The Department of Bioengineering at Rice University is consistently ranked among the nation’s top 10 bioengineering/biomedical engineering graduate programs. Our graduate program offers innovative training and curriculum to prepare the next generation of leaders in basic, applied and translational research at the interface of biology and engineering.

The cornerstone of our success as a leader in bioengineering is capitalizing on Rice’s proximity to the Texas Medical Center (TMC), the largest medical center in the world, which has promoted the development of long-term collaborative efforts with the member institutions of the TMC, including two NIH Grand Opportunity (GO) grants, two NIH Bioengineering Research Partnership grants, and several projects through the BioScience Research Collaborative.

As a member institution of the TMC and through Rice University’s research centers and institutes, we have built numerous interdisciplinary partnerships in education, research and outreach. Working and learning in this environment fosters cooperation with leaders in every specialty of basic science and medicine while providing our graduate students with hands-on training in cutting-edge bioengineering research.

Total research expenditures for fiscal year 2010 were $14 million. More than 130 graduate students are enrolled in the program, and the majority of them are pursuing a Ph.D. in bioengineering. The department has 22 faculty members and 15 multidisciplinary joint appointments within the science and engineering departments at Rice and approximately 40 adjunct faculty members, predominantly from the TMC.

**THE PROGRAM**

The bioengineering graduate program draws on interdisciplinary skills that reach from the biological sciences to modern materials science, systems modeling, computer science and bioprocess design. To prepare students for leadership roles in independent or collaborative research and development in industry or academia, our comprehensive curriculum provides a fundamental understanding of basic life and medical sciences, as well as advanced analytical and engineering expertise. Innovative training programs also give our students additional hands-on experience in translational research that transfers bioengineering advances from bench to bedside.

The department offers programs of graduate study leading to a professional master’s in bioengineering (M.B.E.) degree and the doctor of philosophy (Ph.D.) degree. A joint M.D./Ph.D. is offered between the Rice Department of Bioengineering and Baylor College of Medicine. Few students interested solely in a master’s of science (M.S.) degree are admitted and only under special circumstances.

The M.B.E. is a widely recognized, nonthesis degree. The typical course of study for an M.B.E. is one year and part-time study options are available for individuals who want to continue working.

The typical course of study for a Ph.D. degree in bioengineering is four to five years. In the fall semester of the first year, students select their thesis advisor. A thesis proposal must be completed by the end of summer of the second year. Throughout their course of study, students complete three teaching assignments, generally requiring six to ten hours/week for a semester. For those students planning an academic career, more-involved teaching opportunities are
available. An internship in industry, academia, clinical and national or international laboratories provides an opportunity for real-world exposure and/or broadens a student’s research tools and teaching techniques.

**FACULTY/RESEARCH**

**Michael W. Deem.** John W. Cox Professor in Biochemical and Genetic Engineering; Professor, Dept. of Physics and Astronomy. B.S. (1991) California Institute of Technology; Ph.D. (1994) University of California at Berkeley. Research interests: Development and application of theoretical methods of statistical mechanics to study the collective properties of biological systems. Both computational and analytical methods are of interest. Current areas of interest include immune response to viruses and vaccines, physical theories of pathogen evolution and Newton’s laws for biology.

**Michael Diehl.** Assistant Professor of Bioengineering. B.S. (1997) The College of New Jersey, Ph.D. (2002) University of California at Los Angeles. Research interests: Studies the cooperative dynamics of proteins and their operation as highly organized and integrated assemblies; develops engineering approaches that enable model systems of natural multiprotein assemblies to be reconstructed in vitro while preserving the intricate molecular features of these assemblies; and uses instrumentation to investigate the collective protein dynamics of these systems with single-molecule precision.

**Rebekah A. Drezek.** Professor of Bioengineering and of Electrical and Computer Engineering. B.S. (1996) Duke University; M.S. (1998), Ph.D. (2001) University of Texas at Austin. Research interests: Interface of basic, applied and translational research in medicine, engineering and nanotechnology to develop minimally invasive photonics-based imaging approaches. This includes new optical spectroscopy and imaging instrumentation and molecular-specific optical contrast agents; experimental studies into the biophysical origins of measured optical signals; and computational modeling of the interaction of light and biological tissue.


**Jeffrey G. Jacot.** Assistant Professor, Bioengineering at Rice University and Texas Children’s Hospital. B.S. (1994) University of Colorado, Ph.D. (2005) Boston University. Research interests: The design and development of contractile and conductive tissue patches to repair congenital heart defects. Focus on the use of stress, strain and electrical stimulation to direct differentiation and maturation of cardiac tissue from progenitor cells; develop an understanding of mechanics and electrical conduction in hearts with congenital defects; and improve tissue engineered therapies.
Herbert Levine. Hasselmann Professor of Bioengineering. B.S. (1976) Massachusetts Institute of Technology; Ph.D. (1979) Princeton University. Research interests: The physics of nonequilibrium systems, both deterministic and stochastic, with applications in a wide variety of biological systems. Projects focus on combining theoretical approaches and advanced experiments to understand directed cell motion in eukaryotic cells and to elucidate both signal transduction and cellular mechanics aspects of this critical process. Additional areas of research in biological physics include calcium-based cell signaling (most recently at the neuronal synapse), the statistical mechanics of Darwinian evolution, and pattern formation in microorganism colonies.

Jiapeng Ma. Professor of Bioengineering at Rice University; Lodwick T. Bolin Professor of Biochemistry and Molecular Biology at Baylor College of Medicine. B.S. (1985) Fudan University, P.R. China; Ph.D. (1996) Boston University. Research interests: Relationship between structure and function in biological molecules through computational biophysics, structural biology and the development of mathematical algorithms for computer simulation; supermolecular complexes; computer-aided drug designs; and structural refinement strategies.


Antonios G. Mikos. Louis Calder Professor, Bioengineering, Chemical and Biomolecular Engineering; Director, Cox Laboratory for Biomedical Engineering; Director, Center for Excellence in Tissue Engineering. Dipl.Ch.E. (1983) Aristotle University of Thessaloniki, Greece; M.S.Ch.E. (1985), Ph.D. (1988) Purdue University. Research interests: The synthesis, processing and evaluation of new biomaterials for use as scaffolds for tissue engineering, as carriers for controlled drug delivery and as nonviral vectors for gene therapy. His work in nanobiotechnology and tissue engineering has led to the development of novel orthopedic, cardiovascular, neurologic and ophthalmologic biomaterials.

Joel L. Moake. Senior Research Scientist; Associate Director, J.W. Cox Laboratory for Biomedical Engineering at Rice University; Professor of Medicine at Baylor College of Medicine (1984–2007-retired). B.A. (1964), M.D. (1967) Johns Hopkins University. Research interests: Platelets, VWF and endothelial cells. First to describe the mechanisms of: (1) platelet aggregation under high shear-stress; (2) platelet-VWF adhesion in thrombotic thrombocytopenic purpura (TTP); and (3) renal platelet thrombosis in the hemolytic-uremic syndrome (HUS).

Amina Qutub. Assistant Professor of Bioengineering. B.S. (1999) Rice University; Ph.D. (2004) University of California, Berkeley/San Francisco. Research interests: Biological systems modeling theory and design to understand and characterize hypoxic response signaling, angiogenesis, and cerebrovascular systems biology; experiment and imaging-coupled modeling. Advances in these interconnected focus areas are leading to discoveries in cancer therapy; treatments for ischemia and Alzheimer’s disease; and increased understanding of cellular and sub-cellular organization in vascular biology.

Robert M. Raphael. Associate Professor of Bioengineering. B.S. (1989) University of Notre Dame; M.S. Biophysics (1992), Ph.D. Biophysics (1996) University of Rochester. Research interests: Combines advanced optical microscopy, electrophysiology and micromechanical techniques to study the cellular and molecular basis of auditory function, including the electroctive motor protein prestin and inner-ear ion homeostasis. Investigates how coupling between mechanical, electrical and transport properties of biomembranes regulate cellular processes and inspire the design of biosensors and microscale biomedical devices.


Jeffrey J. Tabor. Assistant Professor of Bioengineering. B.A. (2001) University of Texas, Ph.D. (2006) University of California at San Francisco. Research interests: Synthetic biology, engineering cell-cell interactions, problems addressed by constructing synthetic genetic circuits. Projects include programming cells to respond to light, constructing synthetic phosphorelay cascades, engineering synthetic social interactions and pattern formation, engineering “smart biotherapeutics,” and using synthetic circuits for metabolic engineering. Diverse model organisms — including bacteria, yeast, social amoeba and mammalian cells — are used.

Jennifer L. West. Isabel C. Cameron Professor in Bioengineering; Professor of Chemical and Biomolecular Engineering; Chair of the Department of Bioengineering. B.S. (1992) Massachusetts Institute of Technology; M.S. (1994), Ph.D. (1996) University of Texas at Austin. Research interests: Design of biomimetic scaffold materials for vascular tissue engineering, development of biofunctional nanoparticles for cancer diagnostics and diagnostic and therapeutic applications of metal nanoshells.

RESEARCH FOCUS AREAS

The Department of Bioengineering faculty members have diverse research interests focused on applying engineering principles and developing cutting-edge technologies to solve basic science and medical problems. Applicants are asked to note one or more focus area of interest in their application. Specific research focus areas include:

Biomaterials and Drug Delivery

The Biomaterials and Drug Delivery group focuses on the synthesis, fabrication and evaluation of biomaterials, including nanobiomaterials for important applications in biomedicine. Their research efforts emphasize the development of new or improved biomaterials with exciting physical, chemical and biological properties. These innovative materials are exploited for a variety of technologies, including imaging contrast agents, tissue engineering scaffolds, drug delivery and artificial viruses for gene therapy. Researchers include: Drs. Diehl, Jacot, Ma, McDevitt, Mikos, Qutub, Suh, Tabor and West.

Biomedical Imaging and Diagnostics

Biomedical Imaging and Diagnostics faculty conduct research in translational molecular imaging and diagnostics. Their multidisciplinary efforts focus on the development of novel, nanoscale contrast agents for molecular imaging as well as the development of hardware systems to image and monitor cancers and other disease processes in vivo in real time. Their research leverages the department’s unique capabilities in nanobiotechnology with application in basic science and translational biomedical application. Researchers include: Drs. Drezek, McDevitt, Richards-Kortum, Suh, Tkaczyk and West.
Cellular and Biomolecular Engineering
This area has enormous potential to make truly significant contributions to mankind in both medical and nonmedical fields over the next decades. Much of this group’s research is focused at the cellular and molecular scales. They apply the principles and tools derived from engineering to solve a host of problems in cellular and molecular biology, thus enabling new types of studies of biological systems. Researchers include: Drs. Deem, Diehl, Grande-Allen, Igoshin, Jacot, Levine, Ma, McDevitt, Mikos, Moake, Qutub, Raphael, San, Suh, Tabor and West.

Computational and Theoretical Bioengineering
Natural systems from our world and engineered systems from biotechnology offer a wide variety of phenomena for study. New field-theoretic techniques, new computer simulation methods and new random energy models have resulted. The Computational and Theoretical Bioengineering group works to explain, model and provide the means to manipulate medically related biological systems. Investigations range from biomechanics to protein–protein interactions to stem cell differentiation and immune system therapies. Researchers include: Drs. Deem, Diehl, Grande-Allen, Igoshin, Jacot, Levine, Ma, Mikos, Qutub, Raphael, San and Tabor.

Systems and Synthetic Biology
Research in these areas is tightly related through the use of quantitative experimental and theoretical approaches to characterize biological networks and to understand emergent functional relationships and behaviors. Systems biology attempts to understand how biological processes, within cells, a group of cells, or an entire tissue work at the “network level,” and generally seeks to determine how biological components interact to produce physiological responses. Synthetic biology involves reprogramming living cells for novel functions at the level of their DNA. There are broad scientific and engineering applications including the construction of simple cellular networks for detailed analysis and the production of next generation fuels, therapeutics and commodity chemicals. Researchers include: Drs. Deem, Diehl, Igoshin, Levine, Ma, McDevitt, Qutub, Raphael, San, Suh, and Tabor.

Tissue Engineering and Biomechanics
Research efforts in this area are focused on the 1) understanding of biochemical, molecular, cellular, and biomechanical characteristics of normal and diseased tissues; 2) design and fabrication of novel scaffolds; and 3) development of optimal culturing conditions for tissue engineered constructs. The effects of mechanical stimulus are being investigated from the level of single-cell gene expression to tissue mechanical properties. Scaffold designs incorporate novel biomaterials, bioactive molecules and combinatorial variations in subunit scaffold micro-architecture. Culture conditions involving biochemical and mechanical cues are being optimized for engineering bone, cartilage, heart valves and small-diameter vascular grafts. Researchers include: Drs. Grande-Allen, Jacot, Mikos, Qutub, Suh and West.

RESEARCH FACILITIES
The Department of Bioengineering is housed in a new 484,000 square-foot research facility called the BioScience Research Collaborative (BRC). Located at the border between the Rice campus and the Texas Medical Center (TMC), the interdisciplinary research facility is a reflection of Rice’s Vision of the Second Century and is shared with member institutions of the TMC. The center represents a major investment toward reaffirming our long-term history and positioning as one of the most powerful bioscience and biomedical research efforts in the world.

The BRC facility provides common areas for technical laboratory facilities and includes a broad range of research and computing equipment. In addition, graduate students have access to campus supercomputing facilities as well as core equipment and facilities via the Rice Shared Equipment Authority program and the Ken Kennedy Institute for Information Technology. State-of-the-art research facilities include: tissue culture, confocal/
electron/video microscopy, mass spectrometry, TIRF microscopy, flow cytometry, polymer synthesis, materials characterization and testing, mechanical testing, histology, electrophysiology, biomedical lasers, optical tweezers, micro-CT and many others.

**RESEARCH CENTERS AND INSTITUTES**

Bioengineering faculty and graduate students benefit from membership in centers and institutes at Rice, including the Institute of Biosciences and Bioengineering (IBB), the Smalley Institute for Nanotechnology, the Center for Biological and Environmental Nanotechnology (CBEN), Rice 360°: Institute for Global Health Technologies, the Center for Excellence in Tissue Engineering (CETE), the Ken Kennedy Institute for Information Technology, and the W.M. Keck Center for Interdisciplinary Bioscience Training (Keck Center) and the Gulf Coast Consortia (GCC).

**ADMISSION**

Admission to the graduate program is competitive, and the Graduate Admissions Committee uses both quantitative and qualitative factors in its decision process. In addition to GRE and TOEFL scores, academic records, personal statement and letters of recommendation are included in the evaluation.

**STIPENDS AND FELLOWSHIPS**

All Ph.D. students in the Rice bioengineering program are supported by competitive stipends through a range of fellowships, scholarships and assistantships. In addition, tuition for Ph.D. students is waived. M.B.E. students are not eligible for financial support through the department.

Students also may apply for competitive fellowships in graduate training programs administered at Rice such as the HHMI Med Into Grad (Translational Cancer Diagnostics and Therapeutics for Bioengineers and Biophysicists), NIH Biotechnology Training Program (IBB), NSF IGERT in Nanophotonics (LANP), and several training programs through the Gulf Coast Consortia’s (GCC) W. M. Keck Center for Interdisciplinary Bioscience Training (Keck Center) and the Gulf Coast Consortia (GCC).

**DEGREE REQUIREMENTS**

Most students admitted to the Rice graduate program in bioengineering follow a course of study that leads directly to the Ph.D. degree. The graduate degree curriculum has three components: foundation, supporting and advanced topics courses. Collectively, these components afford students broad exposure to their chosen field of research. Students initially reinforce their knowledge through foundation courses in bioengineering. With the help of their thesis advisor, students plan a coherent course of study that is most appropriate to their research work from among the wide range of supporting and advanced topics courses available. A variety of courses available reflect the diverse research interests within the Department of Bioengineering.

Doctor of Philosophy (Ph.D.)

The Ph.D. candidate in bioengineering must:

- Prerequisites: Fundamentals of System Physiology (BIOE 322 or equivalent), Cell Biology (BIOS 341 or equivalent), and Statistics.
- These courses must be taken during undergraduate training, or they will be additional requirements for the Ph.D. degree.
- Complete 30 semester hours of foundation, supporting and advanced topics courses; 15 of these credit hours must be graduate-level or higher BIOE courses.
- Maintain an average GPA of 3.2 or higher
- Complete three semesters as a teaching assistant for six to ten hours per week
- Prepare a thesis proposal and present it to the thesis committee
- Complete a publishable thesis representing research that is an original and significant contribution to a field of bioengineering
- Pass a public oral examination in defense of the thesis

Medical Scientist Training Program (M.D./Ph.D.)

Rice University and the Baylor College of Medicine have collaborated for nearly 30 years to administer the Medical Scientist Training Program (MSTP). Students in the MSTP program receive their Ph.D. in bioengineering from Rice and their M.D. from Baylor. Many of these students are jointly advised by Rice bioengineering faculty and Baylor clinical faculty. Students must initiate their application through Baylor. To learn more about the MSTP, visit the Baylor College of Medicine Web site at www bcm edu/mstp /

Joint M.B.A./M.B.E. Program

The Jones Graduate School of Business and the Department of Bioengineering offer a Master of Business Administration/Master
of Bioengineering (M.B.A./M.B.E.) degree program. Designed to meet the growing demand for managers with technical expertise, the M.B.A./M.B.E. program trains students to apply management strategies that meet the needs of high-technology companies. Curriculum must be approved by the Graduate Academic Affairs Committee and the department. This is done on a case-by-case basis and includes:

- Prerequisites: Fundamentals of Systems Physiology (BIOE 322 or equivalent), Cell Biology (BIOS 341 or equivalent), and Statistics. These courses must be taken during undergraduate training, or they will be additional requirements for the M.B.E. degree.
- Complete a total of 63 credit hours (39 toward the M.B.A.; 24 toward the M.B.E.). At least 15 of the 24 bioengineering credit hours of the M.B.E. portion must include:
  - Graduate-level or above MATH, STAT or CAAM (3 credit hours)
  - Nine bioengineering elective (400-level or above) credit hours
  - Six engineering elective credit hours
  - Six approved elective credit hours
- Maintain an average GPA of 3.0 or higher.

**Master of Bioengineering (M.B.E.)**
The Master of Bioengineering (M.B.E.) is a nonthesis degree that provides students with greater depth in their bioengineering training to advance their career objectives. Curriculum must be approved by the Graduate Academic Affairs Committee and the department. This is done on a case-by-case basis and includes:

- Prerequisites: Fundamentals of Systems Physiology (BIOE 322 or equivalent), Cell Biology (BIOS 341 or equivalent), and Statistics. These courses must be taken during undergraduate training, or they will be additional requirements for the M.B.E. degree.
- Complete 30 semester hours of upper-level (300 or above) courses, including at least 15 bioengineering credit hours at the graduate level or above:
  - Six engineering credit hours
  - Graduate-level or above MATH, STAT or CAAM (3 credit hours)
  - Six general elective credit hours
- Maintain an average GPA of 3.0 or higher.

**HOW TO APPLY**

**Doctor of Philosophy (Ph.D.) Program**
The application deadline for the Ph.D. program is January 15. Students are strongly advised to check bioe.rice.edu for official dates. (It is best to start the application process before September of the year applying.) Forms can be found at: http://bioegradapps.rice.edu.

**Masters in Bioengineering Program (M.B.E.)**
The online application deadlines for the M.B.E. (nonthesis masters) are October 30 and April 30. Forms can be found at http://bioegradapps.rice.edu. Students applying after the April 30 dead-

In addition to the application, all Ph.D. and M.B.E. candidates must submit the following items to the Graduate Admissions Committee:

- Transcripts from all undergraduate and graduate schools attended
- At least three letters of recommendation from teachers and advisors
- GRE scores and TOEFL scores (TOEFL is needed for any student requiring a visa. Make arrangements with the Educational Testing Service at www.ets.org/ or International English Testing Service [IELTS] at www.ielts.org to have official test scores sent to Rice.)
- An application fee of $70

Submit all inquiries and application materials to:

Rice University
Graduate Admissions Committee
Bioengineering Department–MS 142
P.O. Box 1892
Houston, Texas 77251-1892
Phone: 713-348-5869 (x5063)
Fax: 713-348-5877
E-mail: bioeng@rice.edu
Web site: www.bioe.rice.edu

Courier deliveries should be sent to:

Rice University
Graduate Admissions Committee
Bioengineering Department–MS 142
6100 Main Street
Houston, TX 77005
ABOUT RICE AND HOUSTON

Rice is a leading American research university—small, private and highly selective—distinguished by a collaborative, interdisciplinary culture and a global perspective. Only a few miles from downtown Houston, it occupies an architecturally distinctive, 285-acre campus shaded by nearly 4,000 trees. State-of-the-art facilities and laboratories, internationally renowned centers and institutes and one of the country’s largest endowments support an ideal learning and living environment.

The university attracts a diverse group of highly talented students and faculty with outstanding graduate and professional programs in the humanities, social sciences, natural sciences, engineering, architecture, music and business. With just 2,275 graduate students and 3,485 undergraduates, it offers an unusual opportunity to forge close relationships with eminent faculty scholars and researchers and the option to tailor graduate programs to specific interests.

Houston offers all the expected educational, cultural and commercial advantages of a large urban center, and more. It’s home of the Texas Medical Center, the largest concentration of medical schools, hospitals and research facilities in the world, as well as several other universities. Rice has cooperative programs with the University of Houston, Baylor College of Medicine, the University of Texas M.D. Anderson Cancer Center, the University of Texas Health Science Center and the University of Texas Medical Branch at Galveston. Houston is one of the few U.S. cities with resident companies in all four major performing arts—drama, ballet, opera and symphony. It also boasts a museum district featuring exhibits of national and international prominence.

As urban as it is, Houston also is a surprisingly green city. Houstonians enjoy the outdoors in more than 300 municipal parks and 120 open spaces, and many frequent the beach at Galveston Island, only a 45-minute drive away. Other short trips include Austin, the state’s capital, and historic San Antonio, both of which are a little more than three hours away.

FOR MORE INFORMATION:

Rice University homepage:  
www.engr.rice.edu

George R. Brown School of Engineering homepage:  
www.engr.rice.edu

Rice University Office of Graduate and Postdoctoral Studies homepage:  
graduate.rice.edu

Graduate Student Association homepage:  
gsa.rice.edu

City of Houston homepage:  
www.houstontx.gov

Houston information from the Houston Chronicle:  
www.chron.com

Houston information from Microsoft Citysearch:  
houston.citysearch.com