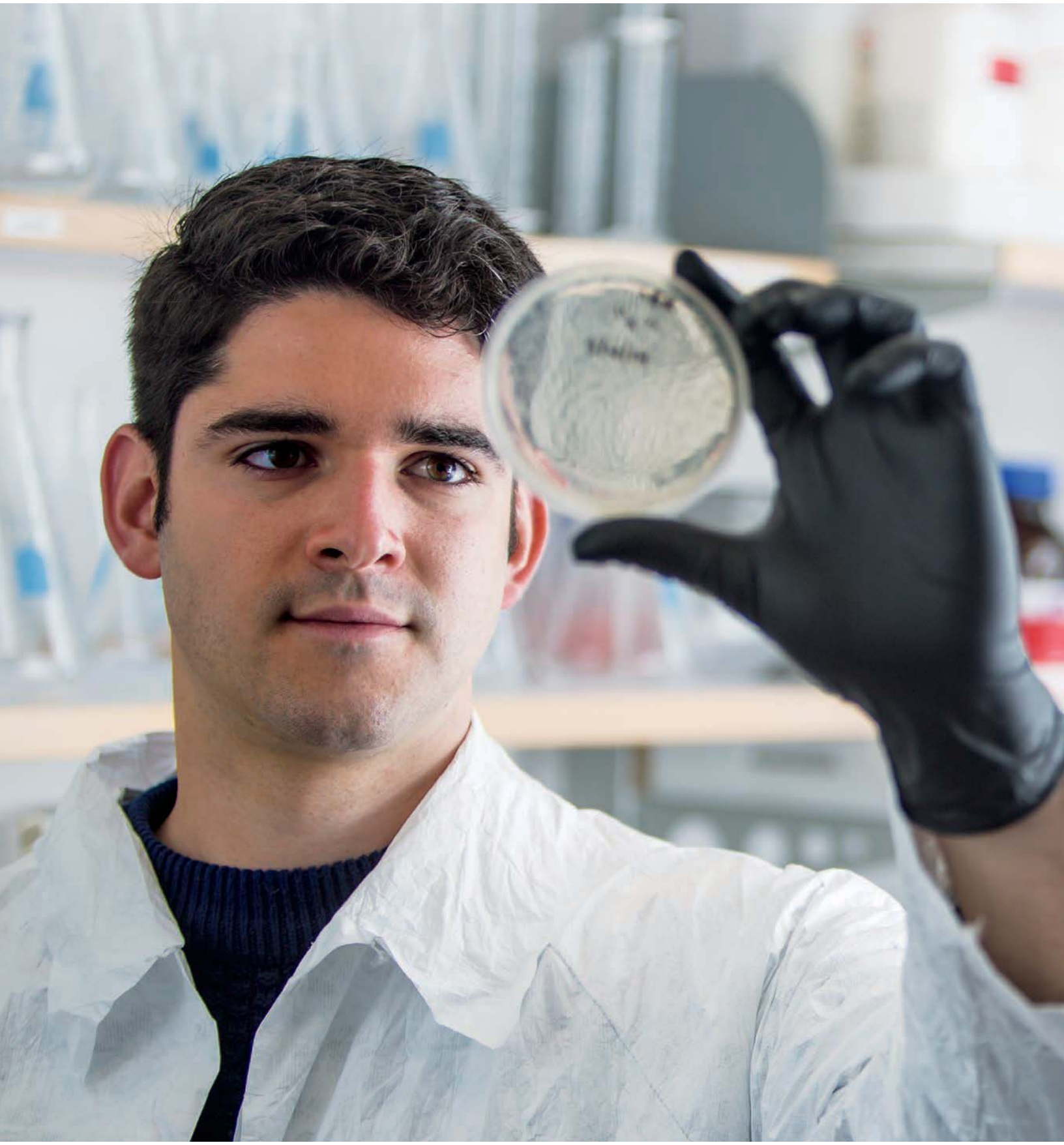
Who wouldn't want to be here?

The virtual "thick envelopes" were emailed on March 27, announcing to a very select cohort of high school seniors that they had been admitted to the University of Pennsylvania Class of 2018. Penn has become such a popular school; this year it received a record 35,868 applications. An equally significant record is that 7,855 of them applied to Penn Engineering, up a remarkable 34 percent from last year!

Although our entering class size at Penn Engineering is kept constant at 410 freshmen, the great depth of the applicant pool means that the talent within the admitted class is boundless. Imagine the privilege of teaching and working alongside such accomplished young people. Wouldn't you want to be here? Better yet, wouldn't you want to be one of them?

Who are these students? Statistics tell only one aspect of the story. As in the past, 15 percent are international students. We have set new records, however, in that 21 percent are under-represented minorities and 37.5 percent are women, whose average SAT score happens to be higher than those of their male classmates. Our students have been selected for admission not just because of their academic achievements, which are of course expected, but because each of them brings a unique richness to the mix: uncontestable evidence of leadership, of creativity, of passion. Every story is fascinating and every individual makes the others better.

The explosion in the popularity of Penn Engineering is the result of an alignment of many stars: the Penn campus and its interdisciplinary offerings are very attractive; technology has become a clear driver of the culture and of the economy; our innovative majors are magnets; and our new facilities are of the highest caliber and continue to receive recognition. Above all, our faculty and staff are world-class. Read about them in this issue, which also bursts with the activities of our students and alumni. Penn Engineering offers an experience that is unparalleled, and we are very fortunate that the word is out!



Junior Daniel Cabrera selects a viable monoclonal bacterial colony.

Engineering a Win

Bioengineers Develop an "Epigenetic Toolbox"

By Amy Biemiller

Take a toolbox full of pieces of DNA, build biological systems and operate them in living cells.

It's not surprising that this challenge from the International Genetically Engineered Machine (iGEM) competition garnered interest from engineering schools across the country. What was surprising was that the competition's North America Grand Prize winners, Penn Engineering's iGEM team, had no synthetic biology training when they entered the competition. "Prior to developing their project, the team had practically none of the design or molecular cloning experiences of other teams, and had little understanding of what synthetic biology is," explains Brian Chow, assistant professor of Bioengineering and the team's primary faculty advisor.

To obtain the necessary fundamentals, the team of five undergraduates, Daniel Cabrera, Mahamad Charawi, Danielle Fields, Brad Kaptur and Josh Tycko, went to "synthetic biology boot camp," starting with an intensive one-week training session in molecular cloning at the Penn Genome Frontiers Institute. Under the mentorship of Spencer Glantz, Michael Magaraci, Jordan Miller and Avin Veerakumar, all of whom were responsible for initiating Penn's participation in iGEM in 2011, the team quickly learned how to apply their individual engineering knowledge to molecular biology. "It helped all of us learn a vast skillset quickly which, for the iGEM competition, was crucial," says Charawi, a computer science major. "It helped to bring us together."

Collaboration and Determination Define a Winning Team

That collaborative foundation proved strategic when the team needed to agree on what aspect of synthetic biology to target. "We spent weeks brainstorming ideas and reading papers for inspiration," says Fields, a bioengineering major. "It took us a while to find a project idea that was both interesting and doable. Ultimately, we chose a project in epigenetics with the target of methylation because all of us were excited about the idea, and we saw a lot of potential."

Epigenetics reveals how chemical and structural modifications to an organism's DNA alter heritable traits. Methylation of DNA is a signaling tool that is important in numerous cellular processes, including embryonic development, genomic imprinting, X-chromosome inactivation and preservation of chromosome stability. The team wanted to see if adding this chemical cap to specific sites on a

The team's tenacity resulted in the prototype development of three tools: an engineered enzyme designed to methylate specific regions of a gene, an easy-to-use measurement assay to analyze whether or not targeted methylation has occurred, and a software package for analyzing the data.

genome could prevent certain genes from turning on. They originally planned on incorporating the use of BioBricks™, modular genetic assemblies that perform a specific function. Like LEGO® construction toys, BioBricks can be linked to create novel circuits for programming cells.

Shortly after receiving the iGEM-provided toolbox, the team ran into their first two roadblocks: there were no tools available to target DNA methylation, and there was no easy way to measure the process. "The most important thing that the mentors and I set out to do was to give the team ownership of the project, for better or worse, because that is what makes Penn iGEM unique compared to other undergrad research opportunities," says Chow. "Because they had full ownership of the project, when they ran into these roadblocks they didn't change course, but forged ahead."

The team's tenacity resulted in the prototype development of three tools: an engineered enzyme designed to methylate specific regions of a gene, an easy-to-use measurement assay to analyze whether or not targeted methylation has occurred, and a software package for analyzing the data.

Champions Two Years Running!

Like last year's Penn Engineering iGEM team, which also took home the Grand Prize in the North America Region and recently published their findings in the peer-reviewed journal *ACS Synthetic Biology*, this year's team aims to publish their project in a scientific journal and freely share their work with researchers. "One of the principal tenets of iGEM and synthetic biology is the 'design-build-test' cycle of biological systems. A very important goal of iGEM is to have teams contribute novel and well-characterized BioBricks for future teams to utilize," says Chow, who as a student himself participated in the inaugural workshop that would later become the iGEM competition. "At that time, my project was not terribly successful. However, the modular ribosome-binding site BioBricks I created for the project have since been used in roughly 12,000 different iGEM designs over the past decade," he says.

Perhaps the best outcome of the project, over and above winning, was that the students developed broader perspectives about research and epigenetics. "Students can often become so focused on winning competitions that they lose sight of the bigger scientific picture," says Chow. "This experience helped them not only see that great science increases their probability of winning, but that their scientific innovation has the potential to make a lasting impact on society."

Professor Brian Chow (middle) examines a scheme for light-activated protein cleavage with iGEM team member Daniel Cabrera (right) and team mentor Spencer Glantz (left).

Paulo Arratia

Fascinated by Fluid Flow

By Janelle Weaver

If you've walked down the hallways of the Towne Mezzanine in recent years, you've probably noticed colorful images and movies of flowing liquids, dancing organisms and splashing droplets. These mesmerizing displays are the visual representations of Paulo Arratia's obsession with complex fluids—everything that flows and is not water or air. It all started when Arratia was a graduate student at Rutgers University and he saw a picture of two fluids mixing together at a lab meeting. "I thought it was so beautiful. I kept asking, 'How does this happen? Why does this happen?' And it drew me in. It was love at first sight," says the associate professor of Mechanical Engineering and Applied Mechanics (MEAM).

Whether it's blood or solutions filled with polymers, Arratia is interested in studying how they flow. He uses a combination of techniques, from microfluidic devices and fluid dynamics equations to microscopy and genetic engineering, to understand fluid flow and how organisms move through complex fluids. "The hardest part is deciding what problem to work on: What is the question of the year?" Arratia notes.

One question that fascinates him is how turbulence arises as the rate of fluid flow increases. For example, when you barely turn on the faucet, water comes out smoothly, but the flow becomes turbulent as you turn the handle more. Scientists previously believed that complex fluids such as polymer solutions never became turbulent because they were too viscous and lacked inertia. But in a landmark study, Arratia discovered that turbulence actually does occur in complex fluids in the absence of inertia.

These types of breakthroughs have earned Arratia numerous honors, such as a National Science Foundation CAREER Award and his recent appointment as a Penn Fellow, as well as deep admiration from his colleagues, including John Bassani, Richard H. and S.L. Gabel Professor in MEAM. "Paulo is an incredibly creative experimentalist who is inspired to study phenomena that others say cannot possibly occur in nature," Bassani says. "There are many other examples of unusual phenomena that he has captured with exquisite photography and taught us about using elegant and often simple explanations."

Scrutinizing Swimming

Through a collaboration with Todd Lamitina, assistant professor of Physiology in the Perelman School of Medicine at Penn, Arratia is investigating the swimming behavior of a small worm called *Caenorhabditis elegans* (*C. elegans*), an important model system in biology. The researchers have studied worms carrying a mutation that causes muscular dystrophy in humans, creating an imaging platform that could be used to screen for potential new drug treatments. By revealing how organisms swim in complex fluids such as blood, their studies could lead to the development of artificial swimmers for targeted drug delivery as well as new strategies for altering fluid environments in the human body to treat a wide variety of diseases.

Arratia and Lamitina have also developed a library of measurements related to swimming behavior to shed light on the process of aging. As organisms grow older, they move more slowly because their muscles become weaker. The genetic and molecular underpinnings of the aging process are primarily investigated in *C. elegans*. "Despite all of its advantages, tools for measuring the physiological properties of aging in *C. elegans* are extremely limited," Lamitina says. "Paulo and his group are always addressing questions in ways that we as biologists almost certainly would never have considered. So with his knowledge of fluid mechanics and our expertise in aging biology and the *C. elegans* system, we have been able to solve this problem and open up a completely new area of aging research."

Teaching Appreciation

Before Arratia showed a penchant for science, he was a skilled athlete. Growing up in Brazil, he became a competitive tennis player by the time he was in high school and earned an athletics scholarship to compete as a college student in the United States, where he went on to play professionally for about five years and even crossed paths with Andre Agassi.

Now, Arratia finds little time for tennis, but he credits the sport for bringing him to the United States and exposing him to educational opportunities and different points of view. He attended Hampton University, a historically black university in Virginia. Putting this experience to use at Penn after earning his Ph.D. in Chemical and Biochemical Engineering at Rutgers University, Arratia has served as MEAM's Diversity Officer and co-advisor of the Penn Society of Hispanic Professional Engineers. "Paulo has been a champion for advancing diversity in engineering, and he sets an impressive example for us all," says Robert Carpick, John Henry Towne Professor and chair of MEAM.

Arratia's inclusive approach toward students is apparent in the classroom as well as the lab. "I'm always thinking about how to make the material more accessible to everyone through interactive demonstrations and movies," says Arratia, who has been recognized by the American Physical Society for the stunning images and videos of his experiments. "Even if they don't understand all of the mathematical details, students can still get an appreciation of it. Just like you don't have to be a good painter to appreciate art, you don't have to know everything about fluid mechanics to appreciate how beautiful fluid flow can be."

Graduate students Alison Koser and David Gagnon work with Professor Arratia to research the flow of complex fluids, such as blood and liquids containing polymers and/or particles, in microfluidic devices.

Pioneer & Pacesetter

Jadbabaie Explores New Science for a Networked World

By Jessica Stein Diamond

Today's super-networked world of data and interdependency offers engineers important problems to solve and surprisingly transferrable solutions.

Penn has first-mover advantages in this realm academically through its Networked & Social Systems Engineering (NETS) program for undergraduates. "Being first has its own risks. But these sets of problems are here to stay," says Ali Jadbabaie, NETS director and co-founder of the program, which is now in its third academic year. "No other university offers a comparable undergraduate program that applies rigorous scientific, mathematical and computing concepts to networked systems such as the Internet, online social networks and advertising, virtual and real-world markets, the current power grid and the future smart grid."

"Traditional degree programs in engineering are what they've been since post World War II. The structure is the same while the content has changed. Meanwhile, the problems society faces have all changed," says Jadbabaie, Alfred Fitler Moore Professor of Network Science in Electrical and Systems Engineering. "We created NETS for students who are excited and able to tackle multidisciplinary challenges, create disruptive technologies, work at companies like Google and Facebook, and develop new types of businesses."

Penn is similarly a leader in research applying network science to diverse economic and social science domains. Jadbabaie is principal investigator for a $7.5 million Multidisciplinary University Research Initiative (MURI) award with collaborators from Cornell, MIT, Stanford and Georgia Tech.

The five-year project, "Evolution of Cultural Norms and Dynamics of Socio-Political Change," began in 2012. It reflects what NETS co-founder Michael Kearns describes as "a research revolution you might even

Ali Jadbabaie

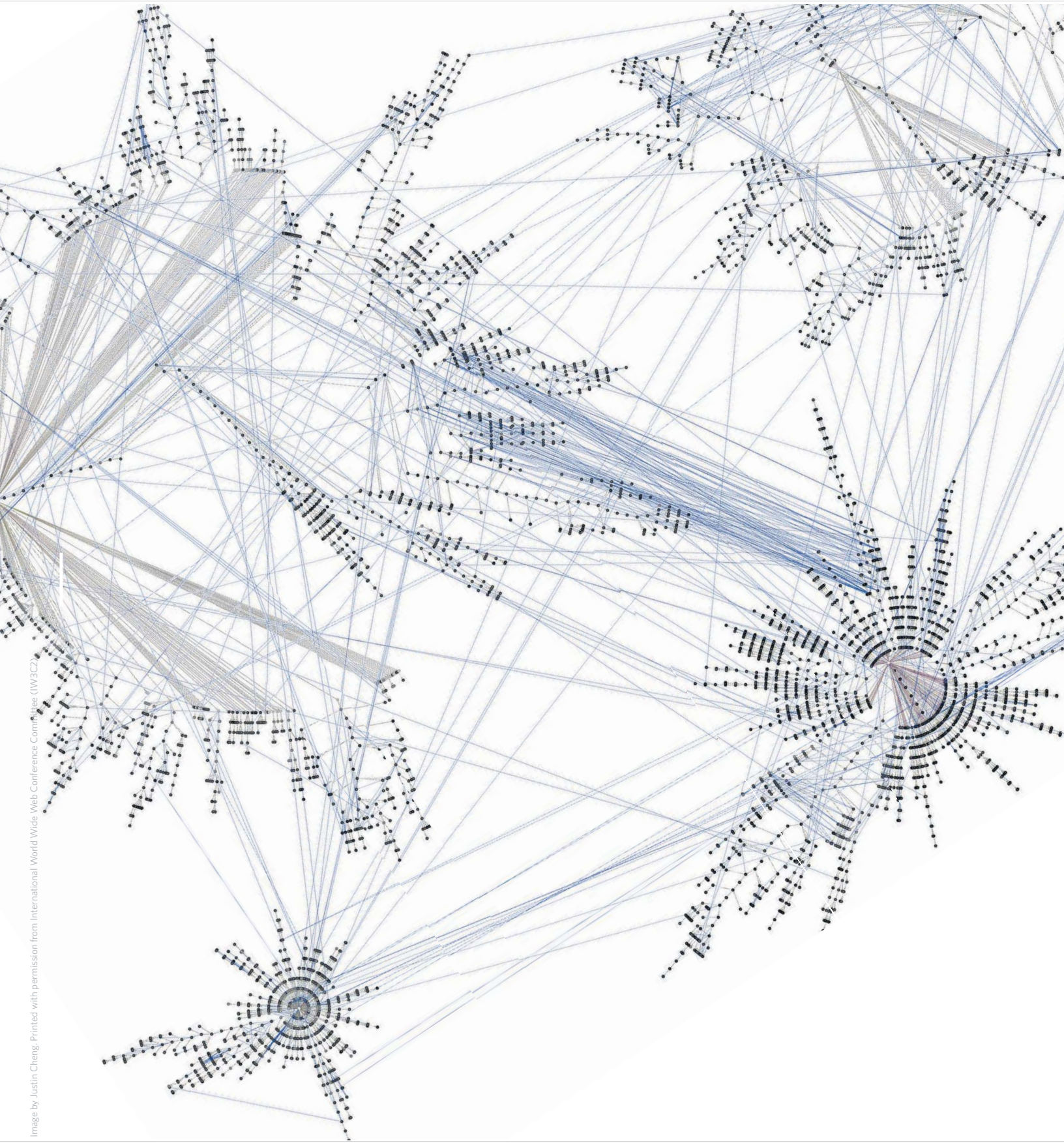
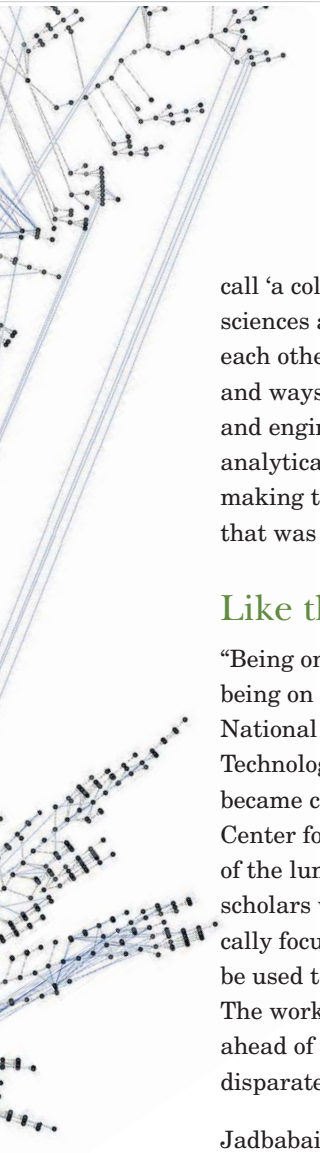


Image by Justin Cheng. Printed with permission from International World Wide Web Conference Committee (IW3C2).

This image represents a "cascade" of photo shares on Facebook. Note the considerable overlap in the friendship edges (blue) between the four cascades of the same photo.



call 'a collision' around the realization that the social sciences and engineering have a lot to talk about with each other. Social sciences are bringing new problems and ways of thinking about systems to engineering, and engineering is bringing new solutions and analytical tools to a lot of sociological problems. What's making this possible is vast data online and offline that was never available before."

Like the 1987 Lakers

"Being on this incredible MURI research team is like being on the 1987 Los Angeles Lakers," says Kearns, National Center Professor of Management and Technology in Computer and Information Science, who became co-director of Penn's new graduate Warren Center for Network & Data Sciences in 2013. "Ali is one of the luminaries and leaders of a young generation of scholars who are realizing that disciplines that historically focused on traditional engineering problems can be used to understand very different types of systems. The work of this extremely ambitious grant is largely ahead of us and reflects his rare talent for integrating disparate input and ideas."

Jadbabaie came to Penn in 2002 as a theoretician with expertise in control theory, which integrates math with electrical and mechanical engineering. "It's basically the idea of getting a system to behave the way you want it to," Jadbabaie says, "like a home thermostat or a car's cruise control." His 2003 paper on coordination among mobile autonomous agents has been cited 4,100 times.

Inspired by the movement of schools of fish and flocks of birds, Jadbabaie then expanded control theory to reflect communication patterns within a group. He and Vijay Kumar, UPS Foundation Professor in Mechanical Engineering and Applied Mechanics, collaborated to program groups of aerial robots to fly autonomously around moving obstacles.

Epiphany: Broad Relevance

In 2008, Jadbabaie and his students realized there were similarities between the rules governing collective behavior in flocks of birds and the dynamics of opinion in crowds. Jadbabaie, together with former postdoctoral associate Victor Preciado, currently the Raj and Neera Singh Term Assistant Professor in Electrical and Systems Engineering, soon realized that network theory can be used to predict the speed at which the contagion (as in fads, fashion, products and rumors) spreads.

These insights have been broadly influential, especially in economics. "Historically, economists have not thought about interactions between different decision-makers from a network perspective. They usually focus on a market interaction," says Alireza Tahbaz-Salehi, assistant professor at Columbia Business School. Jadbabaie was his Ph.D. advisor. "Network science provides us with a new perspective and an extra set of tools."

"Engineering and computational approaches offer useful tools and insights of broad utility to problems outside the engineering discipline," says George Pappas, Joseph Moore Professor and chair of Electrical and Systems Engineering. "Most of the biggest advances in the last 60 years have brought technology closer to people's daily lives. To translate the issues and opportunities this raises into an undergraduate, research-rich program means our graduates will be amazingly well-prepared for the 21st century networked world."

Jadbabaie concurs. "As an engineering discipline, this is very close to the marketplace. We are emphasizing the disciplinary fundamentals that are here to stay. Our graduates will have enormous opportunities for recruitment."

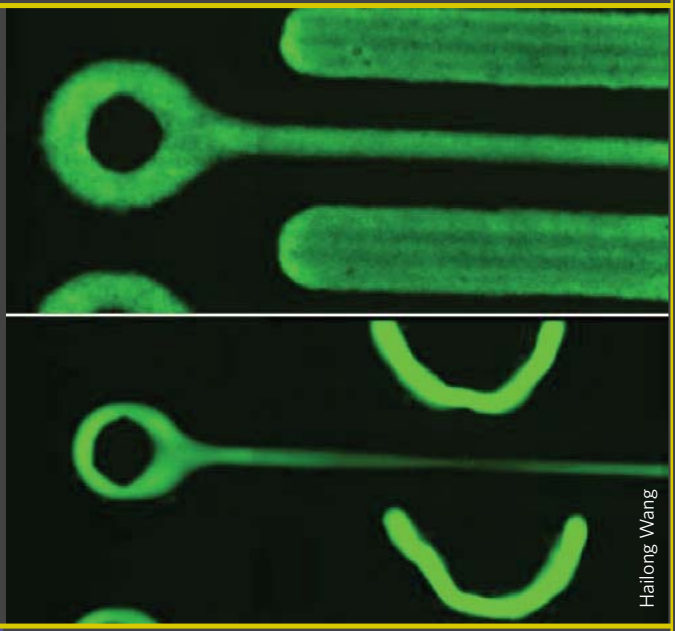
Through the Lens

Research Images from Penn Engineering

Modeling Tissue Failure

To advance the understanding of tissue growth and affiliated stresses on developing cells, a collaboration led by **Vivek Shenoy**, professor in Materials Science and Engineering, developed a mathematical model that shows how cells respond to external stress by pulling harder on their environment, eventually tearing the tissue apart. Researchers performed a series of experiments using heart tissue samples under various mechanical constraints. When the cells in developing tissue pull on each other in "dogbone-shaped" wells, they first break in the middle section.

Cardiac cells growing in "dogbone-shaped" wells are shown stretching themselves to failure.



Hailong Wang

Mohamed Amine Gharbi

Using "Nano-flowers" as Lenses

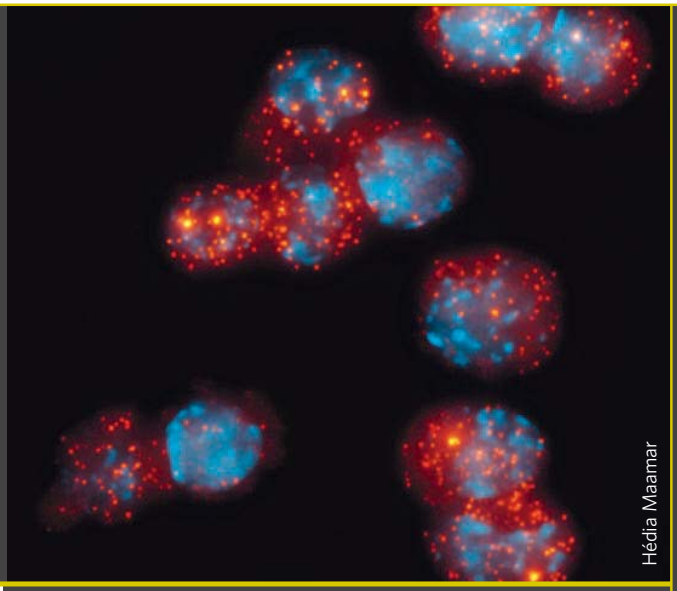
A collaboration involving **Kathleen Stebe**, Richer & Elizabeth Goodwin Professor in Chemical and Biomolecular Engineering and Penn Engineering's Deputy Dean for Research; **Shu Yang**, professor in Materials Science and Engineering; and **Randall Kamien**, professor in Physics and Astronomy, has developed a way to use transparent liquid crystals to create complex 3D patterns in the shape of a flower. Because of their compound eye-like structure, the flowers contain a central focal point and can be used as lenses.

A "flower" under magnification, where the center is a silica bead that generates the flower's pattern.

Revealing the "Dark Matter" of the Genome

Traditionally, scientists have thought that most of the genome was filled with DNA sequences with no apparent function, but they now realize that some of this so-called "junk" DNA may actually give rise to RNA molecules that play important roles in the cell. In the laboratory of **Arjun Raj**, assistant professor in Bioengineering, researchers have developed techniques to visualize individual RNA molecules in single cells, and have turned those techniques toward illuminating this "dark matter" of the genome.

Individual RNAs (orange spots), which control key genes involved in development and disease, are shown arising from "junk" DNA.



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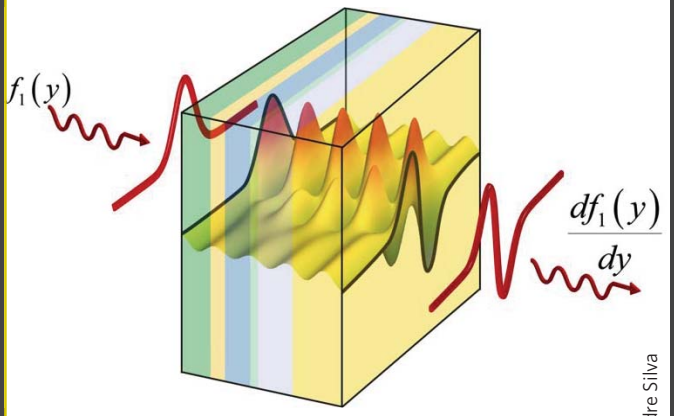


Alexandre Silva

Computing with Metamaterials

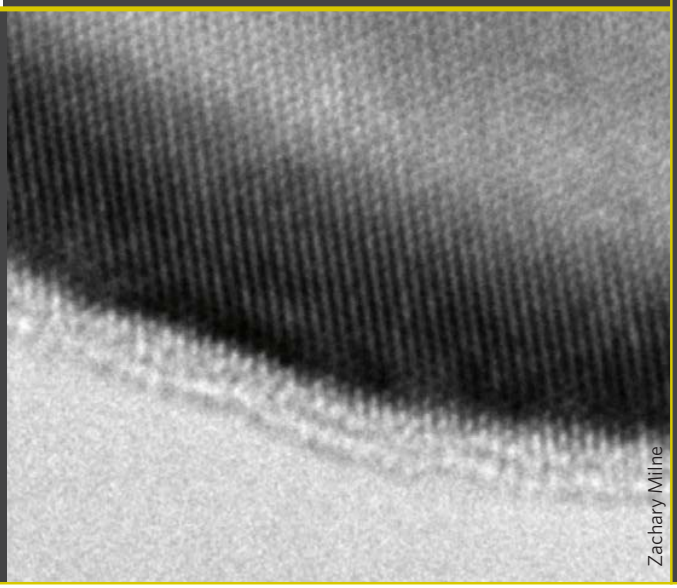
A multi-university study led by **Nader Engheta**, H. Nedwill Ramsey Professor in Electrical and Systems Engineering, shows that metamaterials can be designed to do "photonic calculus" as a light wave goes through them. The team's theoretical material can perform a specific mathematical operation on a light wave's profile, such as finding its first or second derivative, as the light wave passes through the material. Essentially, shining a light wave on one side of such a material would result in that wave profile's derivative exiting the other side.

A conceptual sketch of a metamaterial block showing a mathematical operation on arbitrary wave signals as they pass through the material.

Visualizing Atomic Wear

Silicon atomic force microscopy (AFM) tips are used in the laboratory of **Robert Carpick**, John Henry Towne Professor and chair of Mechanical Engineering and Applied Mechanics, to study friction and wear at the nanoscale. Since nanoscale objects already have less material to start with and their shape and surface structure drastically impact their functionality, wear affects nanoscale objects more strongly than objects at the macroscale. As scientists are developing more nanoscale devices, a better understanding of wear is crucial.

Silicon atomic force microscopy (AFM) tip magnified 600,000 times, where the pattern that the lattice of atoms makes is visible, allowing one to practically "see" atoms.



Zachary Milne

The Vagelos Integrated Program in Energy Research

Penn's New Dual Degree

By Patricia Hutchings

Interdisciplinary study is a hallmark of a Penn education. Vagelos is a name synonymous with visionary leadership and philanthropic support of interdisciplinary scholarship and research across the University. In 2011, Trustee Emeritus P. Roy Vagelos, MD, C'50, and his wife Diana, established the Vagelos Integrated Program in Energy Research, or VIPER.

With a curriculum based in both Penn Engineering and Arts & Sciences, the program was created to immerse students in energy research and its applications. In addition to coursework, students work in a research lab during the summer of their first year. The inaugural class will graduate in 2016 with two undergraduate degrees: one from the School of Engineering and Applied Science and the other from the School of Arts & Sciences.

However exciting the concept of integrated dual degrees, it is only the exceptional undergraduate who can face down the challenges of a heavy course load and the rigors of scientific investigation.

If VIPER had been designed with one prospective student in mind, it could have been **Julia Fordham**. Having inherited the "engineering gene" from her father, an environmental engineer at Los Alamos National Laboratory, Fordham's academic future was clear to her early on. Putting her strengths in math and science into action, Fordham spent the summer of her junior year in high school in a Los Alamos research lab and interned there during her senior year, receiving (no doubt to the envy of her classmates) both academic credit and a salary for her work in photovoltaics.

Julia Fordham inspects a sample of colloidal semiconductor Quantum Dots, potential building blocks for low-cost solar cells.

Penn was always first on the list of her college choices, and when Fordham got word of VIPER's launch set for the fall of 2012, she applied and was accepted into the program. She believes her willingness to enthusiastically jump into a new and basically untested curriculum is a trait she and her fellow VIPERs share, and sees her classmates as adventurers and path-breakers. At the advice of a Ph.D. mentor at Los Alamos and further solidified by her freshman engineering survey course, EAS 101, Fordham decided upon Materials Science and Engineering as her engineering major. Her Bachelor of Arts degree will be in Geology.

VIPER: Deconstructing the acronym to reveal the people and ideas behind the program

VAGELOS Trustee Emeritus P. Roy Vagelos, MD, C'50 (pictured), and his wife Diana, established the Vagelos Integrated Program in Energy Research in 2011. The high volume of competitive applications for the first incoming class indicated the relevance and interest in the program's content and design. The inaugural class will graduate in 2016 with two undergraduate degrees.

INTEGRATED Collaborative research and teaching in more than one academic discipline is a tenet of Penn President Amy Gutmann's Penn Compact 2020, the University's recently renewed strategic plan. VIPER exemplifies the best of what Eduardo D. Glandt, Nemirovsky Family Dean, has defined as "Penn's strongest differentiating trait: University-wide interschool curricula."

PROGRAM Co-directors John Vohs, Carl V. S. Patterson Professor in Chemical and Biomolecular Engineering, and Andrew Rappe, professor in Chemistry, have built a course of study designed to challenge and inspire undergraduates with a passionate interest in exploring alternative energy resources.

ENERGY The production, conversion and use of energy informs every aspect of the program's initiatives, which are grounded in the search for technological and scientific solutions and alternatives.

RESEARCH A year-long required seminar introduces students to the standards and techniques of conducting research. VIPER students, advised by research mentors, enter existing labs as contributing members of the group. It is expected that by graduation, students will have completed a Senior Design project in their engineering major and co-authored a research paper in a peer-reviewed journal.

David Lim conducts computational research in the theoretical physical chemistry lab under Professor Andrew Rappe.

Fordham has carved out time in her busy schedule for additional friendships and service with her sorority sisters in Zeta Tau Alpha (ZTA). As a self-described "foodie," Fordham is apparently as indefatigable in her culinary research as she is in a campus lab; she is assiduously working her way through a cookbook of 140 vegan cookie recipes.

David (Jin Soo) Lim is an adventurer of the highest order. So that he could fully express his devotion to academics and music in equal measure, Lim chose to leave his home and family in Incheon, South Korea, to study in the U.S. when he was in the sixth grade.

At Eaglebrook, a junior boarding school in Deerfield, MA, and Philips Academy Andover in Andover, MA, Lim pursued music, his "serious hobby," and cultivated his academic interests. As a rising high school junior, he was selected for a summer internship in environmental engineering at Georgia Tech and invited back the following summer to assist in the investigation of biofuels. Intrigued with the many possibilities of VIPER, Lim enrolled with majors in Chemical and Biomolecular Engineering and Chemistry.

An adventurer he may be, but hardly a solitary one. Lim has found that the VIPER path is well-charted and attended by a team of engaged mentors and faculty members. He has three advisors ("It's just awesome!") who offer help with the ins and outs of research, the strategies for acquiring the necessary credits for dual degrees, and guidance intended to prevent the disappointments inherent in course overload.

As for his love of music, Lim performs and continues his study of the piano with coaches brought to Penn under the aegis of Penn Chamber, an organization of about 20 chamber ensembles. He also studies voice, performing

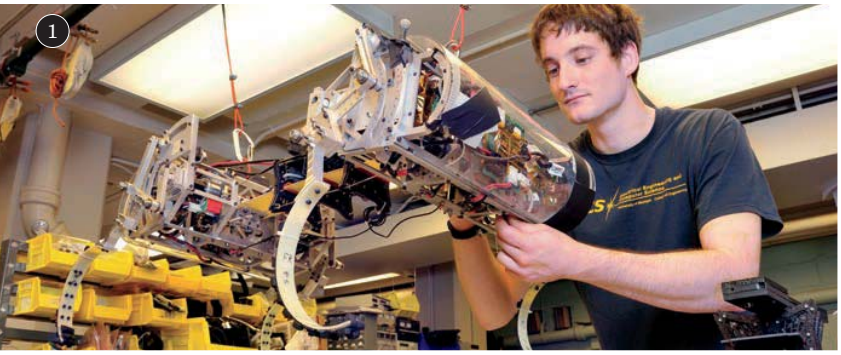
Gerardo Cedillo Servin performs atomic force microscopy on transition-metal doped solid oxides in the Gorte/Vohs Lab.

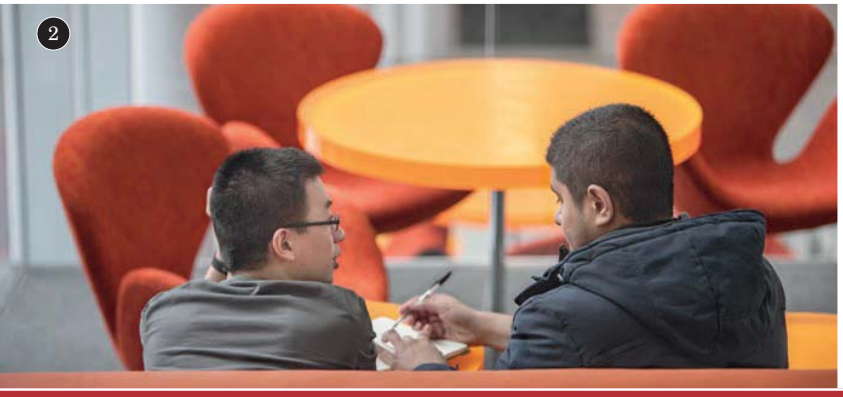
with Ancient Voices, an a cappella chorus concentrating on works of the Middle Ages and Renaissance.

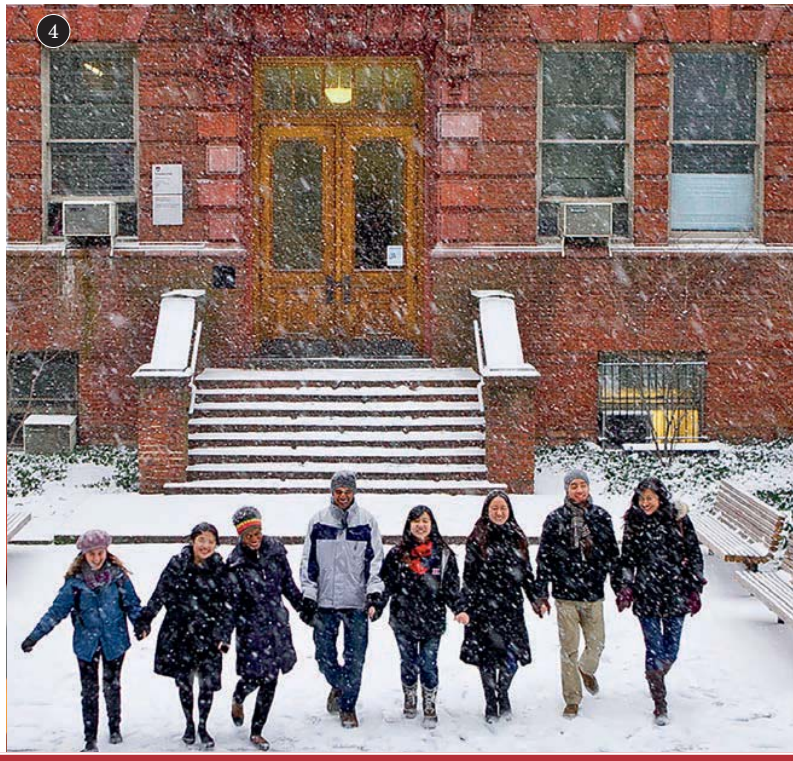
Navigating the U.S. college application process was the first step on **Gerardo Cedillo Servin's** road to VIPER; requirements for university admission in his native Mexico are significantly different. Although he had won medals in Mexico's Science Olympiads since middle school and had received the highest score in the chemistry entrance exam to Universidad Nacional Autónoma de México (UNAM), he had not yet taken the required SAT exam to quantify his high scholastic achievements. Undaunted, Cedillo arranged to take the exam, and further made his case for pursuing his passion in an essay specific to the VIPER application.

With a career in research as his long-range goal and Chemistry and Materials Science and Engineering as his majors, Cedillo found VIPER's required year-long Introduction to Research seminar extremely useful. He surveyed contemporary research topics, learned lab etiquette and how to prepare a research proposal, and found himself thinking like a researcher by the seminar's end. His freshman summer was spent in the Vohs/Gorte Lab, where his project focused on increasing the fuel efficiency of solid oxide fuel cells.

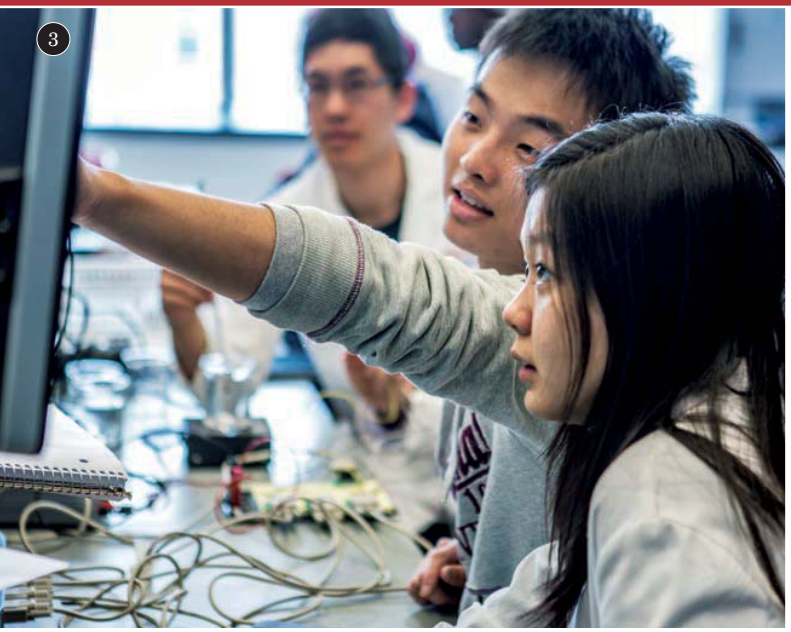
Cedillo describes his sophomore class of VIPERs as more collaborative than competitive, with group study and pooled resources a valued part of the culture. Weekly meetings during their first summer increased the shared sense of community and camaraderie among class members, and a group hike along the Wissahickon followed by dinner at the home of an advisor served to strengthen the bond.







On Our Camera Roll



1 *Adjustments are made to a quadrupedal spined robot.* **2** *A study session in the sun-filled Singh Center for Nanotechnology.* **3** *Students examine neural touch sensors, or simply, how cockroaches feel their environment.* **4** *Hayden Hall on a snowy January afternoon.* **5** *Assistant Professor Dan Huh discusses biological transport processes in Berger Auditorium, Skirkanich Hall.*

6 *Taking notes the old-fashioned way—with paper and pencil.* **7** *Giving the phrase "biking to class" a whole new meaning.*
8 *Computers, coffee and concentration in the Accenture Café.* **9** *Investigating quadrotors in the GRASP Lab.*
10 *Students share a light moment in the Stephenson Foundation Undergraduate Laboratory.*

"Engineering is the best skill to bring to a startup," states Ric Calvillo. "I've seen the effects of a real shortage of engineers in the United States, so I'm trying to do my part to fix that problem."

Ric Calvillo

Introducing the Advertising Innovator

By Janelle Weaver

Every day, Facebook attracts about 750 million users from around the globe, and advertisers fiercely compete for their attention, hoping that the money they spend will translate into new customers. But this goal is shortsighted as it doesn't take into account how much revenue the customers generate over time.

Empowering marketers to predict and optimize the lifetime value of customers is a challenge that Ric Calvillo, Penn alumnus and Penn Engineering benefactor, set out to tackle when he co-founded Nanigans in 2010, and all measures suggest that he has succeeded. As Nanigans' Chief Executive Officer, Calvillo has led the company to become one of the largest Facebook advertising platforms and was instrumental to the company's rapid growth in retail, e-commerce, social gaming, travel, education and financial services.

At the center of the company is a platform that uses automated machine learning algorithms to track purchase behavior over time, target audiences based on their similarities to existing high-value customers, and quickly adapt to market conditions. Nanigans' customers, including eBay, Rosetta Stone, Vistaprint and Zynga, can achieve more than 30 percent cost savings by taking control of their advertising campaigns and acquiring high-value customers that maximize the lifetime return on investment. "Nanigans has the potential to disrupt the online advertising industry, just like Google and Facebook have," Calvillo says. "And the online ad world is ripe for disruption."

Lessons Learned

The road to success did not come easy for Calvillo. Shortly after earning his bachelor's degree at Penn in 1990, he founded and led Conley Corporation, which developed data storage software and was acquired by EMC Corporation in 1998. He put in about 80 hours each week and never had more than a few months' payroll, relying on funding from his Penn connections rather than venture capital. "I was an unproven CEO with no track record, so I couldn't secure venture funding," Calvillo says. "It was a tough slog for a long period of time."

The next time around was a totally different story. In 2001, Calvillo founded Incipient, a data storage infrastructure software company, with plenty of venture capital. But he soon discovered that accepting large investments came at the cost of giving up control of the company.

Ric Calvillo, as illustrated for his Nanigans avatar.

Nanigans is known for their one-of-a-kind avatars, which represent the company's unique culture and team. Each team member receives a custom caricature, personalized with hobbies and interests.

Learning his lesson from these Goldilocks-like experiences, Calvillo co-founded Nanigans with a mix of funding from his Penn connections and venture capital firms. "I made sure we were cash flow positive and growing organically so we didn't need the money, and I could negotiate so that I didn't have to give up control," Calvillo says. "Now that I've found the right balance, I'm focused on making Nanigans as successful as possible."

Giving Back

Calvillo's entrepreneurial drive has clear roots at Penn. As an economics major, he was heavily influenced by his courses at Wharton and a former professor named Edward Moldt, MBA'59, who taught an entrepreneurial management course during freshman year. "Being in that environment really got my competitive juices flowing," Calvillo says. "I remember on the first day of class, Professor Moldt warned us about the golden handcuffs: If you go to a big company and stay there for a long time, it gets harder and harder over time to start your own company."

Taking that advice to heart, Calvillo started his first company during his freshman year. After offering on-campus resume services at PageSetters for one year, he founded Hardware House to provide Macintosh computer rentals and memory upgrades from his fraternity house.

Grateful for the education and hands-on training he received at Penn, Calvillo has given back to the University by establishing a need-based scholarship for students at the School of Engineering and Applied Science, and by giving guest lectures to aspiring entrepreneurs. "Engineering is the best skill to bring to a startup," Calvillo says. "I've seen the effects of a real shortage of engineers in the United States, so I'm trying to do my part to fix that problem."

Beyond Penn, Calvillo has spread his generosity to a local sports program and plans to continue charity work in the future. "The way I justify making money is that I know I will eventually give it back to the community," Calvillo says. "And the more successful the company becomes, the more I'll give back."

Jeff Rosenbluth

Finding Inspiration on the Unpredictable Path

By Elisa Ludwig

Above all, curiosity drives Penn Engineering Board of Overseers member Jeffrey Rosenbluth, ENG'84. His eclectic career choices, from Wall Street to academia to the nonprofit sector, have always been based on passionate interests, rather than a preset idea of what should come next—and that's just the way he likes it.

When he first came to Penn as a freshman, Rosenbluth only knew he was interested in mathematics. "My family expected me to be a doctor, but that wasn't for me. After taking summer classes in computer science, I decided to transfer to the engineering school," he says. After graduating, Rosenbluth pivoted again: He obtained an MBA in Finance from the University of Chicago, and then joined Salomon Brothers, where he worked for 14 years, eventually running the Fixed Income Arbitrage group, an internal hedge fund. "I was working alongside very smart Ph.D.s and all of the problem-solving skills I learned in my engineering training at Penn enabled me to succeed," Rosenbluth says.

For the Love of Math

Unforeseen circumstances—his company's acquisition by Citibank and the dissolution of his group—brought Rosenbluth to a crossroads. It was then, at age 36, that he went back to school at NYU, inspired by his doctorate-wielding peers.

"One of the things I've learned is the value of an engineering education," notes Jeff Rosenbluth. "The course materials are very important but what you take away in the end is how to orient to a problem, how to ask the right questions and how not to accept things at face value. Those skills stay with you and guide you through your life, whatever you choose to do."

While at NYU, Rosenbluth leveraged his Wall Street experience to help start the university's mathematical finance program, serving as both student and teacher. Returning to school mid-career proved a humbling but exciting experience. "It wasn't easy, but it was right. I realized by the time I got my doctorate that I wasn't going back to finance."

When he finished his degree, Rosenbluth and his sons started a small company to develop iOS mobile apps. To refresh his knowledge, Rosenbluth worked with the lecture notes and homework from several of Penn's computer science classes, one of which was led by (then) Ph.D. candidate Brent Yorgey. Rosenbluth contacted Yorgey and asked if he could collaborate with him on an open-source library called "diagrams."

By then, Rosenbluth recognized that he had many interests and was in the unique position of being able to pursue them. That led him to enroll in Juilliard classes in music composition while managing his portfolio by day. "It was something I always wanted to do," he explains.

Rosenbluth also wanted to give back, so he helped establish Math for America, an organization that helps support exceptional math and science teachers through fellowship opportunities and other incentives. Math for America's model was later adopted by the National Science Foundation Teaching Fellows.

Familiar Place, New Frontiers

The foundation and his work with NYU led Rosenbluth back to the University of Pennsylvania, where he saw an opportunity to share his insight. He served as advisor for the inception of the Networked & Social Systems Engineering (NETS) program and was then invited to sit on the Penn Engineering Board of Overseers. Today, Rosenbluth's son Reed is a freshman at Penn Engineering and it has been exciting for him to observe his son's process of intellectual discovery at a very changed Penn. Not everything, however, is different. "Dr. Max Mintz was my probability professor in 1982, and his class was the inspiration for my Ph.D. When I found out he was still teaching, we reconnected and he wound up advising my son."

Mastering the Mission

NROTC at Penn Engineering

By Stephanie Sayago Bell

Demanding academics, the rigors of the Naval Reserve Officers Training Corps (NROTC) program, and a social life. Students who elect NROTC at a prestigious university like Penn usually accept the conventional wisdom that says a person can be successful in two of the three angles of this triangle of challenges. Keelen Collins, a senior in Mechanical Engineering and Applied Mechanics (MEAM), seems to have mastered all three, at a sacrifice of course. Collins doesn't get a lot of sleep.

Support Network

Collins, the youngest of four children, grew up in Pittsburgh, and watched as his next-oldest sibling succeeded at Penn while also engaged in NROTC. In return for his full scholarship to Penn, Collins has committed to serving as a Naval Officer for the next five years. He believes NROTC has "been a challenging path, but it offers great rewards and has also given me an opportunity to serve my country." In addition to his mechanical engineering workload, Collins is required to take two courses each semester at the NROTC Unit, covering such subjects as navigation and ethics, with the additional ongoing responsibility of billets (the semester jobs required to run the Unit). Nonetheless, he thrives on the high expectations of both the physical rigors and the academic demands.

Collins also appreciates the networking opportunities created by his participation in NROTC. His Unit includes students from Penn, Drexel, and Temple universities, and Collins notes "the chance to make friends at other schools" as one of the strengths of the Philadelphia Unit and one of the satisfying features of his service.

Editor's Note: Keelen Collins will serve his first tour of duty aboard the USS Mobile Bay, a cruiser, in San Diego, CA.

Captured in a photo reminiscent of the style of Norman Rockwell, Collins integrates mechanical, electrical, and computer engineering to build an autonomous robot to compete in MEAM's Design of Mechatronic Systems Robockey tournament. In the culminating project in the course, Collins' team nailed a third-place finish.

When he arrived at Penn, Collins' support network widened to include Lt. James Giles. Collins credits Giles as being a crucial influence as he adjusted to the demands of a challenging academic program coupled with the requirements of NROTC.

Collins' foundational network also included his father, a mechanical and electrical engineer, and founder of his own company, American Robot Corp. Going to work with his father as he grew up sparked Collins' interests and developed his initial real-world engineering skills.

The Academic Angle

One of the aspects of MEAM that captivates Collins is the integration of the knowledge and skills necessary to complete projects successfully. As a student in MEAM's Design of Mechatronic Systems course, Collins relished the opportunity to integrate mechanical, electrical, and computer engineering to compete in the Robockey tournament, the culminating project in the course. Led by Jonathan Fiene, senior lecturer in MEAM, the event requires each team of three or four students to build an autonomous robot that they enter in a hockey tournament. Collins admitted he and his teammates got little sleep during the final stages of building their robot, devoting 60-80 hours a week during the final weeks, but says it was "really fun, a very valuable class, and tons of people came to cheer us on." Many of the class projects are both challenging and fun, but also prepare students to accomplish the academic aspect of the triangle.

Finding Time for Fun

Through his fraternity, Pi Kappa Alpha, Collins maintains a social life and takes the time to stay connected to his love of music. "I recently picked up banjo and play some guitar. I'll occasionally host bluegrass jams with some friends that also play bluegrass-style instruments," he says. Collins is the National Anthem Ensemble director for the NROTC Unit. He is also on the Penn Clay Team, which competes in various intercollegiate skeet, trap and sporting clay competitions, and says "those outings are a lot of fun and a nice change of scenery."

From Classroom to Ship

What does the future hold for a fun-loving, highly skilled Navy ensign? His current Unit's senior class advisor, Lt. James Peluso, says that Collins is "one of only a few graduates in the country who is joining the Engineering Duty Officer community." Early in the spring, before Collins' anticipated commission in the Navy and graduation from Penn, he will engage in the service selection system. Ranked an impressive 21st of more than 250 new ensigns seeking spots in the open billets "draft," Collins is hoping for an assignment to a cruiser/destroyer, a ship he describes as small, because there are only thirty officers, so "you're in the spotlight all the time." Collins relishes that opportunity to shine and credits his experiences in Penn NROTC with raising his profile and providing the platform for him to distinguish himself.

Both Lt. Peluso and Bruce Kothmann, senior lecturer in MEAM and Collins' senior project advisor, cite Collins' relentless "can-do" attitude. Collins acknowledges how much NROTC has helped him "maintain a high capacity for workload and stress" and has fostered skills he will need to successfully engineer real-world solutions to whatever challenges he will face.

Paul McKenzie

"Penn taught me the value of networking to learn and benefit the broader good, and how to team up with people to solve problems. That skill carries over to healthcare where you can't move a project forward unless you collaborate with diverse disciplines, from biologists to chemists to clinicians to regulatory experts."

Paul McKenzie

From Aspiring Entrepreneur to Pharmaceutical Industry Leader

By Jessica Stein Diamond

Scrubbing pots and selling shoes aren't typically viewed as training grounds for high-ranking pharmaceutical industry leadership.

Yet these formative work experiences began the rapid career trajectory for Paul McKenzie, CHE'87. Education has since turbocharged his path from a full scholarship to Penn Engineering to a Carnegie Mellon University Ph.D., earning both degrees in Chemical Engineering, and a remarkable sequence of accomplishments since.

Today, McKenzie oversees worldwide manufacturing activities for Janssen Supply Chain, a division of Johnson & Johnson that supported worldwide sales of $28.1 billion in 2013. "The most compelling aspect of my job is that it spans all technology areas from small molecule chemistry and biologics to what we call 'fill-finish,' putting a biologic in a vial, syringe or device or making a pill or capsule," says McKenzie, who manages 29 internal manufacturing plants plus alliances at nearly 200 external manufacturing plants. "Every step, from the raw materials to the final packaged product, is executed by my team, including procurement and environmental health and safety."

His leadership scope doesn't surprise John Quinn, Robert D. Bent Professor Emeritus of Chemical and Biomolecular Engineering and McKenzie's undergraduate advisor. "Paul was in charge of every situation he found himself in. I have no doubt that he'll be a CEO somewhere someday," says Quinn, who remains close to McKenzie and his extended family (McKenzie's equally accomplished siblings preceded him at Penn). Quinn noticed McKenzie's leadership traits early. As a work-study student, McKenzie cleaned tables and scrubbed pots at a campus dining hall; as a senior, he supervised eight student managers and 150 work-study students.

"What I learned in that job is how to work at all levels, from the head of dining services to union employees and fellow students," says McKenzie. "Penn taught me the value of networking to learn and benefit the broader good, and how to team up with people to solve problems. That skill carries over to healthcare where you can't move a project forward unless you collaborate with diverse disciplines, from biologists to chemists to clinicians to regulatory experts. To be successful in this industry you need to collaborate and connect; that's where I have been able to put my experiences at Penn to great use."

The McKenzie clan, proud Penn Quakers, boasts 11 Penn alumni plus two Penn employees, an impressive presence in the Penn community.

Valuable Lateral Moves

After graduate school, McKenzie was one of several team leaders for Merck's development of one of the first HIV protease inhibitors; he led the drug production scale-up from one kilo to 10,000 kilos a month, obtaining a record 42-day Food and Drug Administration approval, a first for Merck for a Research and Development (R&D) pilot plant. Next, at Bristol-Myers Squibb, he led development of an $800 million plant for biologic drugs, overseeing design, budget, construction, staffing and operations. Prior to moving into Supply Chain in 2012, McKenzie was head of the Global Development Organization in Janssen R&D, where he worked with teams across clinical operations, pharmacology, regulatory medical writing, toxicology and pharmaceutical development to drive content for the numerous regulatory filings for the new product pipeline.

About future career options, McKenzie says, "I've never chased levels, just experiences. I've taken many lateral career moves in order to learn what was to the right or left of me in my current role." Convinced of the value of lateral moves, McKenzie developed a Johnson & Johnson program, "Bridges," allowing mid-career individuals to take on two one-year rotations outside their current responsibilities; it now has 75 participants.

Cash in a Coffee Can

As the second youngest of seven children, McKenzie remembers how family spending money was saved in and dispensed from a coffee can; his family didn't use credit cards. His father was a salesperson and manager at a Philadelphia shoe store for 37 years. McKenzie and his siblings worked there as well during high school. His mother was a homemaker, and neither parent had a college degree.

"Their passion was to make sure their kids went to college and went on from there," McKenzie says. Each January, their kitchen table was covered with college financial aid forms.

All seven McKenzie siblings attained advanced degrees. The eldest, Martin T. McKenzie Jr., received a Penn Ph.D. in Chemistry in 1983 and taught high school chemistry prior to his death in 2010. Steven E. McKenzie, obtained a Penn MD/Ph.D. in 1985 (Quinn was his advisor), and is a professor at Thomas Jefferson University's Cardeza Foundation for Hematologic Research (currently on sabbatical at Penn's Chemical and Biomolecular Engineering Department). Daniel McKenzie, MEAM'79, is currently lead engineer with GE Wind Energy in Greenville, S.C. Paul's sister Patricia McKenzie, MSN, NU'79, is a Cardiac Care Coordination Counselor at the Children's Hospital of Philadelphia.

Together with spouses, in-laws and children, the McKenzie clan boasts 11 Penn alumni so far, plus two Penn employees, an impressive presence in the Penn community, which includes dozens of families with more than 10 alumni.

Your Legacy at Penn Engineering

The character of Penn Engineering has been shaped and strengthened by generations of alumni and friends through Planned Giving. You have the opportunity to join them. A ***planned gift*** ensures that your philanthropy both maximizes the benefit of available tax incentives and generates enduring support for our students, faculty and campus.

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New Faculty

Firooz Aflatouni
Skirkanich Assistant Professor in Electrical and Systems Engineering

Ph.D. in 2011 in Electrical Engineering
University of Southern California
Postdoctoral position at the California Institute of Technology

Dr. Aflatouni works on integrated electronic and photonic circuits with applications in communication, sensing and imaging. His group studies integrated electronic-photonic co-design with the goal of improving the performance of electronic systems using photonic devices and improving the performance of photonic systems by incorporating electronic devices and techniques. Applications of this research include communication, imaging, Radar, LIDAR and multi-modal bio-sensing. Dr. Aflatouni designs both electronic and photonic chips and packages fabricated chips to form the electronic-photonic system and measure its performance. In a monolithic approach, both electronic and photonic systems are designed and fabricated on a single platform.

Lee Bassett
Assistant Professor in Electrical and Systems Engineering

Ph.D. in 2009 in Physics
Cambridge University
Postdoctoral position at the University of California, Santa Barbara

Dr. Bassett uses optics and electronics to study quantum mechanical effects in solid-state materials. Drawing from atomic physics, materials science and electrical engineering, his research centers on controlling the nanoscale quantum properties of charge, spin and light in different materials toward the development of future technologies that harness quantum effects for practical purposes. Potential applications include quantum computers, secure communication networks, and the development of new optical sensors for probing nanoscale dynamics in biological systems and new materials.

Jennifer Phillips-Cremins
Assistant Professor in Bioengineering

Ph.D. in 2008 in Biomedical Engineering
Georgia Institute of Technology
Postdoctoral positions in Systems Biology at
the University of Massachusetts Medical School

Dr. Cremins runs the Epigenomics and Systems Neurobiology Lab, with a particular focus on investigating the link between three-dimensional organization of genomes and development of the mammalian central nervous system. The lab employs systems-level experimental and computational approaches to (1) create high-resolution 3D genome architecture maps and (2) integrate 3D architecture maps with genome-wide maps of epigenetic modifications and gene expression. Current work is focused on understanding the role for higher-order chromatin organization during differentiation of embryonic stem cells into neurons, during reprogramming of neurons into induced pluripotent stem cells and in models of neurodegenerative disease. The long-term goal of the Cremins Lab is to engineer and perturb chromatin structure to control brain regeneration for neurodegenerative disease treatment applications.

Celia Reina
William K. Gemmill Term Assistant Professor in Mechanical Engineering and Applied Mechanics

Ph.D. in 2011 in Aeronautics
California Institute of Technology
Postdoctoral positions at University of Bonn and
Lawrence Livermore National Laboratory

Dr. Reina's research interests are focused on the multiscale modeling and simulation of materials. She works on the development of new techniques for scale transition as well as on the use of existing techniques to understand inelastic and non-equilibrium processes in materials. Examples of her research include modeling of plasticity in the large deformation setting, understanding of fast phase transformations for applications to new memory devices and developing multiscale models for ductile failure. Dr. Reina's research is very interdisciplinary and combines tools from continuum mechanics, statistical physics, applied mathematics and high performance computing.

Honors & Awards

Danielle Bassett, *Skirkanich Assistant Professor of Innovation in Bioengineering,* and **Chris Callison-Burch**, *Aravind K. Joshi Term Assistant Professor in Computer and Information Science,* were among this year's Sloan Fellowship recipients. Since 1955, the Alfred P. Sloan Foundation has granted yearly fellowships to early-career scientists and scholars whose achievements and potential identify them as the next generation of scientific leaders.

Russell J. Composto, *Professor in Materials Science and Engineering*, is the recipient of the 2014 Geoffrey Marshall Mentoring Award from the Northeastern Association of Graduate Schools (NAGS). The Mentoring Award is given in memory of Geoffrey Marshall, former President of NAGS, for outstanding support of a graduate student or graduate students from course completion through research and placement.

Ertugrul Cubukcu, *Assistant Professor in Materials Science and Engineering*, received a 2014 Young Investigator Award from the IEEE Photonics Society for "contributions to photonics beyond the diffraction limit with nanoantenna-based devices and sensors."

Cherie Kagan, *Stephen J. Angello Professor in Electrical and Systems Engineering,* was elected Fellow of the American Physical Society for "innovative research in manipulating and exploring properties of inorganic and organic materials for electronic, optical and optoelectronic devices."

Joseph Devietti, *Assistant Professor in Computer and Information Science*, received an Intel Early Career Faculty Honor Program Award for "Programmability challenges raised by multicore architectures."

Ali Jadbabaie, *Alfred Fitler Moore Professor of Network Science in Electrical and Systems Engineering*, was elected an IEEE Fellow for "contributions to the theory of multi-agent coordination and control." Dr. Jadbabaie has also been appointed as editor-in-chief of *IEEE Transactions on Network Science and Engineering*.

Sampath Kannan, *Henry Salvatori Professor and Chair in Computer and Information Science*, was named Fellow of the Association of Computing Machinery (ACM), and was recognized "for contributions to algorithmic approaches to program reliability, bioinformatics, and for service to the computer science research community."

Ladislav Kavan, *Assistant Professor in Computer and Information Science*, is a recipient of a National Science Foundation CAREER Award for his proposal, "Geometric Shape Deformation with Applications in Medicine."

Daeyeon Lee, *Associate Professor in Chemical and Biomolecular Engineering*, is the recipient of the 2014 Unilever Outstanding Young Investigator Award from the American Chemical Society (ACS) Division of Colloid and Surface Chemistry. This award recognizes fundamental work in colloid or surfactant science by researchers in the early stages of their careers.

Dan Lee, *Professor in Electrical and Systems Engineering*, was elected an IEEE Fellow for "contributions to machine learning algorithms for perception and motor control."

Allison Pearce, *a senior majoring in Computer Science*, has been named a recipient of a 2014 Thouron Award. A graduate exchange program between Penn and British universities, the Thouron Award aims to improve relations between the United States and the U.K.

Pedro Ponte Castañeda, *Raymond S. Markowitz Faculty Fellow and Professor in Mechanical Engineering and Applied Mechanics*, has been elected a Fellow of the American Society of Mechanical Engineers.

Dr. Castañeda was also awarded the Humboldt Award in recognition of his lifetime achievements in research.

David Srolovitz, *Joseph Bordogna Professor in Materials Science and Engineering*, received the 2013 MRS Materials Theory Award for his "decisive and highly influential contributions to the theory and simulation of microstructure, morphological evolution, mechanical behavior, and the structure and dynamics of interfaces."

Val Tannen, *Professor in Computer and Information Science*, has been awarded the Test-of-Time award from the International Conference on Database Theory (ICDT) for his seminal paper, "Naturally Embedded Query Languages," which strongly contributed to the establishment of the complex-object data model and its accompanying query languages.

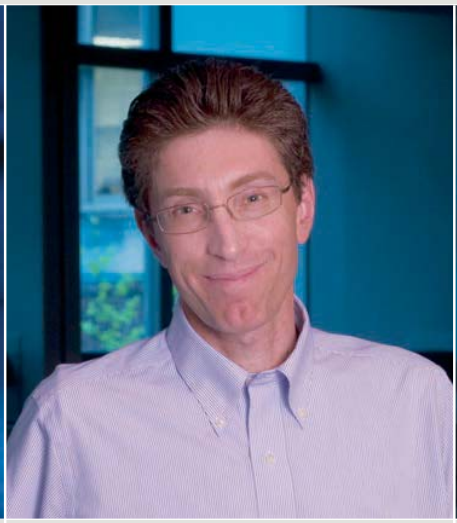
Dr. Tannen was also named Fellow of the Association of Computing Machinery (ACM) for "for contributions to query languages, query optimization and data provenance."

Teaching Awards

The recipients of the annual Penn Engineering teaching and advising awards are selected directly by Penn Engineering students after thoughtful consideration. The School is filled with gifted educators who inspire students with their dedication and excellence.

David Issadore, *Assistant Professor in Bioengineering*, has been awarded the ***S. Reid Warren, Jr. Award***, which is presented annually by the undergraduate student body and the Engineering Alumni Society in recognition of outstanding service in stimulating and guiding the intellectual and professional development of undergraduate students.

One student noted, "Dr. Issadore has made an amazing effort to be involved in all the student projects in his lab. He is always willing to sit down and talk about a project and possible problems, directions, or ways he can help. I have received hours of personal teaching and advice from Dr. Issadore on topics related to my schoolwork, projects in his lab and professional growth."



Russell J. Composto, *Professor in Materials Science and Engineering (MSE),* has been awarded the **Ford Motor Company Award for Faculty Advising**. The award recognizes dedication to helping students realize their educational, career and personal goals.

One student wrote, "Dr. Composto is both my MSE advisor and my Senior Design advisor. He is extremely accessible and always eager to help students. With his guidance, I was able to study abroad and find appropriate classes to fulfill my MSE requirements, even after transferring to MSE late in my sophomore year. He has been an amazing resource for me!"

Thomas Farmer, *Lecturer in Computer and Information Science and Electrical and Systems Engineering (ESE)*, has been awarded the **Hatfield Award for Excellence in Teaching in the Lecturer and Practice Professor Track**. The award recognizes outstanding teaching ability, dedication to innovative undergraduate instruction, and exemplary service to the School in consistently inspiring students in the engineering and scientific profession.

A student writes, "Dr. Farmer completely revamped ESE 215 to provide a better learning experience and more in-depth knowledge about circuits to the students. Dr. Farmer has a very enthusiastic personality that inspires and motivates students to explore further."

John A. Lepore, *professor emeritus of Civil Engineering Systems in the Department of Electrical and Systems Engineering*, passed away on February 14 at age 78.

Raised in South Philadelphia, Dr. Lepore earned a B.S. in civil engineering from Drexel in 1957 and master's and Ph.D. degrees in mechanical engineering from the University of Pennsylvania in 1965 and 1967, respectively.

After working as a project/systems engineer for General Electric, Dr. Lepore pursued a career in academia at Penn, where he was appointed an assistant professor in 1968. He was promoted to associate professor in 1973 and then to full professor in 1980. Dr. Lepore retired in 2003.

In 1979 he received Penn Engineering's S. Reid Warren, Jr. Award for Distinguished Teaching. "John was a beloved member of our faculty," said Eduardo D. Glandt, Nemirovsky Family Dean of Penn Engineering. "He will be remembered very fondly by those of us who were fortunate to witness his dedication to his students and his wonderful collegiality."

His research interests included earthquake analysis and design, new engineering materials, stochastic processes, structural dynamics, environmental resources and natural disaster mitigation. He was also very passionate about educational innovation and curriculum development.

Dr. Lepore is survived by his wife Patricia; his children William and Thomas Muldoon, Jacqueline Navin and John Lepore, Jr.; 12 grandchildren; four great-grandchildren; a brother Anthony Lepore; and a sister Giovanna Eisenstein.

Mitchell Litt, *professor emeritus in the Department of Bioengineering*, passed away on March 2 at age 81.

Dr. Litt was a founding member of the Department of Bioengineering, which was officially established at Penn in 1973. He was first appointed to Penn's faculty in 1961 as an assistant professor of chemical engineering and chaired the Department of Bioengineering from 1981-1990.

Praised for his teaching, Dr. Litt received a Lindback Award for Distinguished Teaching in 1963. "His work in education brought a national focus to our program, and has been duplicated countless times across the country in many different engineering curricula," said Dr. David F. Meaney, Solomon R. Pollack Professor and chair of Bioengineering. "In this aspect, his legacy left an imprint on thousands of young minds across the country, and continues to this day."

Dr. Litt published dozens of papers on his research in biotransport, cellular bioengineering and biorheology. He helped develop biomedical instruments for measuring the viscosity and elasticity of tracheal mucus and other secretions, which improved the understanding and diagnosis of respiratory and other diseases. Born in Brooklyn, NY, Dr. Litt was a graduate of Columbia University. He earned a B.S. and M.S. in Chemical Engineering in 1954 and 1956, respectively, and an Eng.Sc.D. in 1961.

Dr. Litt is survived by his wife Zelda; children Ellen Simons and Steven Litt; grandchildren Louis, Abby, Jocelyn, Jennifer and Melissa; and sister Dr. Naomi Quenk.

Pulkit "Josh" Singh, a junior in the School of Engineering and Applied Science and The Wharton School, passed away on January 12 at age 20.

Mr. Singh was from Long Island, NY, and had graduated from Bethpage High School. At Penn, he studied computer science, finance and management. He had lived in the Harnwell and Du Bois College Houses and was currently living off campus.

"He was the star of our family, and he had a brain that could think at least 10 or 12 years ahead of his time," his uncle Joginder Singh told *The Daily Pennsylvanian*.

Mr. Singh is survived by his uncle and aunt, Mr. and Mrs. Joginder Singh, and brother Ankur Singh.

Kevin Zhao, a senior in the School of Engineering and Applied Science and The Wharton School, passed away on December 26 while traveling with his family in China. He was 21.

Born in China but raised in Long Island, NY, Mr. Zhao was a graduate of Ward Melville High School. At Penn, he studied computer science, retail, operations and information management and had lived in Mayer Hall.

Mr. Zhao had been in the Penn Undergraduate Research Mentoring Program, where his research was entitled, *How Good of a Measure of Tax Risk Are Disclosed Amounts of Unrecognized Tax Benefits?* In addition, he served on the board of the Wharton China Business Society.

Mr. Zhao is survived by his parents Jay and Lin Zhao, and his sister Kathryn.

Sonya Gwak

Sonya Gwak, Ph.D., is the Director of Student Life and Director of Graduate Admissions at Penn Engineering.

What brought you to Penn?

I was born in Korea and grew up in Ghana. I came to Penn as a freshman and never left. I was a dual major in Design of Environment and English. I also earned my M.S.Ed. in Intercultural Communication and Ph.D. in Education at Penn. You could say I am a "Penn Lifer."

What are your key responsibilities in the Academic Programs Office?

I wear several hats. I am the Director for Student Life, which means that all non-classroom student matters fall under my purview. I am the primary liaison between Penn Engineering and University-wide student and academic support systems. I also oversee both undergraduate and graduate student activities. I would never be able to do this part of my job without the dedicated student leaders we have in our School.

And there's more to your job?

I am also the Director of Graduate Admissions, where I oversee the recruitment of talented students to our graduate programs and ensure the smooth operation of the application process.

What do you do when you have free time?

It is very important for me to be healthy mentally and physically, to be able to juggle all the things I do, so I have a few hobbies. I like baking and origami because both can be completed in a short amount of time and I can share the finished product with friends. I am also a distance runner and have completed three marathons and several shorter races.

What do you like most about working with engineering students?

I am always amazed by our students, and find them very bright, interesting and well-rounded. A student once told me, "Sonya, you think like an engineer." I take that as a compliment. I am in good company!

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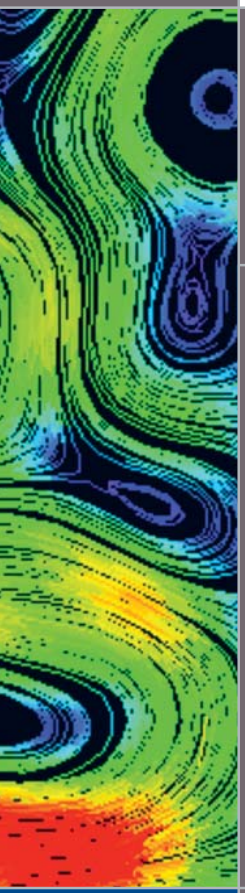

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