UNIVERSITY OF ROCHESTER

SCHOOL OF ENGINEERING AND APPLIED SCIENCES

IDEAS TO INNOVATION



Our first endeavors are purely instinctive prompting of an imagination vivid and undisciplined. As we grow older reason asserts itself and we become more and more systematic and designing. But those early impulses, though not immediately productive, are of the greatest moment and may shape our very destinies.

—Nikola Tesla



As I begin my first year as member of the faculty and Dean of the School of Engineering and Applied Sciences (SEAS) at the University of Rochester, I see countless possibilities in our future. In an era when technology is truly pervasive in our society, engineers have become the "magicians" of that technology, created for the benefit of humanity, sometimes out of necessity and at others for pure entertainment. While a significant part of the world competes for fuel to supply energy that sustains and grows the developed nations, other parts of the world struggle with the simple need for clean water. Clearly, energy and water are two resources essential for our civilization, and solutions to alternative energy as well as clean water will be enabled through engineering.

However, engineering alone is not the solution. Public policy plays a critical role in the deployment of such technological solutions and holds the key, in many instances, to influencing public behavior, which is why it is so very important for engineering students to be artful in the communication of their work to the broader public. It is also why it is important for the broader public to have a basic understanding of engineering. In a recent commentary in the Chronicle of Higher Education, I noted the need for engineering schools to provide opportunities for nonengineering students to enroll in classes with engineering students. Our students take numerous classes in the liberal arts, sometimes as electives, and sometimes as requirements; however, historically, engineering schools have not provided such opportunities for arts and sciences majors. Engineering schools nationwide need to change this practice so that our future colleagues in Washington, D.C., and beyond better understand what our profession has to offer in terms of hope for our future.

The University of Rochester is leading in this type of education due to the overall structure and collaborative nature between the School of Engineering and Applied Sciences and the School of Arts and Sciences. After all, why should engineering students have all the fun? The study of engineering is not limited to, or bound by, science and mathematics; it is a field that embraces creativity, personal expression, and design—for the betterment of society. Students trained in the field of engineering are the future inventors of technology, entrepreneurs, doctors, lawyers, investment bankers, CEOs, and educators. In my humble opinion, an engineering degree is a springboard to countless possibilities in finding the career path that is right for you, our future students.

I spoke of countless possibilities in my opening and ended with countless possibilities in the closing of this message. For me, that pretty much summarizes the field of engineering. I couldn't be happier to be a part of this university, and I sincerely hope that you will consider the field of engineering in your future undergraduate education, whether here at the University of Rochester or beyond, for the sake of our nation and humanity.

Sincerely,

Rob Clark Professor and Dean <u>School of Engineering</u> and Applied Sciences

School of Engineering and Applied Sciences

Degree Programs

Biomedical Engineering: B.S., M.S., Ph.D. Chemical Engineering: B.S., M.S., Ph.D. Computer Science: B.S., M.S., Ph.D. Electrical and Computer Engineering: B.S., M.S., Ph.D. Materials Science: M.S., Ph.D. Mechanical Engineering: B.S., M.S., Ph.D. Optics: B.S., M.S., Ph.D.

Interdisciplinary Degree Programs

B.S. in Engineering and Applied Science: This interdepartmental program is tailored to a student's individual educational objectives by allowing the student to choose specific courses from all engineering departments.

B.A. in Engineering Science: This option is ideal for students who want a technical background for such fields as law, medicine, business, etc.

B.S. in Geomechanics: This interdisciplinary program is designed for students interested in the quantitative aspects of the earth sciences.

Minors

Biomedical Engineering

Chemical Engineering

Electrical and Computer Engineering

Environmental Engineering

Materials Science

Mechanical Engineering

Optics

Special Programs

3-2 Programs: This option enables a student to earn both a bachelor's and a master's degree in just five years.

Take Five Scholars: Students who apply and are accepted to this program are able to pursue broader academic interests in a fifth year of tuition-free study.

GEAR (Graduate Engineering at Rochester): Exceptionally promising undergraduates may be guaranteed admission to our 3-2 B.S./M.S. program in any department in the School of Engineering and Applied Sciences as well as computer science. GEAR students receive a minimum 50-percent tuition scholarship in the fifth year of study through a teaching or research assistantship.

Industry Practicum: Designed for engineering and computer science students, this program provides quality workplace experience through paid, full-time employment.

KEY (Kauffman Entrepreneurial Year) Program: Students are able to continue their studies tuition free to pursue entrepreneurial endeavors with the help of SEAS and Simon School faculty. Qualified students may propose to devote as much as an entire academic year to internships, special projects, business plan development, research into various factors for a successful entrepreneur, or analysis of how culture and public policy influence entrepreneurial activities.

ORT Braude College Exchange: This is an English-language exchange program in Karmiel, Israel, designed especially for Rochester science and engineering students.

Study Abroad: Other opportunities to take science and engineering classes abroad during the academic year are available to students of science and engineering.





Edmund A. Hajim

The man who presented the University of Rochester last year with the largest single gift commitment in its 158-year history recalls a rigorous undergraduate program that prepared him for a variety of challenges throughout his highly successful investment career.

"It taught me how to work," says Edmund A. Hajim, a 1958 graduate of the University's School of Engineering and Applied Sciences and chairman of its Board of Trustees. "There were very few things harder to do in my life than getting an engineering degree from the University of Rochester."

Hajim's memories are of an engineering program that has evolved from what was more of a trade school to a place of interactive, highly specialized, multidisciplinary learning.

"Modern engineering allows society to continue to improve itself," he notes.

And with its individualized attention and a new dean he describes as enthusiastic and indefatigable, the School of Engineering and Applied Sciences is positioned to improve on its global reputation for finding solutions to some of the world's toughest problems.

That reputation is built upon a longstanding history of supporting innovation—although that support is much more accessible than it used to be.

When Hajim wanted to do his senior project on the nucleation of glass, the University, which had no in-house capability, matched him with a scientist from Corning Glass Works more than 90 miles away. Hajim and his partners traveled back and forth during the project and used University lab space at odd hours when it was available.

"Students could innovate in those days, but it wasn't easy," says the 2007 recipient of the Hutchison Medal, the University's highest alumni award. "What's happened is that what was the exception back then has become a rule now."

One thing hasn't changed over the years.

"Students come here knowing that what they're going to get is a very serious, very solid education."

Kearns Scholars

The David T. Kearns Center for Leadership and Diversity in Science and Engineering offers advising, mentoring, and scholarship aid to underrepresented minority students who plan to major in computer science, mathematics, or an engineering field, including students of color, women, and students from low-income backgrounds, to help them support their educational, research, and career interests.

So that no student will be deterred by financial concerns, modest scholarships are awarded to undergraduates to recognize the academic achievement and potential for advanced education or careers in science and engineering of a diverse student body. Kearns Scholars also are provided travel funds and book allowances to assist them in taking full advantage of their undergraduate experiences. In order to receive continued Kearns Scholarship support, Kearns Scholars must remain in a science, mathematics, or engineering degree program at the University of Rochester, maintain satisfactory academic progress toward degree completion, and participate in program activities.

The Kearns Scholars program helps to promote the development of strong relationships between students and faculty, to create a community atmosphere amongst the scholarship recipients, and to encourage students to explore their scholarly and professional potential.



Since its inception in 1970, the Laboratory for Laser Energetics has positioned itself as a unique national resource for research and education in science and technology. As a center for the investigation of the interaction of intense radiation with matter, it houses OMEGA—the world's most powerful ultraviolet laser system—and is a major player in the Rochester area's long history of technological sophistication. The laboratory's primary focus is studying the feasibility of inertial confinement fusion as an inexhaustable energy source, though its five-fold mission includes developing laser and materials technologies; providing graduate and undergraduate education in electro-optics, high-power lasers, high-energy-density physics, plasma physics, and nuclear fusion technology; operating a National Laser Users' Facility, which allows qualified researchers to use the OMEGA facility for a variety of experiments; and to conduct research and development in advanced technology related to high-energy-density phenomena.

More than 800 students have received large-scale laser research training here, and—contributing to a reputation for innovation—more than 65 patents have been earned by our scientists.

Laboratory for Laser Energetics

B.S., M.S., Ph.D. | www.lle.rochester.edu



THE OMEGA EP LASER COMPRISES A SET OF FOUR ULTRA-HIGH-INTENSITY LASER BEAMS THAT WILL UNLEASH MORE THAN A PETAWATT—A MILLION BILLION WATTS—OF POWER ONTO A TARGET JUST A MILLIMETER ACROSS.

"You have a lot of independence running your own experiments."

Catherine Fromen

With both parents as engineers, Catherine Fromen figured that following in their footsteps "sounded like the most awful thing ever." She even declared a chemistry major and then switched to a biology/premed track before realizing that a love and aptitude for engineering must be in her genes.

As a technical assistant at the Laboratory for Laser Energetics, the senior works with liquid crystals for eventual use with flexible reflective displays. She clocks about 10 to 15 hours a week at the lab alongside chemistry and mechanical engineering majors who can offer several viewpoints on her project. It was here that she developed an interest in materials research, which she hopes will translate someday into a career working with alternative energy applications.

Her next step is applying to graduate programs.

"They love to see you've been involved with hands-on research like this, where you have a lot of independence running your own experiments," she says. "It definitely looks good for anything in the future."



ROCHESTER'S OMEGA LASER, ONE OF THE WORLD'S MOST POWERFUL, GETS EVEN STRONGER WORKING IN CONJUNCTION WITH LLE'S ORIGINAL 60-BEAM OMEGA LASER, THE OMEGA EP MAY BE ABLE TO DRAMATICALLY INCREASE THE ENERGY DERIVED FROM FUSION EX-PERIMENTS AND PROVIDE A POSSIBLE NEW AVENUE TOWARD CLEAN FUSION POWER.

WWW.ROCHESTER.EDU/NEWS/SHOW.PHP?ID=3160



Derek Crowe

Derek Crowe had wanted to be a Navy pilot for as long as he could remember, so as a freshman mechanical engineering major, he joined the University's Naval ROTC program. But after learning about the biomedical engineering program, he switched course—and majors—and since has seen firsthand how research can have commercial appeal.

After working with cell motility and fluorescent imaging, Crowe shifted to countercurrent exchange through his work with the Nanomembrane Research Group, an academic laboratory that works closely with SiMPore Inc., a University of Rochester spin-off company that specializes in ultra-small technology.

Looking back, the senior can see how the relationships he initiated with professors played into the entrepreneurial insights he has gained from working in such an innovative laboratory. In fact, he is spending a fifth, tuition-free year of college in a program that encourages students to pursue their own entrepreneurial endeavors; Crowe and three other students hope to establish a tutoring center in southwest Rochester.

"The decisions I've made over the years have led to where I am now," he says. "When I see the big picture, I think, 'Wow, I'm lucky to be where I am.' This has been an amazing fit for me."

Biomedical Engineering

B.S., M.S., Ph.D. | www.urmc.rochester.edu/bme

Bringing together the technical expertise of the School of Engineering and Applied Sciences with the clinical experience of the world-renowned University of Rochester Medical Center, the Department of Biomedical Engineering fosters continuous innovations in medicine and healthcare.

Also in close physical proximity to the venerable Institute of Optics and the new Center for Nanotechnology Applied to Medicine, the department encourages collaborations across all fields, offering students hands-on research opportunities in biomedical optics, biomechanics, neuroengineering, cell and tissue engineering, and medical imaging. That research happens both in and out of the laboratory. A partnership between the Clinical and Translational Science Institute and the Center for Entrepreneurship gives undergraduates the chance to watch their medical discoveries move from the laboratory bench to the patient's bedside.

During a yearlong Senior Design program, students develop prototypes of medical devices to solve problems presented by local companies, clinicians, or researchers, and in the process learn about the regulatory process, economic constraints, and ethical challenges of introducing new technology to a growing medical industry.

In 2007, the state-of-the-art Robert B. Goergen Hall for Biomedical Engineering and Optics opened to support close interactions among students, faculty, and staff.



NEW ULTRA-THIN MEMBRANE OFFERS LIMITLESS POSSIBILITIES A NEWLY DESIGNED POROUS MEMBRANE DEVELOPED AT THE UNIVER-SITY OF ROCHESTER MAY REVOLUTIONIZE THE WAY DOCTORS AND SCIENTISTS MANIPULATE OBJECTS AS SMALL AS A MOLECULE. WWW.ROCHESTER.EDU/NEWS/SHOW.PHP?ID=2743

Music and Acoustics

In elementary school, **Justin Mathew** started playing the classical Indian drums and then, after hearing Louis Armstrong on his dad's car radio, picked up the trumpet. He took keyboard lessons in middle school and taught himself how to play guitar as a high school sophomore.

With such an extensive musical background, the electrical and computer engineering major was in his element as an undergraduate research assistant at the Music Research Lab, a University of Rochester and Eastman School of Music research and teaching facility that combines music theory and performance with acoustics, signal processing, telecommunications, and computing. The lab's innovative work has resulted in a digital reproduction of a 20-second clarinet solo nearly 1,000 times smaller than a regular MP3 file—less than a single kilobyte. The musical reproduction, announced in April 2008 at the International **Conference on Acoustics Speech** and Signal Processing in Las Vegas, is the closest yet to a realistic sound.

During his job at the lab, Mathew tried to better the sound of that 20-second solo by running tests on a driver used to power the clarinet and designing a stand to hold eight microphones surrounding the instrument.

"Most of my friends I talk to at other schools just get jobs or internships—they don't really do a lot of research," says Mathew, who plans to open his own recording studio someday.

His favorite aspect of the Music Research Lab was its weekly meeting of professors and students to talk about the projects they were working on. The informal group routinely drew listeners from throughout the University, including biomedical, physics, and astronomy professors.

Nostalgic for those cross-departmental gatherings, Mathew has applied to the new master's program in engineering and music, in which he hopes to earn his Master of Science Degree in Electrical Engineering with a concentration in Musical Acoustics and Signal Processing.



"Everything that we learn is stuff that the industry uses now. They prepare you very well."



Entrepreneurship

The idea hit while studying for finals last year. **Samantha Ruiz,** a chemical engineering major interested both in preserving resources for future generations and owning a business someday, decided to start building the foundations of a sustainability consulting firm.

Together with fellow seniors **Howard Kanter** (on right) and **Jordan Parker**, also chemical engineering majors, Ruiz is participating in the Kauffman Entrepreneurial Year (KEY) Program, which offers selected students a fifth, tuition-free year of college to help transform an idea into reality. The group's mission is to provide sustainability assessments for local companies, focusing on energy usage, waste management, recycling, and alternative work practices.

Over the next year, Ruiz, president of the University chapter of the American Institute of Chemical Engineers; Kanter, a professional liaison of AIChE; and Parker, an active member of Sigma Nu, will create a solid business plan, develop an assessment, and go through trial runs of that assessment with the campus financial aid and admissions offices and at least one business unaffiliated with the University.

The School of Engineering and Applied Sciences celebrates the entrepreneurial spirit in numerous ways. The annual Forbes Entrepreneurial Award established in 1989, for example, encourages undergraduate engineering students to consider the commercial potential of their design projects or research. Recent winners invented health-monitoring devices and an identity confirmation system.

SEAS faculty are accessible and inspiring, says Ruiz, who often has lunch with her advisor and appreciates that her professors are familiar with her strengths and weaknesses.

"There's a very supportive environment whether you want to do something new or something that's been done before," she adds. "Since the school is so small, I can do a lot, and people will notice right away. It really is encouraging." The Institute of Optics has been educating the next generation of leaders in the field since its founding in 1929 as the first optics education program in the country, made possible by a grant from Eastman Kodak Company and Bausch & Lomb. It has handed out more than 2,400 degrees—approximately half of all optics degrees awarded nationwide.

Providing the finest educational and research experience in optical physics, applied optics, and optical engineering, the internationally acclaimed Institute of Optics uses rigorous academic instruction, laboratory exercises, informal events, and networking to prepare students for a broad industry. Half of the 16 full-time professors have joint appointments in diverse departments such as radiology, biomedical engineering, physics, dermatology, the Simon School of Business and the Laboratory for Laser Energetics.

Since 1962, the Institute of Optics has offered the Optics Summer School, a collection of short courses ranging from fundamentals to advanced topics in optical science and engineering, taught by national experts from the Institute and throughout the United States. In 2007, the Institute expanded to share new space and increase collaboration—with the Department of Biomedical Engineering in the state-of-the-art Robert B. Goergen Hall for Biomedical Engineering and Optics.



Rebecca Berman

Rebecca Berman was a teaching assistant for the first time her sophomore year, for a freshmen-level mechanical engineering class. Her second stint, as a junior, was for a sophomore-required optics class. Now the senior is fresh from assisting an introductory course in optics—which she chose as her major because "it's absolutely fascinating how light works."

Starting to gain such experience early on in her college career helped Berman excel while researching nanofibers during a study-abroad program at the University of Sydney in Australia last year. While working with distinguished faculty there, she was able to transmit light through microstructured optical fibers that had been shrunk more than 100 times in size, to a diameter of one micron.

Berman, who also takes private violin lessons at the Eastman School of Music and is a member of the University of Rochester Chamber Orchestra, most appreciates her department's student-faculty ratio.

"It's such a tight-knit community here," she says. "You get to know your peers and your professors really well, and that translates into the work field because everyone in the optics community knows each other, too."

Berman has had a few job offers but is hoping to pursue a master's degree first.

As she puts it, "It's nice to have options."

The Institute of Optics

B.S., M.S., Ph.D. | www.optics.rochester.edu

"It's such a tight-knit community here. You get to know your peers and your professors really well . . ."

RESEARCHERS CREATE GOLD ALUMINUM, BLACK PLATINUM, AND BLUE SILVER BY USING INTENSE LASER LIGHT, UNIVERSITY OF ROCH-ESTER RESEARCHERS HAVE DEVELOPED TECHNIQUES TO ALTER THE COLORS OF A VARIETY OF METALS. SINCE THE PROCESS CHANGES THE INTRINSIC SURFACE PROPERTIES OF THE METAL ITSELF AND IS NOT JUST A COATING, THE COLOR WON'T FADE OR PEEL.

WWW.ROCHESTER.EDU/NEWS/SHOW.PHP?ID=3106

Chemical engineers are in high demand, command some of the highest salaries of any major, and work to solve some of our global society's most challenging problems.

Our programs in the specialized areas of clean energy, biotechnology, and nanotechnology put students, nearly half of whom are women, at the forefront of today's leading research. Laboratory courses give life to classroom lectures and highlight connections among chemical engineering and biology, advanced materials, and the environment. Eisenberg internships give students the chance to work alongside a faculty member, share in the authorship of published technical articles, and even present papers at national conferences. And, advisors working with the student chapter of the American Institute of Chemical Engineers help students learn about career opportunities after graduation.

About one-third of our students go on to graduate school in chemical engineering or a related discipline. Others use their diploma as a foundation for branching out into other fields such as law, sales, manufacturing, and the microelectronics industry. In either case, graduates are being aggressively recruited by companies large and small, both of which offer exciting opportunities to apply the basic principles of chemistry to real-life solutions.

Chemical Engineering

B.S., M.S., Ph.D. | www.che.rochester.edu

Ben Yezer

Ben Yezer was 16 when, after a weeklong backpacking trip on the Appalachian Trail, he decided to research and design alternative technologies that would lessen threats to the environment. These days, while working toward that goal, the sophomore is an academic standout who juggles a hearty workload with numerous athletic and social responsibilities. Inside the classroom, his enthusiasm earned him letters from the chemistry and physics departments offering congratulations on his midterm performance. Outside, the defensive lineman for the University's football team tutors freshman teammates; is involved with the St. Sebastian Community Service Society, a campus organization for student athletes; and is a member of the student chapter of the American Institute of Chemical Engineers. The size of the chemical engineering department was a huge draw for Yezer, who wanted to take advantage of the close relationships he would be building with some of the industry's top researchers. He plans to participate in a summer internship that pairs undergraduates with professors on a side-by-side project.

"I won't just be working with graduate students," he says. "That was something I really wanted, and now I'm actually going to get to do it."



GENOME SEQUENCING REVEALS KEY TO VIABLE ETHANOL PRODUCTION RESEARCHERS AT THE UNIVERSITY OF ROCHESTER HAVE FOR THE FIRST TIME IDENTIFIED HOW GENES RESPONSIBLE FOR BIOMASS BREAKDOWN ARE TURNED ON IN A MICROORGANISM THAT PRO-DUCES ETHANOL FROM WASTE PRODUCTS SUCH AS GRASS CLIPPINGS AND WOOD CHIPS.

WWW.ROCHESTER.EDU/NEWS/SHOW.PHP?ID=2803

School of Engineering and Applied Sciences

- Approximately 650 engineering undergraduates: 28 percent women; 7 percent underrepresented minorities
- About 125 graduating seniors: 46 percent conduct independent research projects; 35 percent go on to full-time graduate programs; 29 percent earn humanities/social science minors; 20 percent participate in the Take Five Scholars Program; 5 percent earn two bachelor's degrees
- About 70 faculty: all teach undergraduates, and all participate in research; all engineering courses are taught by faculty
- 96 percent of seniors have had at least one career-related experience
- About 15 percent of University of Rochester undergraduates earn a Management Studies Certificate, requiring completion of core and specialized "track" courses taught by faculty of Arts, Sciences, and Engineering and of the distinguished William E. Simon Graduate School of Business Administration
- About 20 percent of University of Rochester students graduate with double majors
- 25 percent of engineering students take music lessons or courses



Students prep for the American Society of Mechanical Engineers' annual pumpkin launch competition.

Internships (Fall 2007) Abbott Laboratories Accenture **Boeing Company** Bronx Zoo Brooklyn Children's Museum **Buffalo VA Hospital** Cape Cod National Seashore Cardio-Vascular Research Institute Carnegie Mellon University Department of Chemical Engineering **Cerner Corporation Changing Young Lives Foundation Citigroup Smith Barney** College of William & Mary Physics REU Colonial Williamsburg Foundation Community Events Inc. **Cornell University** Credit Suisse Dow Chemical Company Eastman Kodak Company EPA Fermi National Accelerator Laboratory Geriatric Fracture Center at Highland Hospital Goldman Sachs Haber Lab in Pharmacology and Physiology Harlem RBI Harvard University Healthcare Association of New York State IBM Indiana University School of Medicine Institute of Optics Johnson & Johnson KeyBank Kings College London KI A-Tencor Lindamood-Bell Learning Processes Lockheed Martin Manning & Napier Advisors, Inc Millennium Pharmaceuticals Inc. Mindshare Interaction MIT Plasma Science and Fusion Center NASA Glenn Research Center Nassau County Department of Public Works National Space Biomedical Research Institute New York State Division of Human Rights New York State Office of Parks, Recreation and Historic Preservation Novartis Pharmaceuticals

Pfaudler, Inc.

Roberts Communications

Rochester Museum and Science Center Strategy Analytics Strong Children's Research Center Strong Medical Center Strong National Museum of Play United Technologies Fire & Security Unity Dental University of Chicago Sleep Lab University of Florida University of Rochester University of Virginia Upward Bound **U.S.** Congress U.S. Navy U.S. State Department Van Note-Harvey Associates Vector Marketing Washington University in St. Louis WXXI Public Broadcasting Wyeth Pharmaceuticals Yale University Yellowstone National Park

Externships (Summer 2008)

ABTECH Scientific, Inc. ACLU Foundation of Massachusetts American Institute for Stuttering Treatment and Professional Training **ARC** Athletics Boston Biomedical Associates GateHouse Media New England International Business Council of Rochester, N.Y. Italian Consulate Office ITA Software J. Chriss & Co. La Rabida Children's Hospital LA STAGE magazine Lighthouse Biosciences, Inc. Lincoln Saltdogs M&T Bank Memorial Sloan-Kettering Cancer Center Mercer Mount Sinai Medical Center Mt. Hope Family Center Nahil Communications Group, Inc. New York State Department of Environmental Conservation Nordoff-Robbins Center for Music Therapy Psychological HealthCare P.L.L.C. Rady Children's Hospital **RIT Robotics Laboratory**

Fast Facts

School of the Arts

Strong Memorial Hospital

University of Central Florida Department of Molecular Biology and Microbiology

University of Rochester Medical Center

Weill Cornell Medical College



Engineers have the chance to go beyond the lab by joining one of a dozen engineering societies.

Engineering Societies

American Indian Science and Engineering Society (AISES) American Institute of Chemical Engineers (AICHE) American Society of Mechanical Engineers (ASME) Biomedical Engineering Society (BMES) Engineers for a Sustainable World (ESW) Institute for Electrical and Electronics Engineers (IEEE) Materials Research Society National Society of Black Engineers (NSBE) Optical Society of America (OSA) Society of Hispanic Professional Engineers (SHPE) Society of Women Engineers (SWE) Tau Beta Pi National Engineering Society

Employment Statistics

From our most recent Senior Survey, May 2008:

- Just over 95 percent of respondents indicated having at least one career-related experience (internship, externship/shadowing experience, REU, etc.)
- 40 percent were going to graduate school; 33 percent had firm employment offers a month before graduation
- 46 percent of students with jobs indicated gaining them through on-campus recruiting, Career Link, Career Center speaker or other event, alumni networking, or faculty networking event

From 2008 Senior Survey

Graduate school (in no particular order): Northwestern University, Carnegie Mellon, Emory, Drexel, Simon Graduate School of Business, University of Rochester, University of Arizona, RIT, University of Massachusetts-Lowell, California Institute of Technologies, University of California–Irvine, Stanford University, University of Maryland, Penn State

Employment (in no particular order): BAE, Monster.com, Xerox, ITT Space Systems, Microsoft, Picatinny Arsenal, Massachusetts General Hospital, IBM, Morgan Stanley, GSI Group, Lockheed-Martin Corp, Vlingo, Vanteon, Paychex, RPO, Zygo Corp., Gyrus ACMI, Facebook, Covidien, Naval Undersea Warfare Center, Northrop Grumman Space Technology, Microsoft, JFK&M Consulting, Premier Rides, Pfaudler, Inc., Qualcomm, Insight Technologies, University of Rochester



More than 50 middle school teams from all over New York State participated in the School of Engineering and Applied Sciences' FIRST LEGO League championship.

SEAS Alumni Companies

ADE Corporation

Advanced Computer Innovations, Inc. Advanced Digital Imaging LLC Alford Design Group. Amarel Precision Instruments, Inc. ASYST Scientific Software Auragen Communications Inc. Barry Babb and Associates Bennett's Buick-Chevrolet-Olds Colorado Medtech Inc. ConsultingAcademy.com CPAC, Inc. Davelocity Fairchild Semiconductor Corporation Frank P. Langley, Inc. Gary Noyes Lens Design Gradient Lens Corporation Hillcrest Press, Inc. Inikori Dance Kessler Optics & Photonic Solutions, Ltd. Kohler Machine Projects LaserMax, Inc. Lucid Technologies Lytle Associates Inc. M/E Engineering, P.C. Niagara Tank Lines, Inc. Optel **Optical Research Associates Outdoor Equipment Supplier** Potential Point Recordsforce Registerfree R. J. Potte Company Ruda & Assocs., Inc. Savvy Optics Corp. Schrack Oil Inc. Solid Works Solo Cup Company Inc. STI Technologies Inc. Supervisuals.com Tailored Lighting Votiv Systems

"It's a fit you won't find anywhere else, which makes it an extraordinary opportunity."

Archaeology, Engineering, and Architecture

B.S., M.S., Ph.D. | www.rochester.edu/college/aea/index.html

Undergraduate research is the hallmark of this distinctive program, which uses study-on-location courses and internships both in Rochester and abroad to offer critical insight into the material culture and technologies of preindustrial societies. Its interdisciplinary and interdepartmental approach blends archaeology, architecture, classics, art history, history of technology, and engineering to address the interpretation, conservation, and restoration of the World Heritage sites.

A course in Roman structures, jointly developed by the University of Rochester's Department of Me-

chanical Engineering and Department of Religion and Classics, brings students on location to the city of Rome and surrounding locations for an unforgettable education in ancient civil engineering from the late Republic to the late Empire. Those who want an intensive experience in Italian language and culture while touring some of the most spectacular archeological and geological sites of Roman Italy can study abroad for a semester in Arezzo.

The program's wellrounded scope prepares students for a multitude of career and graduate study options.



Philip Brune

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Philip Brune is bridging the gap between engineers who lack historical context and historians who lack engineering concepts. The mechanical engineering doctoral candidate, who analyzed ancient Roman concrete and imperial Roman vaulted architecture as a Fulbright Scholar to Italy during the 2007–08 academic year, comes by both pursuits naturally.

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His mother was an artist, and his father was a software engineer.

"They both kind of molded me in their own image, but there was only so much of me to mold, so I had this multifaceted group of interests," he explains.

During his time overseas, Brune refined and calibrated an engineering computational tool, known as a specialized Finite Element Analysis model, toward the analysis of ancient

> Roman concrete. He says that undergraduates in the Archaeology, Engineering and Architecture program will learn techniques that he has used to better investigate what went into building ancient structures and what needs to be done to preserve them. The program offers tremendous potential for understanding these works of art like

never before, adds Brune. "It's a fit you won't find anywhere else, which makes it an extraordinary opportunity."



Over the past several years, electrical and computer engineering majors have been witnessing a time of substantial growth in the department, including the increase in the number of new faculty with diverse areas of interest. Some of our most recent hires work in the emerging research areas of communications, RF and analog IC design, genomic signal processing, and spintronics, all of which offer plenty of opportunities for exciting breakthroughs.

The department provides leadership for University-level initiatives ranging from nanotechnology and energy research to music and engineering research, and we continue to play a prominent role in ongoing programs such as the Center for Electronic Imaging Systems, the Center for Future Health, and the Rochester Center for Biomedical Ultrasound.

With robust research programs in a wide variety of disciplines, undergraduates are positioned to thrive in a department that has been rapidly expanding its graduate programs as well. IMAGE FROM THE INSTITUTE OF OPTICS' ZEISS FIELD EMISSION SCANNING ELECTRON MICORSCOPE (FE-SEM).

Electrical and Computer Engineering

B.S., M.S., Ph.D. | www.ece.rochester.edu/flash.html

Gloria See

Undecided as a freshman about whether she should be majoring in electrical and computer engineering, Gloria See asked for a meeting with Professor Philippe M. Fauchet. Fauchet sent her off with a list of graduate students to speak with and a stack of reading material. When she returned after summer break to say that she had questions about the material but that she was a fast learner, she recalls, "He said, 'Don't worry about it. I just wanted to see if you'd do the reading.' He let me jump right in."

See, a senior, began next-generation nanotechnology research her sophomore year, electrochemically etching twodimensional silicon wafers into threedimensional structures. She has trained graduate students, presented a poster on her research at a conference in Spain, spent a semester abroad studying engineering in Cairo, and did Ph.D.-level work while contracting with an out-ofstate betavoltaics company.

Last fall, she accepted a postgraduation job with global defense and aerospace company BAE Systems, which will pay for See to earn her master's degree.

"University of Rochester students are very competitive to go into the workplace," she says, "and definitely competitive to go to graduate school."





3-D CIRCUITS SIGNAL NEXT BIG ADVANCE IN COMPUTER PROCESSORS THE FIRST THREE-DIMENSIONAL SYNCHRONIZATION CIRCUITRY IS NOW RUNNING AT THE UNIVERSITY OF ROCHESTER. IT WAS DESIGNED AND BUILT SPECIFICALLY TO OPTIMIZE ALL KEY PROCESSING FUNC-TIONS VERTICALLY, THROUGH MULTIPLE LAYERS OF PROCESSORS, THE SAME WAY ORDINARY CHIPS OPTIMIZE FUNCTIONS HORIZONTALLY. WWW.ROCHESTER.EDU/NEWS/SHOW.PHP?ID=3247



Mechanical Engineering

B.S., M.S., Ph.D. | www.me.rochester.edu

Chris Roll

Toward the end of his first semester, for a final class project, freshman mechanical engineering major Chris Roll decided to compare the columns in front of the Rush Rhees Library with buildings designed by the venerable Roman architect and engineer Vitruvius. It gave him the chance to better appreciate the structural integrity of the Parthenon and other temples he toured while on an educational trip to Greece two years ago.

> With guidance from one of his professors, Roll found proportions Vitruvius used in his modular design of a Doric-style temple and measured them against scaled, hand-drawn plans from the Department of Rare Books, Special Collections and Preservation in Rush Rhees Library. Though there were notable deviations, the Rush Rhees architect clearly drew from the ancient draftsman's writings.

Roll finds his daily stroll past the library columns more meaningful now and is proud of the work he accomplished shortly after arriving on campus.

"The professor was real open to discussing the project with me and helping me find the resources for it," he says, "which made it real easy to be able to do something like this right away." Based on a firm foundation of basic science, applied mathematics, and engineering sciences, the Department of Mechanical Engineering offers a rigorous program designed to prepare well-trained, creative, responsible engineers capable of assuming leadership roles in their profession.

Students apply the latest software to problems in the mechanics of solids and fluids, materials science, mechanical systems, and advanced power applications. Broad hands-on laboratory projects offer significant experience in experimental work and complement a curriculum that includes a strong focus on the analysis, design, and development of mechanical and thermal systems. A sister program leading to an undergraduate degree in geomechanics is offered jointly with the Department of Earth and Environmental Sciences.

In addition to strengthening leadership and communication skills necessary for excelling in the field, the program, which includes 16 faculty members and approximately 100 undergraduate students, offers a deep understanding of the broad social and economic impacts of engineering.

PLATINUM NANOWIRES MAY LEAD TO BETTER FUEL CELLS THE CREATION OF LONG PLATINUM NANOWIRES AT THE UNIVERSITY OF ROCH-ESTER SHOULD PROVIDE SIGNIFICANT INCREASES IN BOTH THE LONGEVITY AND EFFICIENCY OF FUEL CELLS. NANOWIRE-ENHANCED FUEL CELLS COULD HELP REDUCE THE USE OF PETROLEUM FUELS FOR TRANSPORTATION.

WWW.ROCHESTER.EDU/NEWS/SHOW.PHP?ID=3106



Sustainability

Three students are creating a reactor and test facility for converting waste vegetable oil from the University's dining facilities into biodiesel for one of its shuttle buses.

The project, which gained momentum after a second-place win in the campus's Forbes Entrepreneurial Competition, originated and is being led by junior political science major **Eric Weissmann** and senior chemical engineering majors **David Borrelli** and **Dan Fink** (from right). Known as the UR Biodiesel team, the trio found an advocate in former School of Engineering and Applied Sciences dean Kevin Parker, who provided some start-up funding. That led to a partnership with—and some funding from—the University Facilities and Services department. Recent months have been spent ordering supplies and retrofitting an old storage garage for the reactor, which will convert the oil into biodiesel through a simple chemical process. The shuttle will run on a blend of biodiesel and regular diesel.

The project has been incorporated into an Energy Alternatives Lab course, in which undergraduates have been helping with the design work and will take turns running the reactor in small groups for several weeks at a time.

"The University of Rochester is very open to student suggestions, opinions, and projects," says Borrelli, who is minoring in math, materials science, and chemistry and is vice president of the University chapter of Engineers for a Sustainable World. "We're bringing this to our campus because it's a sustainable practice, and we want to spread the knowledge."

Study Abroad Programs through the University of Rochester

Whether you want to spend a summer or a semester studying abroad, numerous overseas opportunities are available at the School of Engineering and Applied Sciences. Studying abroad is an integral part of the undergraduate curriculum as about a third of each graduating class completes coursework out of the country. And with more than 100 countries to choose from, most students can find an international experience that is right for them. Whatever your motives, you'll find that your overseas studies complement your academic concentrations and allow you to develop new interests leading to future research or career endeavors.

Buenos Aires Argentina Adelaide Australia Canberra Australia Melbourne Australia Sydney Australia Austria Vienna Brussels Belgium Beijing China Atenas Costa Rica Prague **Czech Republic** Copenhagen Denmark Cairo Egypt Nantes France Ghana Ghana Cork Ireland Dublin Ireland Galway Ireland Jerusalem Israel Karmiel Israel Arezzo Italy Florence Italy Rome Italy Nagoya-Chubu Japan Nagoya-Nanzan U. Japan Tokyo Japan Auckland New Zealand Christchurch New Zealand **U.** Canterbury New Zealand Moscow Russia St. Petersburg Russia Barcelona Spain Spain Salamanca Seville Spain Uppsala Sweden Istanbul Turkey Bath United Kingdom Lancaster United Kingdom London United Kingdom Oxford United Kingdom Sussex United Kingdom







University of Rochester

Ever Better

The University of Rochester is one of the country's top-tier research universities. Our 158 buildings house more than 200 academic majors, more than 2,000 instructional faculty, and some 9,300 students—approximately half of whom are women. Named a "New Ivy" by Newsweek and Kaplan, Rochester attracts an increasing number of applicants each year from every state in the country and countries all over the world. They are drawn by an innovative curriculum, renowned professors, and world-class research facilities. Once here, they become part of a university community searching for new discoveries and more meaningful involvement with our city and the world—a university

that strives to be, in the words of our motto, *Meliora*, "ever better."

River Campus

The University's main grounds are located on the River Campus, 154 acres of wide lawns along a bend of the Genesee River about two miles south of downtown Rochester, New York. The River Campus,



RUSH RHEES LIBRARY

dedicated in 1930, is actually the third home of the University. The private men's college officially opened in 1850 in a former hotel in downtown Rochester and moved a decade later to the Prince Street Campus, just east of the city's center, where women were admitted in 1900. Today's River Campus, with its handsome Greek Revival–style academic quads, research libraries, and state-of-art athletic facilities, is home to more than 80 percent of the University's undergraduates.

Rochester, New York

The University is located in Rochester, a midsized city on the shore of Lake Ontario in western New York. Rochester is situated about 330 miles northwest of New York City, 70 miles east of Buffalo, and 170 miles southeast of Toronto. As the international headquarters of Eastman Kodak Company and Bausch & Lomb, as well as the birthplace of Xerox Corporation, the city of Rochester has been a leader in the imaging industry for more than a century, offering the community support and collaboration critical to the growth of a major research university.



STRASENBURGH PLANETARIUM

Intimate Setting, Unlimited Possibilities

Education at Rochester is guided by the philosophy that students learn best when they love what they study. That is why the Rochester Curriculum—unique in higher education—has no required subjects. Students pursue a major in one of the three main divisions of liberal arts: humanities, social sciences, or natural sciences and complete a cluster of three or more related courses in the two areas outside their major. The result is an education that reflects students' priorities. Learning at Rochester is also on a very personal scale. Rochester remains one of the smallest and most collegiate among top research universities, with just over 4,000 undergraduates. This more intimate size allows for smaller classes, a low 9:1 student to teacher ratio, and increased interactions with faculty. From the first year of study, students have the opportunity to engage in collaborative research with professors and peers, and a vast majority takes the plunge, joining labs, conducting their own research projects, or assisting faculty.



NO REQUIRED SUBJECTS

Deepening the Liberal Arts Experience

By the time of graduation, about a third of undergraduates have studied abroad for a semester, a summer, or an academic year. More than 70 programs in 29 countries offer classroom instruction and research opportunities in all fields, complemented by homestays, academic internships, field study, or community service. Senior scholars devote their final year to a project drawn on their academic interests. It could be a scientific investigation, scholarly research, or a work of art.

When the University pioneered the Take Five Scholars Program two decades ago, it was heralded by the *New York Times* as "one of the more innovative liberal arts programs in the country." Since then, the program has allowed more than 900 students to study, tuition free, for an additional semester or year in areas outside their formal majors.

Athletics

From fitness classes to highly competitive teams, the University has great ways to stay physically active. The Robert B. Goergen Athletic Center, renovated in 2000, features an 11,000-square-foot fit-



YELLOWJACKETS FEVER

ness center, locker rooms, a multi-activity center, an indoor 200-meter synthetic running track, a 25-yard by 25-meter pool with a separate diving well, four basketball/volleyball courts, four indoor tennis courts, five international squash courts, and two racquetball courts.

Outdoor facilities include a lighted FieldTurf playing surface surrounded by a 400meter, all-weather Eurotan running track; six lighted tennis courts; and several grass fields for baseball, softball, club sports, and intramural activities. Nearby Genesee Valley Park features two 18-hole golf courses, more recreational playing fields, an indoor ice-skating rink, a 50-meter outdoor pool, and paved jogging trails along the Genesee River and the Erie Canal.

Eastman School of Music

One of the nation's premiere music schools, or in the words of *Newsweek*, "the hottest music school in America," Eastman School of Music enrolls each year about 270 students selected from more than 1,800 applicants. They come from almost every state, and approximately 25 percent are from other countries. They are guided by more than 95 full-time faculty members. Seven Pulitzer Prize winners have taught at Eastman, as have several Grammy Award winners.



EASTMAN THEATRE

At the Eastman School, students hear and perform the full spectrum of music: from opera to jazz, from medieval music to brand-new pieces composed by their fellow students. Beyond technical mastery, students are challenged to make their art matter through programs like the Institute of Music Leadership. The Eastman Campus is located in downtown Rochester, in the heart of the city's cultural district, about two miles from the River Campus.

Graduate and Professional Education

On the graduate level, Rochester's programs and professional schools—in music, business, education, engineering, medicine, and dentistry—are highly regarded. Rochester offers more than 40 doctoral and about 70 master's programs, attracting students from 80 countries outside the United States.



MEDICAL CENTER

Medicine and Nursing

The School of Medicine and Dentistry ranks among the top 10 percent of medical schools for primary care and is among the top 25 percent of medical schools in the nation, according to *U.S. News & World Report*. The School of Nursing's graduate degree programs consistently rank among the finest in the nation. Our pediatric nurse practitioner program was named the 10th best in the nation in the most recent ranking by *U.S. News & World Report*.

Business

Internationally recognized for academic teaching and pioneering research, the William E. Simon Graduate School of Business Administration was ranked fourth in the *Wall Street Journal*'s 2007 regional list of top business schools. Simon is noted for its economics-based approach to business education, emphasizing the interactive nature of business decisions. The faculty teaches students to frame and analyze complex business problems and effectively communicate solutions.

Education

The Margaret Warner Graduate School of Education and Human Development offers programs in teaching and curriculum, counseling, human development, and educational leadership. The school's commitment to social justice and education reform is evident through its research, community outreach, and interdisciplinary approach.

A Great Place to Call Home

Along with Rochester's surprisingly rich cultural scene, the metropolitan area boasts outstanding historic neighborhoods, excellent schools, first-rate health care, and an affordable cost of livingqualities that led the Places Rated Almanac in 2007 to name Rochester one of the top 10 most livable cities in America. The city's historic park system, designed by Frederick Law Olmsted, creator of New York City's Central Park, includes Genesee Valley Park and its 800 acres of open landscapes, riverfront paths, and century-old trees adjacent to the River Campus. An hour's drive away are the vineyards, ski resorts, and glaciercarved gorges of the Finger Lakes.



CHARITY BUFFALO WING CONTEST



YES, IT SNOWS HERE

The University and the Community

For 158 years, the University has been proud to call the City of Rochester home and proud to serve the community. In part because of that connection, Rochester enjoys an arts scene typically only available in much larger metropolitan areas. Operas, concerts, art exhibitions, literary events, recitals—these are just a few of the University's contributions to the city's cultural roster. The University's Memorial Art Gallery and the Eastman Theatre are community treasures, open to all.

The Memorial Art Gallery (MAG)

The Memorial Art Gallery is one of the country's few university-affiliated art museums open to the whole community. The gallery's permanent collection spans 5,000 years from the ancient world to the 21st century and is recognized as one of the finest regional art museums. MAG hosts exhibitions of international art icons like Georgia O'Keeffe and Edgar Degas as well as regional shows. About 3,500 adults and children have taken classes at the art gallery's Creative Workshop, one of the largest museum art schools in the country.

The Eastman Theatre

Opened in 1922, the Eastman Theatre reflects the opulence of its era and the taste of its patron, Eastman Kodak Company founder George Eastman. Today, the magnificent 3,094-seat theater remains Rochester's preeminent performance space, serving as the primary concert hall for the Eastman School's orchestras, wind ensembles, jazz ensembles, and chorale. The Eastman Opera Theatre presents fully staged operatic productions in the theater each spring. It also is the principal hall for the Rochester Philharmonic Orchestra, one of America's premier orchestras, and is used periodically throughout the year by a variety of community organizations for concerts, lectures, and other special events.



ITALIAN BAROQUE ORGAN AT MAG

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> (585) 275-3221 or (888) 822-2256 (toll free)

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