

Biomedical Engineering



EMORY

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The Wallace H. Coulter Department of Biomedical Engineering (BME) is a joint effort between Georgia Tech's College of Engineering and Emory University School of Medicine and Laney Graduate School. We are a unique partnership between a public and a private institution. The vision is to provide superb education and research in biomedical engineering with an emphasis on applications to human health.

The Coulter Department offers two joint Ph.D. Degrees in Biomedical Engineering, one from Emory and Georgia Tech and the other from Emory, Georgia Tech and Peking University.

The Coulter Department's Ph.D. program consistently ranks among the top five biomedical engineering programs in the country by *U.S. News and World Reports*. The curriculum integrates life sciences, engineering, and mathematics to train researchers who can formulate and solve significant biomedical problems quantitatively and with a systems perspective.

The BME doctoral program combines a tradition of excellence in engineering and a thriving medical research community. Together, we have identified six critical areas of research where our combined strengths are the foundation of strong research programs.

Biomaterials and Regenerative Medicine

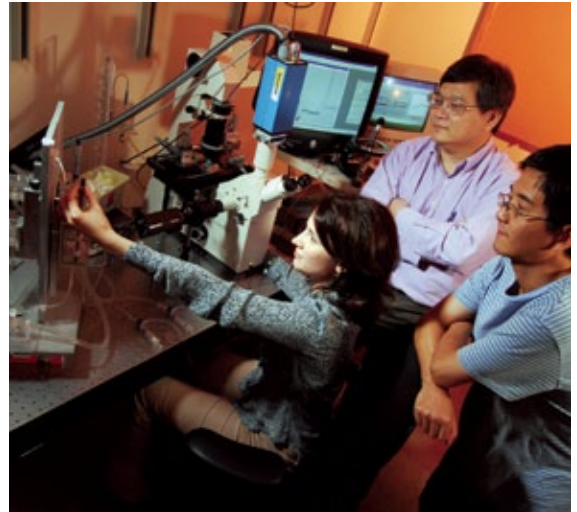
Biomaterials and Regenerative Medicine is the discipline of designing, synthesizing, characterizing, and testing materials that can be used for medical applications. At Georgia Tech/Emory, we have strong biomaterials and tissue engineering groups whose research interests are in the areas of immune/inflammatory response of implanted materials and modulation of this response, synthetic, natural, and bio-inspired polymers and their applications, hydrogels and anisotropic 3D scaffolds, Nano- and Micro-scale drug and gene delivery vehicles, nano- and microstructured engineering of material surfaces, interaction of stem cells with biomaterials and engineered surfaces. Tissue engineering involves the use of living cells and/or other natural biological materials in the development of biological substitutes. The purpose of tissue engineering is to repair, maintain, or enhance function, and it includes such applications as neural tissue replacement, nerve regeneration, blood vessels, heart valves, connective tissues such as bone and cartilage, and for enhanced vaccine/drug/gene contrast agent delivery.

DISCOVER

the unexpected

Cardiovascular Biology and Biomechanics

While biomechanics research spans from the cell to the organ level in fluid and solid mechanics, and includes experimental and computational approaches encompassing a wide range of basic and applied projects, the work in the cardiovascular area is particularly strong. Studies on the fluid dynamics of blood flow are being conducted using in vitro models, in vivo experimentation, and computational methods. Specific applications include the fluid mechanics of the heart and large vessels, coronary arteries, vascular grafts, and the abdominal aorta and peripheral vasculature. Research in fluid dynamics associated with mechanical heart valves, new bioprosthetic designs, and polymeric trileaflet valve prostheses is internationally recognized. Cardiovascular solid mechanics work addresses mechanical properties and stresses in diseased arterial cross sections, and examines the role of mechanical factors in the disruption of atherosclerotic plaques. On the applied side, the effects of cryopreservation on mechanical properties of arteries and veins are being determined to evaluate the potential for cryopreserved tissues to replace injured or diseased vessels as allografts.



Cellular and Biomolecular Engineering

Cellular and Biomolecular Engineering is the development and application of micro- and nano-scale engineering approaches and technologies to studies of biological molecules and cells. Cellular Engineering involves understanding, controlling, manipulating and modifying cell behavior and functions using combined engineering, genetic, biochemical and biological approaches. Biomolecular Engineering includes analyzing proteins, nucleic acids and their interactions; designing, synthesizing and characterizing biopolymers, nanoparticle bioconjugates, therapeutic drugs, biomolecular sensors, connectors and actuators as well as nano-structured devices. The goal is to develop and apply innovative cellular and molecular approaches for the detection, diagnosis, treatment and prevention of human diseases. Research areas include Cancer Technology, Micro/Nanotechnology and Biosensors, Biomolecular Delivery, Targeting and Therapeutics, Molecular Imaging, Genomics, Proteomics, and Bioinformatics.

Integrative Biosystems

Health Systems

Health Systems creates new models for healthcare delivery through integrative interdisciplinary solutions, drawing from medicine, engineering, computing, management and public policy. Integrative Biosystems also develops and implements novel multidisciplinary and collaborative research, education, and outreach programs to transform healthcare delivery systems and lead the nation away from an ineffective, reactive, and disease-focused system to achieve cost-effective, pro-active health and wellness-focused system. Research objectives include advancing fundamental knowledge of issues central to the delivery of health care services through efficient allocation and management of health resources, and the design, development, implementation, and evaluation of integrated, patient-centered, and personalized health care delivery systems that capitalize on state-of-the-art information, communication, decision support, healthcare and biomedical technologies.

Bioinformatics and Biomedical Systems Analysis

Recent advances in molecular biology, genomics and proteomics have resulted in high-throughput technologies that generate vast amounts of data. In response, computational methods of bioinformatics are being developed to organize, mine, and interpret these data. Particular emphasis at Georgia Tech is placed on the development of probabilistic algorithms for identifying functionally important features of DNA and proteins, such as regulatory sites, mobile elements, and protein domains that were conserved through evolution. The bioinformatics methods are complemented with biomedical systems analyses that use a combination of experimental, mathematical, and computational methods to integrate multiple datasets. The results of this integration are models representing mathematically how cells and organisms function. These models have applications in drug development, metabolic engineering and many other areas where cells or organisms are manipulated toward a desired goal. The models also help to elucidate design and operating principles that explain why biological systems are organized and regulated in a particular fashion and not in some other fashion. Areas of research include: Gene Finding, Gene Regulation, Protein Trafficking, Metabolic Networks, Signal Transduction, and Multi-level Modeling.

Medical Imaging

Imaging is critical in advancing biomedical research and improving health care. Georgia Tech has one of the world's premier groups in digital signal processing as well as visualization. Emory has longstanding imaging expertise in the cardiovascular and neuroscience areas. These combined resources of Georgia Tech and Emory enable leading edge research and education in imaging technology.

Neuroengineering

Neuroengineering is the application of engineering technologies and techniques to both interface to the normal nervous system as well as augment or replace parts of the compromised nervous system. At Georgia Tech and Emory, we are advancing the understanding of fundamental neural properties including sensorimotor control, learning, information processing, response to physical trauma, and complex neural dynamics. We are also engaged in developing novel technologies inspired by the disciplines of mathematics, biomechanics, robotics, MEMs, electrical engineering, optical microscopy, biomaterials and tissue engineering. These methods are applied with goals ranging from basic science to clinical application to further our understanding of normal neurophysiology and to help repair damaged brain, spinal or peripheral nervous tissue.

Our research programs are facilitated by state-of-the-art facilities at both Georgia Tech and Emory. Visit our website for a page with links to many of our labs: www.bme.gatech.edu/research/labs.shtml

Curriculum

Georgia Tech and Emory faculty provide an interactive learning environment for students by team-teaching courses. During the first semester, students are matched with a thesis advisor/mentor and co-advisor. The program offers a flexible curriculum that is tailored to the student and advisor to fit the student's undergraduate background and research interests. Requirements include a bioethics course, a teaching course and a teaching practicum.

At the end of the first year in the program students take qualifying examinations. Students typically complete their thesis research, prepare a written dissertation, and defend the dissertation in an oral examination within five to six years



after entering the Ph.D. program. Upon successful completion of all requirements, students are awarded a joint Ph.D. degree from the graduate schools of Georgia Tech and Emory.

Students

The BME Ph.D. program accepts applications from individuals with a BS in Engineering or the Life Sciences. We have an average of about 90 students in the program with 20 new students joining the program each year. Many disciplines of engineering and the sciences are represented in our current students' backgrounds. Our Ph.D.s are entering industry with companies that range from small start-up companies to large corporations. They are also entering faculty positions at institutions across the country.

Biomedical Engineering Faculty

The Department has 34 Faculty (FTE) on Emory's and Georgia Tech's campuses. They are from a wide range of engineering and science backgrounds. Our website has a complete list, with links to individual faculty pages containing information about research interests and more. Visit www.bme.gatech.edu/facultystaff/faculty.php.

We have the largest amount of NIH funding with BME faculty as Principal Investigators in the country. It also is the only BME Department that has been awarded three Nanotechnology Centers by the National Institutes of Health. These centers focus on DNA repair mechanisms, cancer diagnosis and therapeutics, and early identification of vulnerable atherosclerotic plaques in the cardiovascular system respectively.

Joint Ph.D. with Peking University

To meet the needs of a rapidly changing society and global economy, Peking University, Emory University and Georgia Tech have forged an unprecedented partnership in biomedical engineering education and research. The program offers a unique means for U.S. and Chinese students who want to learn and work in a global economy and in global health settings. Program graduates will be prepared to become global leaders of innovation who can contribute to cultural, political, economic and health concerns in their home countries and around the world. Program planners could not have found

a better partner than Peking University: Founded in 1898, Peking University (PKU) is among the first national universities in Chinese modern history. PKU enjoys an outstanding reputation within and outside of China, based on its abundant teaching resources and outstanding research achievements.

Students apply to the program through the school designated as the home campus, either the Department of Biomedical Engineering at PKU in Beijing or the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory in Atlanta. Students will have an advisor at the home campus and co-advisor at the secondary campus. Most of the classes and research will take place on the home campus. However, students will also spend at least one year taking classes and participating in research in the co-advisor's lab on the secondary campus. Most classes will be taught in English and a single dissertation will satisfy thesis requirements of all three institutions. For details regarding program requirements, see <http://www.bme.gatech.edu/pku.html>.

Contact Information

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Requests for Additional Information:

RECRUITMENT AND ADMISSIONS

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http://www.acad.bme.gatech.edu/graduate/grad_joint.php

