BIOENGINEERING
Spring 2019 Seminar

Date: Thursday, March 21, 2019
Time: 12:00 pm - 1:00pm
Location: Krasnow, Room K229

Jeffrey Moran, Ph.D.

Biography: Dr. Jeffrey L. Moran joined George Mason University as an Assistant Professor of Mechanical Engineering in January 2018. Dr. Moran received his PhD from the University of Washington in 2013 and bachelor's and master's degrees from Arizona State University in 2007 and 2011 respectively, all in mechanical engineering. From 2013—2017, he was a postdoctoral associate and lecturer at the Massachusetts Institute of Technology, where he was supported by a Shapiro Postdoctoral Fellowship, and conducted research in the Mechanical, Chemical, and Nuclear Engineering Departments. His research interests broadly lie in thermal-fluid transport phenomena at the microscale, with particular focus on self-propelled microparticles, electrokinetic phenomena, and heat transfer.

Title: Active Colloids: Basic Physics and Biomedical Applications

Abstract: Active colloids are colloidal particles (generally 0.1-10 microns in size) that propel themselves through liquids, typically without moving parts. First introduced in 2004, active colloids move by harvesting chemical, electrical, or acoustic energy from their surroundings and converting it to mechanical work. They have been shown to move in guided patterns, tow and deliver cargo to user-specified locations, and exhibit novel collective phenomena. Thus, active colloids are being considered for a variety of applications, from environmental (e.g., wastewater treatment and oil/water separation) to biomedical (e.g., targeted drug delivery or precision surgery, realizing Richard Feynman's dream of "swallowing the surgeon"). Fifteen years after they were introduced, we are just beginning to understand their properties and capabilities.

This talk will begin with an introduction to the basic physics of swimming at the micrometer scale, in which viscous forces dominate over inertia. Micro-scale swimmers swim according to different rules than macroscopic creatures such as whales, humans, and even "small" animals like tadpoles. I will then describe ongoing work in my group geared towards developing active colloids for new applications. For example, we are investigating the use of active colloids to enhance heat transfer via the convective flows they cause in the surrounding liquid. These novel "active heat transfer fluids" could find application in a variety of warming and cooling applications, including organ rewarming or thermal cancer treatment. We are also developing active colloids to navigate through and deliver cargo in artificial extracellular matrices, which could enable novel treatments for diseases such as cancer. The talk will conclude with an outlook for the future of this nascent and burgeoning field.