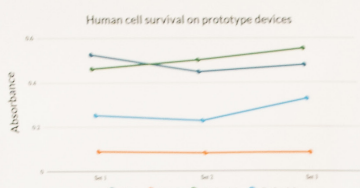
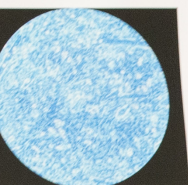


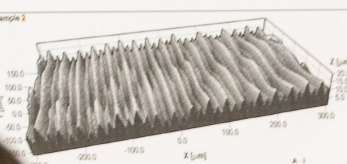
Design Validation

Biocompatibility testing

Biocompatibility testing showed up to 100% cell survival rate when cultured with our prototypes

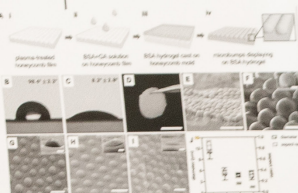


Preventing bacterial adhesion



Structures caused a log 10 reduction in microorganism touch transfer

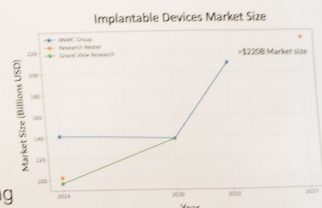
Structured hydrogel inhibited term attachment of resistant bacteria up to more than flat hydrogel



Research with similar antibacterial designs is proof of concept. Bacterial testing not possible due to experimental challenges

Conclusions and Future Work

Go-to-market strategy



Recommended next steps

Bacterial adhesion testing with staph aureus
Form envelope around cardiac device
Workflow testing

Market gap and offers potential for manufacturing; prototypes demonstrated simple fabrication, but more testing required to prevent the prevention of bacterial adhesion

SEVENTH ANNUAL CARNEGIE MELLON FORUM ON BIOMEDICAL ENGINEERING

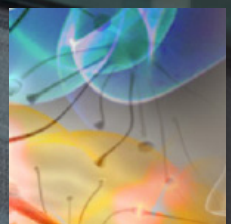
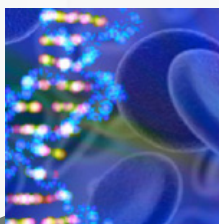
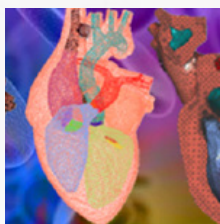
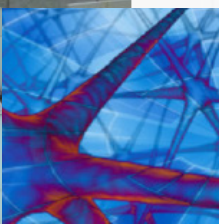
September 19, 2025

Explore Frontiers in Biomedical Engineering!

The Carnegie Mellon Forum on Biomedical Engineering brings together researchers, students, clinicians, and industry leaders from around the world to share groundbreaking discoveries and advance the future of healthcare. Hosted annually by the Department of Biomedical Engineering at Carnegie Mellon University, the Forum provides a dynamic platform for scientific exchange and collaboration.

Each year, the program features keynote lectures by world-renowned experts and an interactive virtual poster competition that highlight cutting-edge research across a broad range of topics from cellular engineering and neurotechnology to medical devices and global health innovations. The Forum offers opportunities for students to showcase their work, gain valuable feedback, and connect with peers, mentors, and potential collaborators.

At its heart, the Carnegie Mellon Forum on Biomedical Engineering is more than a conference — it is a community dedicated to advancing science and engineering for the benefit of human health worldwide.



Program

Friday, September 19

Carnegie Mellon Forum on Biomedical Engineering

08:45 – 09:00 AM**Welcome Remarks****Keith Cook, Ph.D.**

The David Edward Schramm Professor and Head
Biomedical Engineering
Carnegie Mellon University

09:00 – 09:30 AM**Keynote Talk: Computational modeling to advance cardiovascular regenerative medicine****Sandra Loerakker, Ph.D.**

Associate Professor
Department of Biomedical Engineering
Eindhoven University of Technology

Moderator: Jason Szafron, Ph.D.

Assistant Professor
Department of Biomedical Engineering
Carnegie Mellon University

09:30 – 10:00 AM**Keynote Talk: Some Recent Progress in Transient Bioelectronics****John Rogers, Ph.D.**

Louis Simpson and Kimberly Querrey Professor
Materials Science and Engineering,
Biomedical Engineering and Neurological Surgery
Director, Querrey Simpson Institute for Bioelectronics
Northwestern University

Moderator: Tzahi (Itzhaq) Cohen-Karni, Ph.D.

Professor
Biomedical Engineering and Materials Science & Engineering
Carnegie Mellon University

10:00 – 10:15 AM**BREAK****10:15 – 10:45 AM****Keynote Talk: Neurotechnologies for Controlling the Brain: Where are things going?****Garrett Stanley, Ph.D.**

Professor of Biomedical Engineering
McCamish Foundation Distinguished Chair
Department of Biomedical Engineering
Georgia Tech & Emory University

Moderator: Steven M. Chase, Ph.D.

Professor
Biomedical Engineering and Carnegie Mellon Neuroscience Institute
Carnegie Mellon University

10:45 – 11:15 AM**Keynote Talk: Extracellular Matrix for Lung Modeling and Repair****Rebecca L. Heise, Ph.D.**

Inez A. Caudill, Jr. Distinguished Professor and Chair
Department of Biomedical Engineering
Virginia Commonwealth University

Moderator: Keith Cook, Ph.D.

The David Edward Schramm Professor and Head
Biomedical Engineering
Carnegie Mellon University

11:15 – 11:45 AM cell	Keynote Talk: Neurovascular mechanisms of acute vaso-occlusive pain in sickle cell disease. (Why does “emotional stress” trigger a vaso-occlusive crisis?) Thomas Coates, M.D. Section Head, Hematology Attending Physicial, Hematology, Oncology and Blood and Marrow Transplantation Investigator, Hematology-Oncology Professor, Pediatrics and Pathology Keck School of Medicine of University of Southern California Moderator: Sossena Wood, Ph.D. Assistant Professor Biomedical Engineering Carnegie Mellon University
11:45 – 12:15 PM	Keynote Talk: Time Series Intelligence Artur W. Dubrawski, Ph.D Alumni Research Professor of Computer Science Robotics Institute Carnegie Mellon University Moderator: P. Sang Chalacheva, Ph.D. Associate Teaching Professor Biomedical Engineering Carnegie Mellon University
12:15 - 1:00 PM	LUNCH BREAK
1:00 – 1:30 PM	Keynote Talk: Insights on Disc Degeneration and Anterior Vertebral Body Tethering Success through FEM Grace D. O’Connell, Ph.D. Professor Department of Mechanical Engineering Associate Dean for Inclusive Excellence College of Engineering UC Berkley Moderator: Axel Moore, Ph.D. Assistant Professor Biomedical Engineering Carnegie Mellon University
1:30 – 2:00 PM	Keynote Talk: Bioengineering Collaborations to Improve Global Newborn Health: Lessons Learned for Impact at Scale Rebecca Richards-Kortum, Ph.D. Malcom Gillis University Professor Department of Bioengineering Co-Director of Rice360 Institute for Global Health Technologies Rice University Moderator: Keith Cook, Ph.D. The David Edward Schramm Professor and Head Biomedical Engineering Carnegie Mellon University

2:00 - 2:30 PM	Best Abstract Talk: Cell-Penetrating Peptide Mediated Delivery of Gene-encoded DNA Origami Zijuan Liang Doctoral Candidate Mechanical Engineering Department Carnegie Mellon University Moderator: Keith Cook, Ph.D. The David Edward Schramm Professor and Head Biomedical Engineering Carnegie Mellon University
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2:30 - 4:15 PM	Pre-recorded Slide Presentations
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4:15 - 4:30 PM	Announcement of Awards
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**Dr. Thomas Coates**

Section Head, Hematology
Attending Physical, Hematology,
Oncology and Blood and Marrow Transplantation
Investigator, Hematology-Oncology
Professor, Pediatrics and Pathology
Keck School of Medicine of University of Southern California

Dr. Coates primarily works in two areas of basic and translational research: 1) the role of inflammation in the genesis of vascular disease in sickle cell disease; 2) the detection and management of transfusion related iron overload. His research employs various engineering-intensive methodologies (MRI, laser Doppler flow, digital image analysis, signal processing) to explore the basic mechanisms of sickle cell disease and to measure the effect of various treatment modalities. He uses direct measures of microvascular blood flow to monitor the process of vasoocclusion and relate it to simultaneous measures of autonomic nervous system function. In collaboration with members of the Cardiology, Pulmonology, and Radiology Departments at Children's Hospital Los Angeles, the Departments of Biomedical Engineering and Physiology/Biophysics at the Keck School of Medicine, his lab devises methods to measure the sickling process in human sickle cell subjects and relate these measurements to clinical factors that modulate disease severity.

**Dr. Keith Cook**

The David Edward Schramm Professor and Head
Biomedical Engineering
Carnegie Mellon University

Dr. Cook is the David Edward Schramm Professor and Department Head of Biomedical Engineering at Carnegie Mellon University (CMU). At CMU, he also serves as the Director of the Bioengineered Organs Initiative and the Transforming Transplant initiative. As a student, Dr. Cook obtained a BSE in both Mechanical Engineering and Engineering Science from University of Michigan and an M.S. and Ph.D. in Biomedical Engineering from Northwestern University. Dr. Cook's research focuses on the application of biomedical engineering to the treatment of lung disease. His primary research focus is the development of permanent replacement lungs for destination therapy. This work extends into computational modeling and device design, development of novel biomaterials and new drug approaches to reduce blood coagulation within these devices, and in-vitro and in-vivo biomaterials and artificial lung testing. His research also focuses on design and biofabrication of tissue-based lungs. Dr. Cook is a fellow of the American Institute for Medical and Biological Engineering (AIMBE).

INVITED SPEAKERS



Dr. Artur W. Dubrawski

Alumni Research Professor of Computer Science
Robotics Institute
Carnegie Mellon University

Artur Dubrawski received a Ph.D. in robotics and automation from the Institute of Fundamental Technological Research, Polish Academy of Sciences, and a M.Sc. in aircraft engineering from Warsaw University of Technology.

Artur considers himself a scientist and a practitioner. He had started up a small company which turned out successful in integration and deployment of advanced computerized control systems and novel technological devices. He is also affiliated with startups incorporated by others: Schenley Park Research, a data mining consultancy and a CMU spin-off, where he was a scientist; and more recently with Aethon, a company building robots to automate transportation in hospitals, where he served as a Chief Technical Officer. Artur returned to CMU in 2003 to join the Robotics Institute's Auton Lab. He works on a range of applied data mining endeavors and teaches data mining to graduate students at the CMU Heinz School. In January 2006 Artur Dubrawski was named the director of the Auton Lab.



Dr. Rebecca L. Heise

Inez A. Caudill, Jr. Distinguished Professor and Chair
Department of Biomedical Engineering
Virginia Commonwealth University

Dr. Heise is an associate professor of biomedical engineering at Virginia Commonwealth University (VCU). She holds an affiliate appointment in the Department of Physiology and Biophysics at VCU and is a member of the Massey Cancer Center and the Johnson Center for Critical Care and Pulmonary Research. She earned her B.S. in Chemical Engineering with an additional major in Biomedical and Health Engineering from Carnegie Mellon University in 2003. She then earned her Ph.D. in Bioengineering from the University of Pittsburgh in 2008. She then did her postdoctoral work in the Laboratory of Respiratory Biology at the NIEHS in Research Triangle Park, NC. She joined the faculty of Biomedical Engineering at VCU in 2010. Dr. Heise's research focuses on pulmonary mechanobiology and regenerative medicine. She seeks to understand how the mechanical environment in the lung influences cellular behavior in health and disease with in vitro and in vivo models. Dr. Heise also researches the use of naturally-derived extracellular matrix as a biomaterial for cell and drug delivery to the lung. She has been awarded an R01 from the National Institute of Aging to study the effects of ventilator induced lung injury on inflammatory cell signaling, and she has earned a CAREER award from the National Science Foundation to study cell-ECM interactions in pulmonary fibrosis.

INVITED SPEAKERS



Dr. Sandra Loerakker

Associate Professor
Department of Biomedical engineering
Eindhoven University of Technology

Sandra Loerakker is an associate professor at the TU/e department of Biomedical Engineering (research group Soft Tissue Engineering and Mechanobiology). She studied Biomedical Engineering at Eindhoven University of Technology (TU/e) where she obtained both her BSc and MSc degrees cum laude. She completed her Ph.D. at Northwestern University and in collaboration with the University of Alberta (Canada), where she researched the etiology and early detection of deep pressure ulcers in skeletal muscle, using a combination of computational and experimental methods. Currently, Dr. Loerakker's research focuses on modeling the mechanobiology of native and engineered tissues using integrated computational and experimental methods, in order to obtain an improved understanding of the biological mechanisms responsible for soft tissue development, homeostasis, and disease and to translate those findings into novel therapies in the field of regenerative medicine. She primarily focuses on understanding how mechanical factors drive soft tissue growth and remodeling at different spatial and temporal scales.



Dr. Rebecca Richards-Kortum

Malcom Gillis University Professor
Department of Bioengineering
Co-Director of Rice360 Institute for Global Health Technologies
Rice University

Rebecca Richards-Kortum received her B.S. in Physics and Mathematics from the University of Nebraska. She then completed both a Masters in Physics and a Ph.D. in Medical Physics from MIT. Guided by the belief that all of the world's people deserve access to health innovation, Dr. Richards-Kortum's research and teaching focus is on the development of low-cost, high-performance technologies for remote and low-resource settings. She is known for providing vulnerable populations with access to life-saving health technologies that address diseases and conditions that cause high morbidity and mortality, such as cervical and oral cancer, premature birth, sickle cell disease and malaria. For two decades, Richards-Kortum's laboratory has focused on translating research that integrates advances in nanotechnology and molecular imaging with microfabrication technologies to develop optical imaging systems that are inexpensive, portable, and provide rapid point-of-care diagnosis. Her research and engineering design efforts have led to the development of 40 patents, and her work has been supported by many notable organizations including the "genius grant" from the MacArthur Foundation.

INVITED SPEAKERS



Dr. John Rogers

Louis Simpson and Kimberly Querrey Professor
Materials Science and Engineering,
Biomedical Engineering and Neurological Surgery
Director, Querrey Simpson Institute for Bioelectronics
Northwestern University

John Rogers completed a Masters of Science in both Physics and Chemistry from MIT. He continued on to complete his Ph.D in Physical Chemistry from MIT as well. Professor Rogers has invented over 80 patents and patent applications, more than 50 of which are licensed or in active use by large companies and startups that he has co-founded, including Active Impulse Systems, Semprius, MC10, CoolEdge, XCeleprint and Transient Electronics. His current research focuses on soft materials for conformal electronics, nanophotonic structures, microfluidic devices, and microelectromechanical systems, all lately with an emphasis on bio-inspired and bio-integrated technologies.



Dr. Grace D. O'Connell

Professor
Department of Mechanical Engineering
Associate Dean for Inclusive Excellence
College of Engineering
UC Berkley

Grace O'Connell is a professor in the Department of Mechanical Engineering at UC Berkley. She received a Bachelor of Science in Aerospace, Aeronautical and Astronautical Engineering from University of Maryland and completed her Ph.D. in Bioengineering and Biomedical Engineering at the University of Pennsylvania. She then went on to complete her Postdoc in Biomedical/Medical Engineering at Columbia University. Dr. O'Connell's research is focused on soft tissue biomechanics and tissue regeneration. Specifically, her goal is to understand the mechanical function of the healthy, degenerated and injured intervertebral discs in order to develop more physiologically relevant repair strategies. Injury, through herniation, or degeneration may lead to debilitating lower back pain. Current research is focused on understanding alterations in biomechanics and tissue remodeling with degeneration and injury. Other studies are focused on using organ culture techniques to directly measure tissue remodeling and potential biological repair strategies.

INVITED SPEAKERS



Dr. Garrett Stanley

Professor of Biomedical Engineering
McCamish Foundation Distinguished Chair
Department of Biomedical Engineering
Georgia Tech & Emory University

Garrett Stanley is the McCamish Foundation Distinguished Chair in the Department of Biomedical Engineering at Georgia Tech and Emory University, Directs the McCamish Parkinson's Disease Innovation Program, and is the Co-Director of the Georgia Tech Neural Engineering Center. He has formal training, both at undergraduate and doctorate levels, in engineering (specifically trained in Control Theory through all of his graduate work), and has worked extensively in the field of neuroscience, specifically in sensory processing in the brain, and more specifically in vision and somatosensation (touch). From 1999 to 2007, he was an Associate Professor in the Division of Engineering & Applied Sciences at Harvard University, where he was the leader of the Harvard Biocontrols Laboratory. Professor Stanley is now a faculty member in the Department of Biomedical Engineering at Georgia Tech/Emory University and leads several programmatic efforts at the interface between basic neuroscience and neurotechnology. In terms of research, he is the leader of the Laboratory for the Control of Neural Systems. The research of his group has been funded by the National Institute of Health, National Science Foundation, the Office of Naval Research, DARPA, and several private foundations.



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BME Academic Programs at CMU

Graduate Programs Overview

Ph.D. Program

The Ph.D. program is designed to nurture the next generation of leaders in biomedical engineering for the university and industry. Flexible degree requirements allow the student to balance breadth and depth, and to develop a research plan best suited to his/her career goal.

Ph.D. students start thesis research soon after matriculation. A rigorous review system monitors the progress to facilitate timely completion in 4-5 years for students without an M.S. degree, and in as short as 3 years for students with a relevant M.S. degree. All Ph.D. students are supported with full financial aid that covers tuition and stipend. The Department also participates in a joint M.D.-Ph.D. Program with the University of Pittsburgh School of Medicine.

M.S. Program

The M.S. program, built upon the interdisciplinary, collaborative culture of Carnegie Mellon University, provides an ideal opportunity for career advancement in biomedical engineering or transitions from other disciplines into biomedical engineering.

The large degree of flexibility and a wide choice of research advisors allow M.S. education to be tailored according to the student's professional goals, from R&D in biotechnology, health-care, to university faculty. Students may choose between the traditional BME M.S. - Research program and the accelerated BME M.S. - Applied Study program. If choosing the BME M.S. - Applied Study program, a practicum course can provide opportunities for clinical exposure at local hospitals. It may also be combined with programs in Engineering & Technology Innovation Management to form a dual M.S. program. Students wishing to enter Carnegie Mellon's Ph.D. program in Biomedical Engineering must reapply and compete with the general pool of Ph.D. applicants.

M.S. in Artificial Intelligence Engineering - Biomedical Engineering (MSAIE-BME)

Artificial Intelligence (AI) no longer just lives in the digital realm of social media and e-commerce – it has also become a critical part of physical technologies in healthcare, transportation, communication, manufacturing and more. In Biomedical Engineering, AI has the potential to transform healthcare with a wide range of applications. Biomedical AI can help a doctor diagnose a disease, determine its optimal treatment, and predict the patient's prognosis. Biomedical technologies such as brain-computer interfaces, neuroprosthetics and medical imaging have been enriched by the application of AI and machine learning techniques to biological signal analysis and image processing. Biomedical AI can thus be used to improve the quality and length of life.

The MS program in Artificial Intelligence Engineering in Biomedical Engineering offers students the opportunity to gain mastery of AI and Biomedical Engineering domain expertise while learning how to integrate AI/machine learning approaches with engineering design and system analysis to develop effective solutions in biomedical engineering.

CMU BME Research Areas:

- ▢ Biomaterials & Nanotechnology
- ▢ Cardiopulmonary Engineering
- ▢ Cell & Tissue Engineering
- ▢ Computational Biomedical Engineering
- ▢ Medical Devices & Robotics
- ▢ Neural Engineering
- ▢ Biomechanics
- ▢ Biomedical Imaging

Online Graduate Certificate in 3D Bioprinting & Biofabrication

This program's unique, credit-bearing, transcribed curriculum teaches the fundamentals of fabricating 3D tissues, so you can bring actionable knowledge back to your organization. The Certificate is offered online to allow physicians and other biomedical professionals to fit this cutting-edge program into their busy professional lives. Live, weekly, online classes are held in the evening and complemented by videos and activities that you will complete on your own time, at your own pace. In addition, you will have the opportunity to attend an optional, on-campus, week-long lab session over the summer to immerse yourself in the techniques and collaborate with other like-minded professionals. When you finish the certificate program, you will have the information and tools needed to create structurally complex 3D tissues.

Undergraduate Programs Overview

Major in Biomedical Engineering

Biomedical engineering education at Carnegie Mellon University reflects the belief that a top biomedical engineer must be deeply trained in both a traditional engineering practice and biomedical sciences. The unique additional major program leverages extensive collaborations with sister departments in the College of Engineering and with major medical institutions in Pittsburgh. This collaborative approach, combined with a rigorous engineering education, confers unique depth and breadth to the education of Biomedical Engineering graduates.

Additional Major in Biomedical Technology

Biomedical Technology is for students from non-engineering majors who want Biomedical Engineering training beyond the BME minor. The requirements for the Biomedical Technology additional major program consist of the core, the tracks, and the capstone design course. The core exposes students to basic facets of biomedical engineering to lay a foundation. The tracks allow students to build depth in a specific aspect of biomedical engineering. The capstone design project engages students in teamwork to develop real-world applications.

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