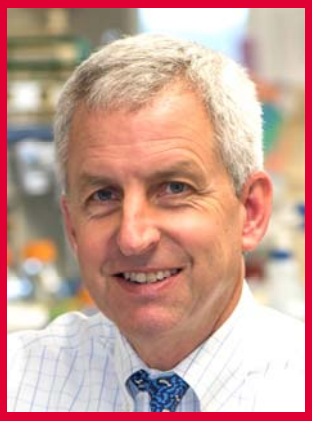
IOWA STATE UNIVERSITY
Department of Chemical and Biological Engineering

Graduate Seminar Series 2017-18



William E. Bentley

Robert E. Fischell Distinguished Chair of Engineering

Founding Director, Robert E. Fischell Institute for Biomedical Devices

University of Maryland College Park, MD

Thursday,

March 8, 2018

11:00 a.m.

171 Durham Center

Iowa State University

Communicating with and controlling biology via biofabrication, synthetic biology, and microelectronics

The ability to interconvert information between electronic and biologic systems has already transformed our ability to record and actuate biological function (e.g., EEG, EKG, defibrillators). In parallel, we have begun to demand biological connectivity from electronic consumer products (fitbit, cell phones, etc.). There are significant gaps, however, that must be overcome before biological information can be seamlessly conveyed and before biological function can be electronically "programmed". A communication gap exists whereby the common vectors for information flow in biology are ions and molecules; they are electrons and photons in electronics. Since there are essentially no "free" electrons in biological systems, there is essentially no direct "translator" of electrons to molecules and vice versa. Gaining access to molecular communication is essential as molecules are the primary vector that drives biological function. There is also a fabrication gap to overcome. It is difficult to construct microelectronic devices that include labile biological components. We are developing tools of "biofabrication" that enable facile assembly of biological components within devices that preserve their native biological function. By recognizing that biological redox active molecules are a biological equivalent of an electron-carrying wire, we have developed biological surrogates for electronic devices, including a biological redox capacitor. We have also turned to synthetic biology to provide a means to sample, interpret and report on biological information contained in molecular communications circuitry. Finally, we have developed synthetic genetic circuits that enable electronic actuation of gene expression. This presentation will introduce the concepts of molecular communication that are enabled by integrating relatively simple concepts in synthetic biology with biofabrication. Our presentation will show how engineered cells represent a versatile means for mediating the molecular "signatures" commonly found in complex environments, or in other words, they are conveyors of molecular communication.

William E. Bentley is the Robert E. Fischell Distinguished Chair of Engineering and was the founding Chair of the Fischell Department of Bioengineering. At Maryland since 1989, Dr. Bentley has focused his research on the development of molecular tools that facilitate the expression of biologically active proteins, having authored over 300 related archival publications. Recent interests are on deciphering and manipulating signal transduction pathways, including those of bacterial communication networks, for altering cell phenotype. To enable discovery, his lab develops new strategies for opening 'communication' between devices and biological systems by the creation and facile assembly of biologically functional interfaces. These concepts are emerging as a field of 'biofabrication' that exploits biological components and processes for assembly. He has mentored over 40 PhDs and 21 postdocs, many now in leadership roles within industry, federal agencies, and academia. He co-founded a protein manufacturing company, Chesapeake PERL, based on insect larvae as mini bioreactors. He is co-PI of Maryland's Center of Excellence in Regulatory Science and Innovation (CERSI), a comprehensive joint initiative with the FDA and Maryland's Baltimore campus. He is also co-PI of the National Capital Consortium for Pediatric Device Innovation, joint with Children's National Medical Center. Dr. Bentley was recipient of the Charles Thom Award of the SIMB, the AIChE's FPB Division Award, and the ACS BIOT Division's Marvin Johnson Award. He is also a Fellow of the ACS, AAAS, and AIMBE and is an elected member of the American Academy of Microbiology.

The Graduate Seminar Series events are part of the required curriculum for chemical engineering graduate students, but open to all Iowa State University graduate students, post-doctoral researchers, scientists, faculty and staff. See the full seminar schedule at cbe.iastate.edu/seminar-series/