Harvard Engineering and Applied Sciences Graduate Studies 2005–2006

Harvard Engineering and Applied Sciences

CONNECT ... INTEGRATE ... APPLY

programs in:

- Applied Mathematics
- Applied Physics
- Bioengineering
- Computer Science
- Electrical Engineering
- Environmental Sciences and Engineering
- Mechanical Engineering
- Information, Technology and Management
  P.h.D only / jointly with Harvard Business School

On the cover: Members of Professor Howard Stone's fluid dynamics lab created "armored" drops of liquid through a novel combination of microfluidics and colloid science. Because many common materials consist of gas bubbles in liquid or have liquid droplets suspended in another liquid, the technology could lead to improved consumer products, like lighter and longer-lasting foams, and improved texture and stability of emulsified products such as ice creams; or it might have applications in medicine, such as novel drug delivery systems and controlled encapsulation; and it could even improve industrial processes, such as alternative methods for processing mineral ores.

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ENTER A BOUNDLESS CULTURE

A *Boston Globe* editorial writer was so intrigued by Professor of Applied Mathematics and Mechanics L. Mahadevan's approach to research, she wrote:

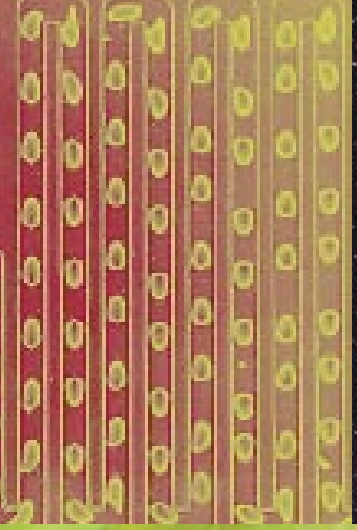
"His philosophy should be inspiration to anyone who wants to keep his or her own gray matter nourished. Seeking an understanding of everything—from a strange plant in a pot to the outermost dust in the cosmos—is the zest of science, and the best way to meet the challenge of living."

That boundless approach to research and to life characterizes the culture you will find at the Harvard Division of Engineering and Applied Sciences (DEAS).

We provide the raw materials to foster future leaders who connect ideas in unexpected ways, integrate technical innovations into everyday life, and apply knowledge and discoveries to improve society and to further our understanding of the world. We are looking for students who will make their vision real and who will challenge those around them.

This brochure—its message told in part in the words of our graduate students—will introduce you to the opportunities available for graduate study in engineering and applied sciences at Harvard University.

If you like what you find, we want to hear from you.



Our core tenets—educating broad-minded students; interdisciplinary research; integration across disciplines; and balancing theory, experimentation, and practice—create an unmatched environment for learning and exploration.

That means ...

- asking the big questions in an age when the rush to application often outshines basic understanding
- conducting science that promotes the social good
- seeing syntax error as an invitation, not an indictment
- moving between fields but remaining anchored by good science
- pursuing active research and an active life
- allowing problems and answers to develop in their own terms.

Natalie Arkus

Degree

Applied Mathematics

Affiliations

DEAS
Harvard Medical School
Paul F. Glenn Laboratories for the Biological Mechanisms of Aging (BBS Program)

Education

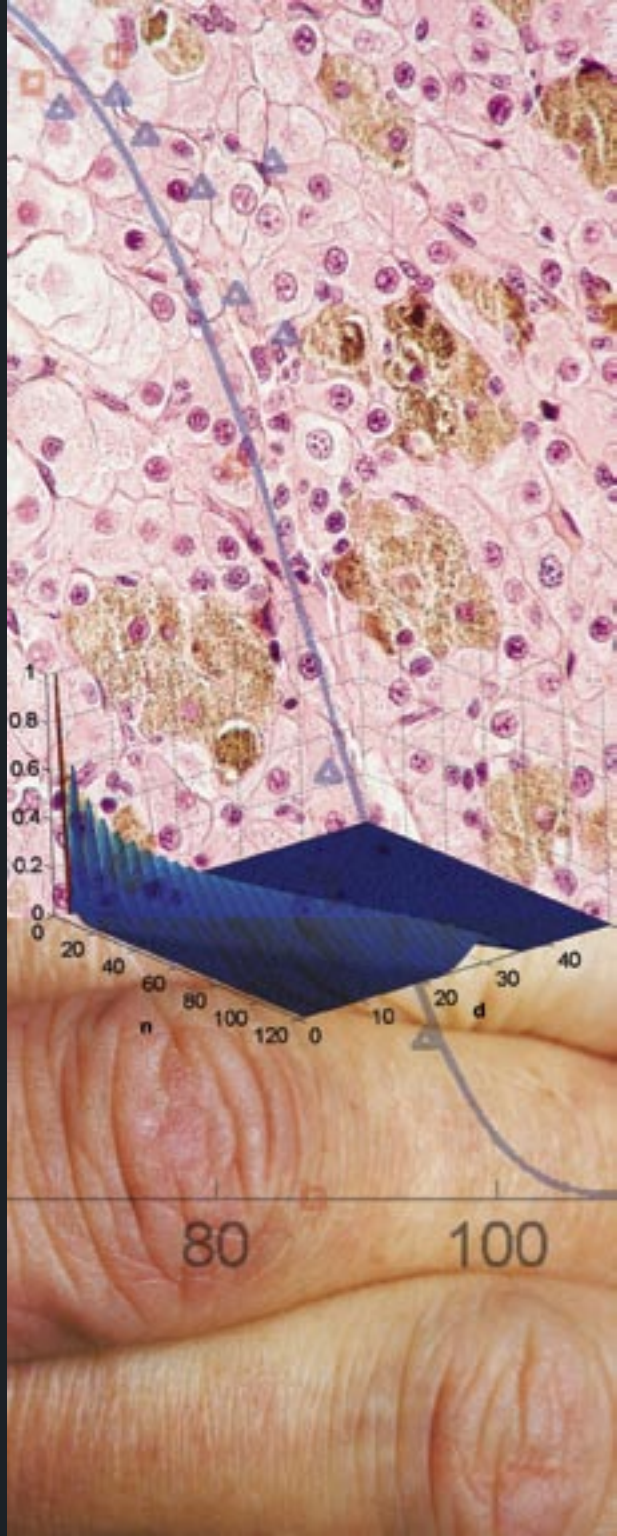
Columbia University, B.A. in Physics and Mathematical Biology; M.S. in Applied Mathematics

Arkus investigates the mathematics of aging: the key molecular events that cause organisms, from yeast to human beings, to grow old and die.

"There are many things that drew me to Harvard and to the Division in particular. I only looked at programs that reported an openness and a drive toward interdisciplinary research. It's funny because there were many other institutions that claimed to do interdisciplinary research, but, once you visited them or looked at the research they were producing, you could see they really weren't.

Quite honestly, when I visited DEAS I was bombarded with people who were doing interesting work in mathematical biology and biophysics. Harvard is really vibrant and exciting; one of the reasons I decided to come here (and it seems also to be a reason that many of my other friends in the program decided to come here) is the atmosphere that you're in—you're around people who will push you, who have a robust background, and whose opinions you would like to hear. The great thing about DEAS is that it's so flexible—as long as you can convince someone that something is worth doing, you can do it!

You will not have the danger of being pigeonholed in one area of research—if you change your mind and want to apply math to solar cells instead of biology, you can! This offers a wonderful degree of freedom that not many other institutions offer."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CONNECT

By being a part of the Division of Engineering and Applied Sciences, faculty and students are linked with the enormous breadth and expertise of the entire University.

"Not a single technical publication from my research in the Division was done just with my advisor. I have collaborated with scientists from academia, industry, and government laboratories."

—T.D. Perry, Ph.D. '05
Environmental Sciences and Engineering

The Division of Engineering and Applied Sciences connects ideas and innovations from all fields.

We have close physical and intellectual links with the basic sciences, from physics to statistics; increasing ties with the Chemistry and Biology departments; and joint efforts with Harvard's professional schools, including those of medicine and business.

Our parallel role is connecting advances in applied sciences and technology with society through building collaborations with industry and government institutions. Harvard is also home to two major research centers, focused on nanoscience and materials, and a government sponsored center dedicated to understanding the global climate.

We have institutionalized a collaborative approach toward other disciplines. This is a place where many of the paths for connections have been laid; you simply need the willingness to travel and the drive to discover the unexpected.

The power to connect

The University offers a unique stage for promoting the best in basic and applied research in science and technology, including:

- a commitment to fundamental research supported by a community of distinguished faculty—from biologists to chemists to physicists
- cutting-edge work in engineering, applied sciences, and technology that cuts across fields and departments
- access to one of the best medical centers in the world—Harvard Medical School and its links to 18 affiliated hospitals—and world-class schools of business and law.

Clifford Brangwynne

Degree
Applied Physics

Affiliations
DEAS; Department of Organismic and Evolutionary Biology

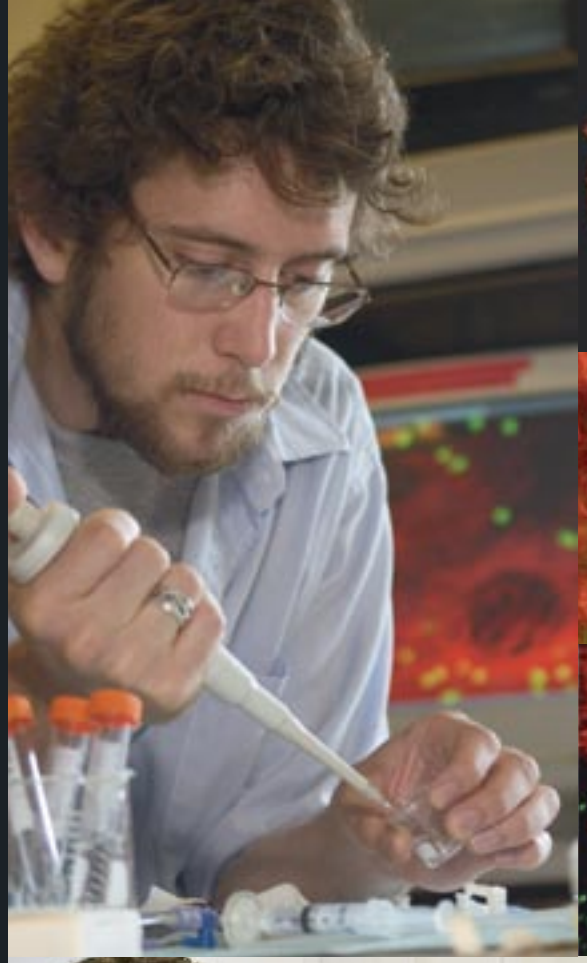
Education
Carnegie Mellon University, B.S. in Materials Science and Engineering; Physics minor

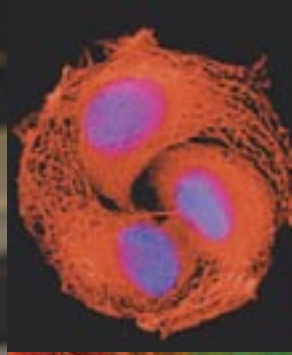
"Toward the end of my freshman year, I came across a biology lab working on cell migration and I was just blown away. In the case of cell microstructure, you've got this extremely complicated network of biopolymers and protein motors that somehow gives the cell this property of being able to move around in a functional way.

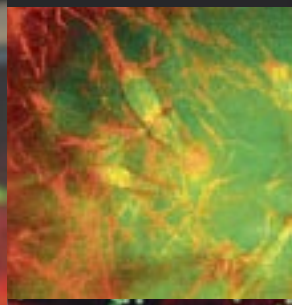
It seemed like the ultimate materials science problem: How do you get this property from that structure? I fell in love with cells and have been poking, stretching, and staring at them since. But in the end they are materials that obey the laws of physics like everything else, and so you've got to take an approach where you look at the physics, chemistry, and biology, and maybe at the end of the day you have some idea of how they work—or maybe not, but at least you'll have more magic to wonder about.

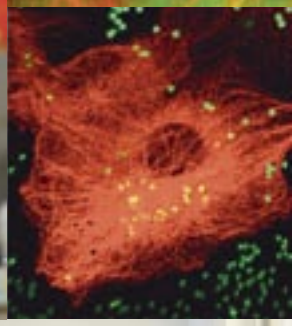
One minute I'm watching groups of tumor cells crawl around and invade the surrounding tissue, and the next minute I'm looking at how much a microtubule is bending inside a tiny compartment of one of those cells. The biggest challenge and the biggest excitement comes from the thought that somehow these phenomena—the behavior of a nanometer-sized tube inside of a cell and the behavior of cells in a tissue—are connected."

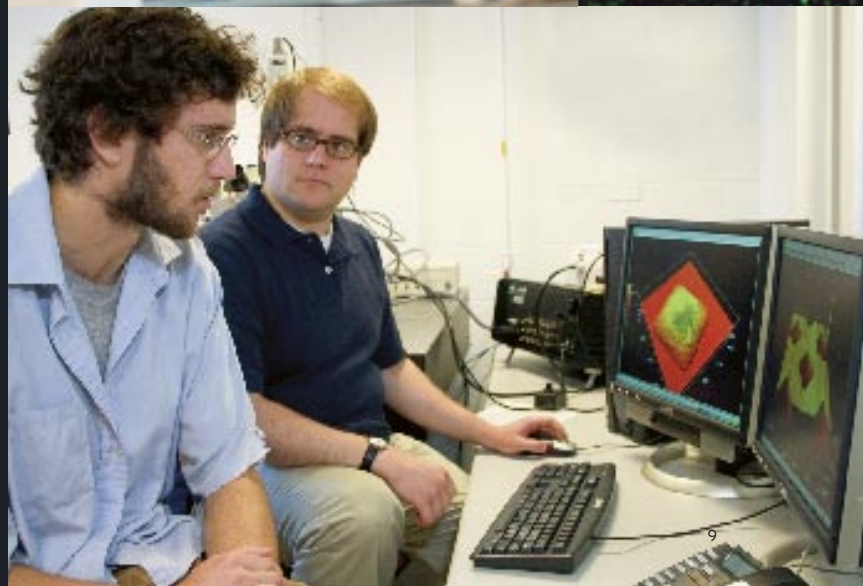
Brangwynne's research involves understanding the structure and mechanics of biological materials and their role in fundamental cell processes such as migration and force generation, including problems that span over four orders of magnitude in spatial scale: from the mechanics of biopolymer networks and the physics of biopolymer bending fluctuations, to the invasion patterns of brain tumors growing into the surrounding tissue.





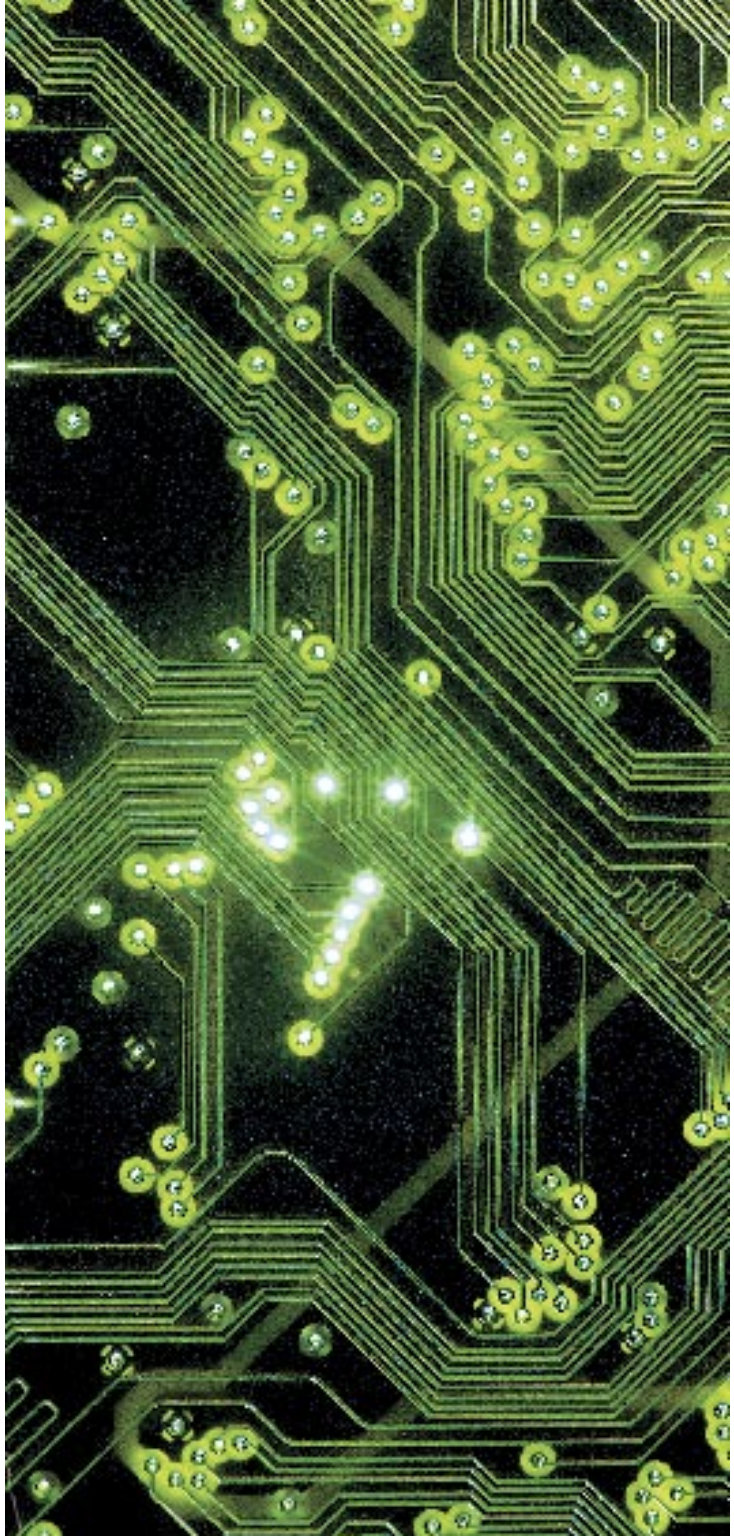


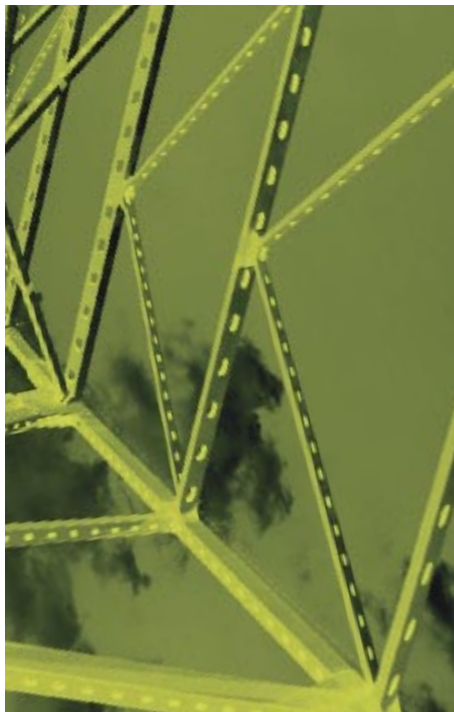




INTEGRATE

Engineering is inherently interdisciplinary and integrative. Not only does the area expose students to multiple fields, but it also inspires them to collaborate and learn together—skills that are essential in everyday life and work.





We have entered an era of "integrationist" science and engineering.

Life scientists draw on the expertise of chemists, physicists, and computer scientists to help them observe, analyze, and simulate complex biological processes, such as how cells differentiate and grow.

In the same way, engineers and other physical scientists take inspiration from nature, with the goal of applying some of its elegant solutions—the structure of spider silk or molecular motors—to the development of human-made materials and other engineered products.

To be successful at integrative science, researchers—from computer scientists to engineers to biologists—require the intellectual and physical resources to transcend existing disciplinary boundaries and collaborate with colleagues from other areas. At DEAS, we supply the means. You supply the mind.

In the words of Harvard systems biologist Walter Fontana, "The issue is to inoculate academic Petri dishes with a special breed of computer scientists, biologists, physicists, engineers, linguists, mathematicians, and chemists whose minds can recombine."

Innovation comes together

A team of Harvard grad student entrepreneurs—pictured above, from left to right: Brian Pulliam, Graduate School of Arts and Sciences, Ph.D. '07; Kathryn Tinckam, M.D., Harvard Medical School, MM.Sc. '05; Jacqueline Harlow, Harvard Law School, J.D. '06; Thomas "Tod" Perry, Division of Engineering and Applied Sciences, Ph.D. '05; and W. Alex Goodwin, Harvard Business School, M.B.A. '05—captured first place in the $125,000 "Ignite Clean Energy" business plan competition, for their proposal to use microbes to clean out the gunk that forms inside water pipes that conduct heat and, in the process, dramatically increase energy efficiency. The process was originally used to preserve outdoor sculptures from decay.

Griffin Weber

Degree
Harvard-MIT Health Sciences and Technology (HST), Biomedical Informatics

Affiliations
DEAS
Harvard Medical School
MIT

Education
Harvard University, S.B. in Biomedical Sciences and Engineering

"The Ph.D. program at DEAS was the only one to which I sent an application. The kind of research I was doing was cutting edge, and I wanted to design a custom curriculum that spanned multiple departments such as computer science, statistics, genetics, and neuroscience.

I knew that DEAS promotes interdisciplinary collaboration, not only among its own faculty, but also with researchers in other fields, such as the life sciences.

One of the projects I am currently working on is phylogenetic tree reconstruction. With faculty member Stuart Shieber, Harvard College Professor and James O. Welch, Jr. and Virginia B. Welch Professor of Computer Science, I developed stochastic search algorithms that take the DNA sequences from different organisms and computationally predict how they are evolutionarily related. I have brought our work over to collaborators at Harvard Medical School and used it to find genetic links between different mitochondrial diseases.

As both a medical student and a DEAS graduate student, I have been in the unique position to see the problem from both viewpoints.

The research I am most proud of consists of those projects in which I have been able to take the skills I learned at DEAS and apply them to applications that benefit the patients I meet in the hospitals."

Weber does more than simply apply programming solutions to medical problems; he has created software that parses human DNA sequences from those of harmful germs in the blood and tissues of a patient. He played a lead role in implementing Harvard Medical School's online curriculum system (MyCourses) and serves as Director of the Brigham Research Informatics Core (BRIC) at Brigham and Women's Hospital (BWH). BRIC is an initiative that utilizes the expertise of the hospital's "informaticians"—with backgrounds in medicine, biology, engineering, biostatistics, and computer science—to facilitate research.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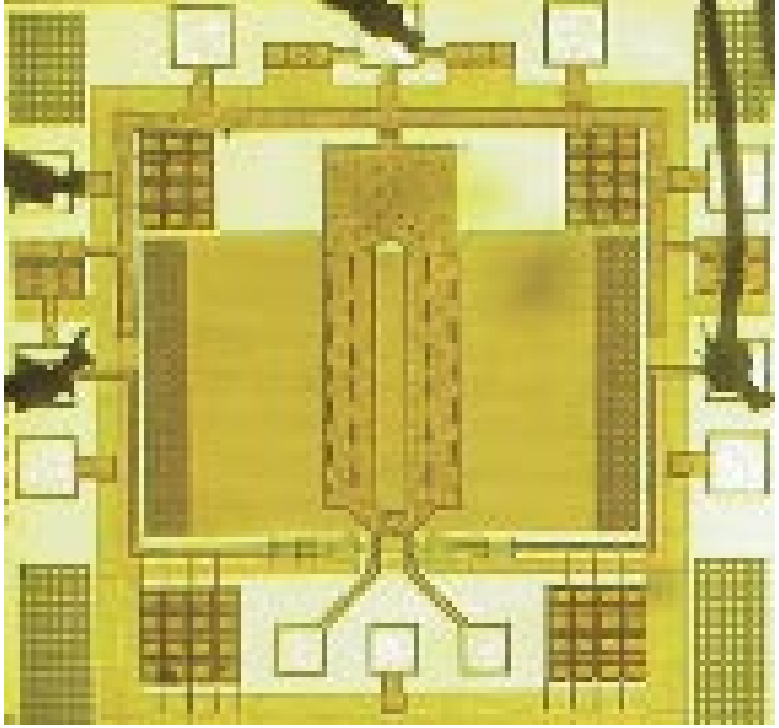
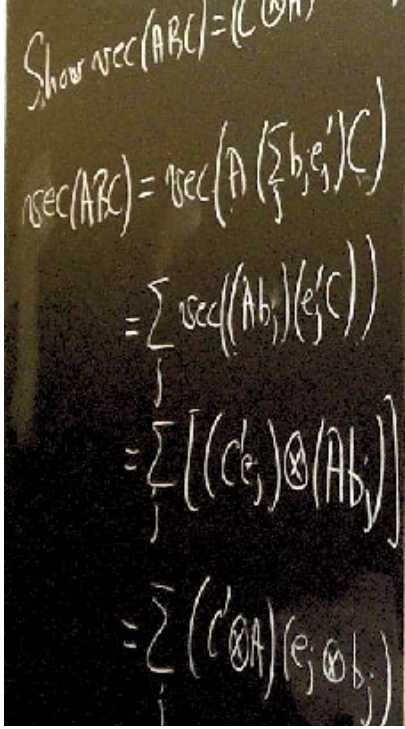
APPLY

Supporting the push-pull relationship between basic and applied research is our golden rule. Strength in foundational disciplines, from applied physics to computer science, provides a basis for advancing the boundaries of knowledge and creating new technologies.





From understanding the behavior of materials to investigating the chemical origins of life, fostering fundamental exploration remains an essential part of the Division's mission.

In certain areas of research, we are known as a quiet giant. While less flashy on the surface, our reputation for nurturing basic science sets us apart. Our faculty members have published some of the most commonly cited conceptual research papers that have elucidated general principles.

At the same time, we are building a strong foundation for invention-oriented disciplines, such as computer systems research, and increasing our collaborations in broad fields like electrical engineering. The development of technologies like sensor networks and future labs will foster innovative tools and techniques in areas like small-scale science and bioengineering.

Our faculty and students work at the interface of basic and applied research. Here you can be a thinker and a doer: part Einstein and part Edison.

Applying the tools of the trade

Electrical engineer Navin Khaneja is using methods from optimal control theory to improve the sensitivity of nuclear magnetic resonance (NMR) spectroscopy devices (commonly used for medical imaging).

Environmental engineers like Daniel Jacob and Steve Wofsy rely on developing and using advanced instrumentation to measure atmospheric trends like CO_2 levels over long periods of time.

Computer scientist Radhika Nagpal takes computing beyond the screen. Her research covers biologically inspired approaches to multi-agent and distributed systems; applications to smart materials, reconfigurable robots, and sensor networks; and models of developmental biology and morphogenesis.

A team of Harvard engineers led by Zhigang Suo proposed that a "molecular car" could shuttle target molecules just as conventional vehicles transport passengers.

Michael Rabin, a pioneer in computer science, developed and implemented HyperEncryption, a system for embedding messages in rapidly moving streams of random digital bits in ways that cannot be decoded, even with unlimited computing power.

Rebecca Nesson

Degree
Computer Science

Affiliations
DEAS
Harvard Law School

Education
Harvard University, A.B. in Folklore and Mythology
Harvard Law School, J.D.

"I knew immediately it was something I would like to do. Pretty much since I graduated from Cambridge Rindge and Latin High, I have been doing tutoring there.

Rindge is a tough school system because students come in with low skill levels when they start in ninth grade, and teachers are not necessarily in a position, with classes as large as they are, to catch everyone up.

What the students do love is technology. I am committed to getting to the bottom of whatever it is that makes many girls and minority students lose interest in computer science before they even have a chance to see how cool it is. Tutoring lets me watch this process up close and gives me the opportunity to start working on it right away.

Admittedly, learning computer science is hard and requires students to push through logical thinking. They are going to make mistakes. So, if we are working on sorting an array of numbers, we will take numbers on a piece of paper and stand at the front of the class and run the sorting algorithm ourselves. The students then can get a sense that the information is already there in their heads, making it easier to put it into the code.

Trying to figure out what does and what doesn't work teaches perseverance. In science and engineering, failure is likely—but that's not a bad thing. Failure often inspires creativity."

Nesson's "day job" at DEAS concerns the study of computational linguistics, a subfield of artificial intelligence that involves building computers that can communicate in languages such as English. She investigates formalisms that can be used to parse sentences into their grammatical structure while simultaneously building a representation of the meaning of the sentences. Nesson also is an active blogger and has taught Internet and Society courses at Harvard Law School.


learn a foreign language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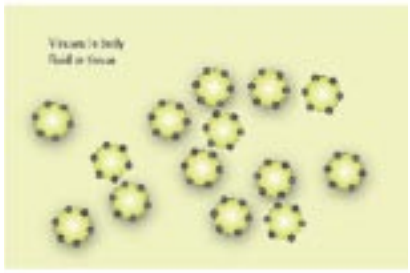
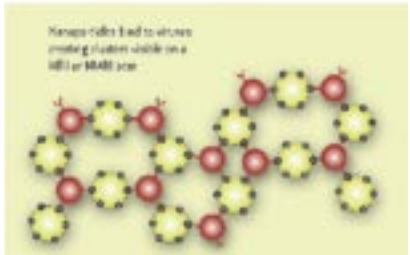
BUILD A BETTER WORLD

The Harvard community is in an ideal position to further a better understanding of the societal importance of science and technology and to foster connections that extend well beyond the ivory tower.





To solve great social problems means science itself must be an increasingly social endeavor. "Veritas" means a willingness not simply to explore frontiers, but to help light the way for the rest of the world. Harvard students and faculty have an exceptional opportunity—and an obligation—to become a resource for anyone confronting the evolving scientific and technological landscape.

That's why local high school teachers are encouraged to experience life in our labs and take the latest research back to the classroom. That's why the faculty and graduate students team with the Museum of Science, Boston, to bring the latest research to the public. That's why our bioengineers created Medicine in Need (MEND), providing ways to treat tuberculosis in the developing world.

A core part of Harvard's institutional values is to promote the betterment of society or to further our understanding of the nature of the universe.

Ultimately, we provide an opportunity for graduate students to be active, engaged, and trailblazing participants in this ongoing conversation.

Making a difference

"I am working on projects that have the potential to make a difference in the world. Many researchers are content with characterizations of known phenomenona or small alterations of current techniques. Here at Harvard I believe that the professors ask big questions and the solutions really have the potential to affect people's lives."

—Adam Siegel, Ph.D. candidate, Medical Engineering and Medical Physics

"Having worked in the spine implant industry prior to coming to Harvard, I saw firsthand the problems associated with nonbiological implants. I am proud that I recognized a clinical need not currently being met in industry and had the courage to devote the next five years of my life to pursuing a solution to it."

—Kristy Shine, Ph.D. candidate, Medical Engineering and Medical Physics

"One of the most fulfilling aspects of working in bioengineering is being able to combine the humanitarian aspects of medicine with the innovation of engineering to address unmet medical needs. Long hours in the lab yield a tangible product that can be used to help people."

—Jean Chen-Ann Sung, Ph.D. candidate, Bioengineering

YOUR LEARNING ...

GRADUATE PROGRAMS

The Division's doctoral and master's degree programs lie at the interfaces of engineering, the applied sciences (from biology to physics), and technology.

In keeping with the interdisciplinary nature of modern research, the Division does not have traditional academic departments and does not award degrees by specific research area (listed on the facing page).

Instead, students may work towards a Master of Science, Master of Engineering, and Doctor of Philosophy degree in one of four subjects—Applied Mathematics, Applied Physics, Computer Science, and Engineering Sciences—or graduate with a Ph.D. in the Information, Technology and Management program (through Harvard Business School).

This flexibility allows research—and you—to go wherever you need to.

Programs

We offer degrees that cover research topics in the following broad areas. Study/research is not limited to just the topics below; most students pursue work that covers multiple areas.

- Applied Mathematics
- Applied Physics
- Bioengineering
- Computer Science
- Electrical Engineering
- Environmental Sciences and Engineering
- Mechanical Engineering
- Information, Technology and Management
  P.h.D only / jointly with Harvard Business School

For complete information on our programs and requirements, visit **www.deas.harvard.edu/gradstudy/programs**

Collaborative options

Medical Engineering and Medical Physics program
http://hst.mit.edu

DEAS and the departments of Biophysics and Physics participate in the Harvard-MIT Division of Health Sciences and Technology (HST) program in Medical Engineering and Medical Physics (MEMP), including a specialized track in Bioinformatics and Integrative Genomics (BIG).

Information, Technology and Management
www.hbs.edu/doctoral/programs/itm

The Ph.D. program, a collaboration of DEAS and Harvard Business School (HBS), seeks to develop new methodologies and to generate research that explores in depth the interaction between information, technology, and management. Areas of emphasis include: Accounting and Control; Competition and Strategy; Marketing; Negotiation, Organizations, and Markets; Organizational Behavior; and Technology and Operations Management.

FACULTY AND RESEARCH

Our faculty members are naturally adventuresome (and encouraged to be so); they work beyond traditional boundaries, allowing problems and answers to develop on their own terms, unfettered by fields. Here's a small selection of what they do.

Research highlights

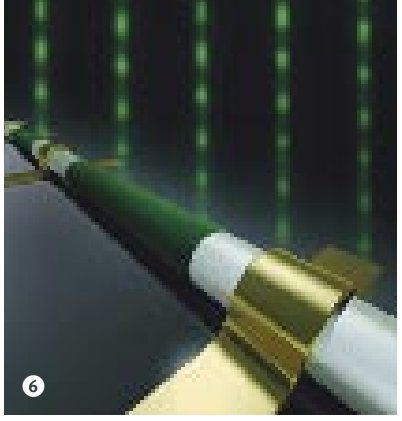
❶ Research with bite ... Gordon McKay Professor of Applied Mathematics and Mechanics L. Mahadevan and former students and postdocs Yoël Forterre, Jan M. Skotheim, and Jacques Dumais discovered how the Venus flytrap snaps up its prey in a mere tenth of a second by actively shifting the curved shape of its mouthlike leaves. The discovery has implications for biomimetic systems.

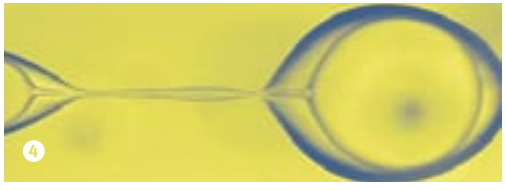
❷ Volcanoes go wireless ... Matt Welsh, Assistant Professor of Computer Science, and colleagues including Research Assistant Geoffrey Werner-Allen, have teamed up with seismologists at the University of New Hampshire and University of North Carolina to fit an Ecuadorian peak with a wireless array to monitor volcanic activity. The sensors should help researchers, officials, and local residents understand and plan for eruptions of Tungurahua, one of Ecuador's most active volcanoes.

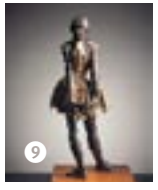
❸ Raman laser packs a punch ... Federico Capasso, Robert L. Wallace Professor of Applied Physics and Vinton Hayes Senior Research Fellow in Electrical Engineering, and his colleagues, including postdoc Mariano Troccoli, have demonstrated the feasibility of a new type of plug-in laser that could lay the groundwork for wide-ranging security applications. Their invention of the Raman injection laser combines the advantages of nonlinear optical devices and semiconductor injection lasers with a compact "plug and play" design. Because the pump laser is self-generated, the device is highly efficient, reducing the standard decline that happens when an external power source is used.

❹ Double bubble ... A new microfluidics-based device made by physicist David A. Weitz, his colleagues, and Unilever Corp. makes precisely controlled double emulsions in a single step. Double emulsions—droplets inside droplets—could be useful for encapsulating products such as drugs, cosmetics, or food additives.

❺ Exhale ... Scientists, including the Division's David Edwards, have found that some individuals exhale many more pathogen-laden droplets than others in the course of ordinary breathing. Oral administration of a safe saline spray every six hours, however, might slash exhalation of germs in this group by an average of 72 percent.



6 Cool runnings ... Chemists and engineers at the Division have made robust circuits from minuscule nanowires that align themselves on a chip of glass during low-temperature fabrication, creating rudimentary electronic devices that offer solid performance without high-temperature production or high-priced silicon. The researchers, led by chemist Charles M. Lieber and electrical engineer Donhee Ham, produced circuits at low temperature by running a nanowire-laced solution over a glass substrate, followed by regular photolithography to etch the pattern of a circuit.

7 Clearly Canadian ... Research Associate Loretta J. Mickley and colleagues found that the frequency of cold fronts bringing cool, clear air out of Canada during the summer months has dramatically declined. These cold fronts, Mickley said, are responsible for breaking up the hot, stagnant air that builds up regularly in summer, generating high levels of ground-level ozone pollution. If their model is correct, there will be an increase in difficult days for those affected by ozone pollution, such as people suffering with respiratory illnesses like asthma and those doing physical labor or exercising outdoors.

8 Book smarts ... Mema Roussopoulos, Assistant Professor of Computer Science, helped develop a peer-to-peer digital preservation system called LOCKSS (Lots of Copies Keep Stuff Safe). Librarians can use the tool to preserve long-term access to content published on the Web. The system is currently being deployed at about 100 libraries around the world.

9 Living art ... Gordon McKay Professor of Applied Biology Ralph Mitchell and members of his microbiology lab, including Research Assistant Kristen Bearce, are working to preserve great works of art such as Degas' wax sculptures. They have found that colonies of bacteria and fungi may be eating away at the pieces, and are investigating ways to slow the process.

For a complete look at research, related faculty research groups, and research facilities, visit

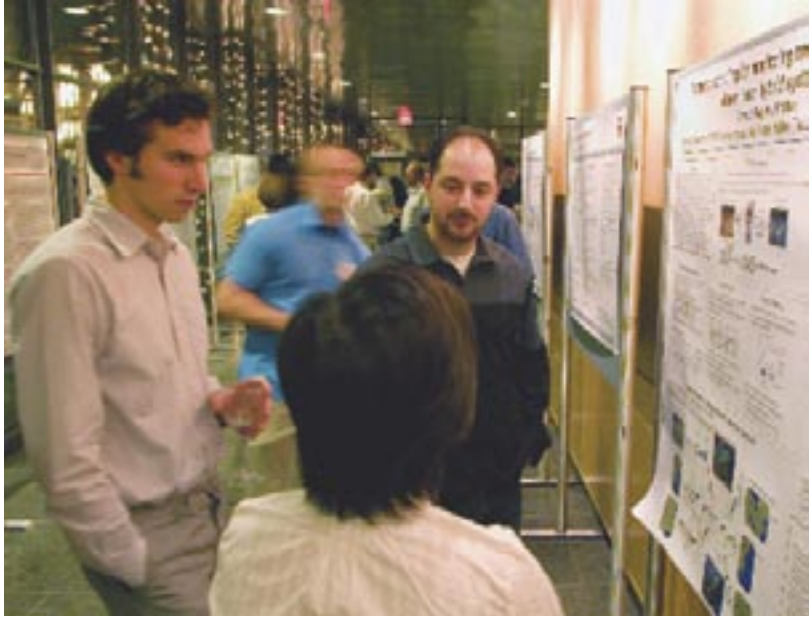
www.deas.harvard.edu/research

For a look at research happening throughout Harvard, see

www.researchmatters.harvard.edu







Economic and social impact

Harvard University's overall economic impact on the Boston area's economy is more than $3.4 billion (2002 figures, reported by Appleseed, Inc.). Our faculty play an increasingly large role in sustaining this growth engine by translating technologies, from new types of materials like black silicon to novel drug delivery methods like nanoparticle inhalation, and by supporting critical basic research ranging from quantum physics to theoretical computer science. In addition to fostering relationships with industry and government labs, Harvard serves as an "incubator" for new ideas and has dedicated programs that aid faculty and student innovation and entrepreneurship.

Fostering new ideas

Support network: The Technology and Entrepreneurship Center at Harvard (TECH), based at DEAS, was created in 2000 to support student and faculty innovation.

Courses: Engineering Sciences 143/243 "Biomedical Transport Phenomena as the Seed of a Biomedical Startup" attracts students from throughout the University.

Fellowships: The Program on Innovation in Science and Engineering, with lead sponsorship from Altran Technologies and Arthur D. Little, was established in 2004.

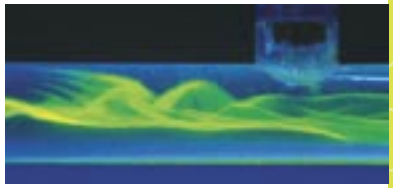
Industrial Outreach Program: A coordinated series of annual workshops, seminars, and events connect the world's leading companies with researchers and graduate students throughout the University.

Creating new companies

Raindance: The recently formed company is devoted to discovering, developing, and commercializing the precise manipulation of minute amounts of fluids in microfluidic devices. 2005; David Weitz (Applied Physics).

Liquid Machines: Computer scientists created this leading provider of Enterprise Rights Management (ERM) solutions to protect critical business content and audit usage while enabling collaboration. 2004; Michael D. Smith (Computer Science).

Pulmatrix: Grown from a novel DEAS course, this venture-funded startup develops products that diagnose, treat, or prevent or inhibit the spread of airborne infectious diseases. 2003; David Edwards and students (Bioengineering).



Emerging areas of expertise at Harvard

- Computational Biology and Neuroscience
- Computer Systems Research
- Electrical Engineering and Devices
- Environment and Energy
- Nanoscale Science and Engineering
- New Materials and Structures
- Physics and Engineering of Complex Systems
- Quantum Science and Technology
- Scientific Computing and Information Technology
- Scientific Concepts and New Tools
- Systems Biology, Biophysics, and Bioengineering

Research by the numbers

400,000 square feet

The area of laboratory, teaching, and office space at Harvard dedicated to engineering and applied sciences

600,000 square feet

The estimated combined area of two buildings under construction, the Laboratory for Integrated Science and Engineering (LISE) and the Northwest Building, with links to engineering and applied sciences

$522 million

Harvard University's research spending in 2002 (more than 75 percent of which was from federal grants). Harvard's affiliated hospitals add to that total, awarded $750 million in 2001 alone

#1

Rank of Harvard University in the 2004 Shanghai Jiao Tong University survey of the world's best research universities

YOUR LIFE ...

CAMBRIDGE, BOSTON, AND MORE

What's life like here? Quite simply, that's up to you. It's what you make of it and what you bring to it.

Harvard graduate students have ample opportunities to take advantage of what the University—a dynamic community within a hub of higher education—and the surrounding area—a friendly town with big-city attractions, from theater to sports—have to offer.

Of course, academics and research translate into hard work and long hours. People are dedicated to what they do. But finding a work-life balance and pursuing outside activities and passions are critical to being successful as a scientist and engineer.

So our faculty and students go outside the Yard, participating in the arts—from photography to dance—and taking off stress by racing motorcycles, hiking mountains in New Hampshire, or running the Boston Marathon.

Community and support

Harvard has an extremely diverse, cosmopolitan, cultural community. The University and the Graduate School of Arts and Sciences provide extensive support for students from all walks of life and from all parts of the world.

Related efforts, such as the Harvard Foundation for Intercultural and Racial Relations, sponsor events for the entire Harvard neighborhood and the W.E.B. Du Bois Graduate Society caters to supporting ethnic groups among the graduate student population. The Division also has its own Graduate Student Advisory Council.

Explore the hub ...

The best way to experience Boston and Cambridge is in person, and on foot. Virtual pedestrians can learn more here:

www.boston.com

www.cambridge-usa.org

www.harvardsquare.com

www.gsas.harvard.edu/student/index.html

The city serves as the gateway to all of New England, from leaf peeping to hiking to skiing. For more, see

www.newengland.com

FINDING BALANCE

On the ground ... Rynda Hudman, Ph.D. candidate in Engineering Sciences focusing on Atmospheric Chemistry, who crossed the country to come here (from San Jose State University, San Jose, California), loves what she does and it shows. "For the past two years I have been an outings fellow for Dudley House, the center at Harvard University for students in the Graduate School of Arts and Sciences. I lead ski trips to New York, Vermont, and Maine; hikes in the White Mountains; rafting and kayaking trips; Red Sox, Celtics, and Bruins outings; trips around Boston; apple picking in October; bike trips; and whatever other fun things we can think up. This has been an amazing highlight of my graduate career. I have truly been able to work hard, play hard. Can you tell I love what I do?!"

On the track ... Elaine Ou, a Computer Science Ph.D. student, designs high-speed circuits for use in fault-tolerant memory as part of the Harvard VLSI Group, led by Professor of Electrical Engineering and Computer Science Woody Yang. She's also dedicated to exploring a different type of circuit, where speed is calculated in miles per hour (often up to 180), not in megahertz, and when a burning smell is a sign of success, not system failure. "Some of the things I do when I'm 'neglecting' my schoolwork are ride my motorcycles (I am racing this season!) and fly airplanes. What's racing a bike like? Traveling at nearly 200 mph, it is hard to think about anything else, so I find it a great way to release stress. The feeling is really hard to describe; it's purely interactive and definitely gives you an adrenaline rush."

On film ... Eric Lauga, Applied Mathematics, Ph.D. '05, who studied fluid dynamics, also found time to study a different kind of motion: film. He wrote, directed, and produced a short, award-winning animated feature, "Baby Monitor," in the spring of 2004. Based on his own experiences of raising a young son, the film chronicles the worries of first-time fatherhood. *New England Film's* description of how he approaches filmmaking (and more broadly, life) hints at why he's so likely to become a rising star in academia: "Lauga's short is clever in its simplicity, using a minimum of images to convey the story. Humor and social commentary are present in many of the images, but the audience is left the space to make of them what they will."

BEYOND THE DEGREE

A Harvard degree opens up doors.

Our graduates have taken on research and teaching positions at some of the finest research institutions in the world, including: Ben Gurion University (Israel), Carnegie Mellon University, Columbia University, Cornell University, MIT, National University of Singapore, Princeton University, University of California–Berkeley, University of Chicago, University of Sydney (Australia), University of Virginia, and right here at Harvard.

Those pursuing careers in industry and government have worked for technology companies such as Pixar, Google, and IBM; defense contractors such as Northrop Grumman; policy and research organizations such as the National Institutes of Health; banking and investment firms like Citigroup; and environmental consulting groups like Boston-based CDM.

Others have become entrepreneurs. DEAS graduates started Tacit Knowledge Systems (www.tacit.com) and SupplyWorks, Inc. (www.supplyworks.com). In fact, some of the most well-known companies in the world were started by Harvard graduates, such as Electronic Arts, 3Com, Sun Microsystems, and Microsoft.

"My hope is to have a joint appointment at an American business school and a Japanese business school. In addition to teaching and research, I would like to consult for high-tech firms and governments on matters related to innovation and strategy. At some point in my career, it would be fun to spend some time as an entrepreneur, a venture capitalist, or a senior strategy executive."

— David James Brunner, Ph.D. candidate
Information, Technology and Management

"I plan on continuing to do research either in academia or industry. I am certain that my research interests will continue to evolve, so I hope to find another environment like the Division, where interdisciplinary work is encouraged!"

— Mary Elizabeth Hughes, Ph.D candidate
Applied Physics

DEAN'S NOTE

Current research

Head of research laboratory in nanoscience and technology with 10 researchers, students, and postdoctoral fellows

Past positions

- **6 years as Dean, College of Engineering, University of California–Santa Barbara**
- **4 years as Vice President of Research and Exploratory Technology, Sandia National Laboratories**
- **19 years at Bell Laboratories; last post as Director of Solid State Electronics Research Laboratory**

Education

- **Ph.D. in Physics from Cornell University**
- **B.Sc. (Hon) and M.Sc. in Physics from University of Delhi**

Hobbies

His recreational loves are running, squash, and his cottage on Cape Cod, where he relaxes by reading, catching up on research, and listening to music.

It's an extraordinary time to study engineering and the applied sciences at Harvard.

The University has a distinguished history of supporting foundational research and asking fundamental and audacious questions about our universe—from dark energy to quantum states—and about who we are—from how our brain develops to how we age.

Because Harvard faculty and students have always embraced flexibility, I can imagine no better place to pursue interdisciplinary and integrative work.

I invite you to become a part of our vibrant and growing community.

Yours,

Venky

Venkatesh "Venky" Narayanamurti

Dean of Engineering and Applied Sciences

Looking ahead

The Division of Engineering and Applied Sciences is evolving to meet the challenges facing the University and society. Over the next decade, our plans are to:

- boost the current size of the faculty
- increase the number of Harvard undergraduates concentrating in engineering and applied sciences, grow the number of graduate students, and provide them with the resources and space to promote a unique sense of community
- strengthen several strategic areas, including bioengineering and the interface of biology with applied physics, math, and computer science, while continuing to nurture foundational research and cross-disciplinary work with Harvard's Faculty of Arts and Sciences and other schools
- connect with and contribute to society through targeted efforts that help analyze real-world problems and offer solutions to them.

LEARN MORE

We encourage prospective students to visit the campus and meet with the Director of Graduate Admissions.

If you have a clear sense of what you would like to do and whom you would like to work with, let us know. We will put you in touch with relevant faculty and will be happy to discuss the details of your application.

All students admitted to the Ph.D. program receive full financial support. This includes tuition, fees, and a cost-of-living stipend ($2,150 per month before taxes in 2005–06). There is no financial support available to students in our master's programs.(Applicants to our master's programs should complete the Statement of Financial Resources for Graduate Study as part of their application.)

Note: All accepted Ph.D. students are invited to an informational Open House held each spring.

If you wish to apply ...

All prospective full-time graduate students of the Division of Engineering and Applied Sciences (DEAS) apply through the Harvard Graduate School of Arts and Science (GSAS). Part-time (S.M.) students apply directly to the DEAS Academic Office. Special Students and those wishing to apply for Visiting Scholar status apply directly to GSAS. Special Students can apply for general studies or for affiliation with a specific department.

For complete details on the application process, see

www.gsas.harvard.edu
www.deas.harvard.edu/admissions

The application deadlines for full-time students applying for the fall 2006 term are:

Preferred: December 15, 2005
Final: January 2, 2006

If you have questions, please contact us at

Harvard Engineering and Applied Sciences
Director of Graduate Admissions
Pierce Hall 130
29 Oxford Street
Cambridge, MA 02138

(617) 495-2747
(617) 496-9410
admissions@deas.harvard.edu

"There are very few places in the world where one can spend the morning thinking about some phenomenon seen in a microfluidic device and the afternoon thinking about how fish swim or why microorganisms are shaped in the way that they are."

— Marcus Roper, Ph.D. candidate
Applied Mechanics

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