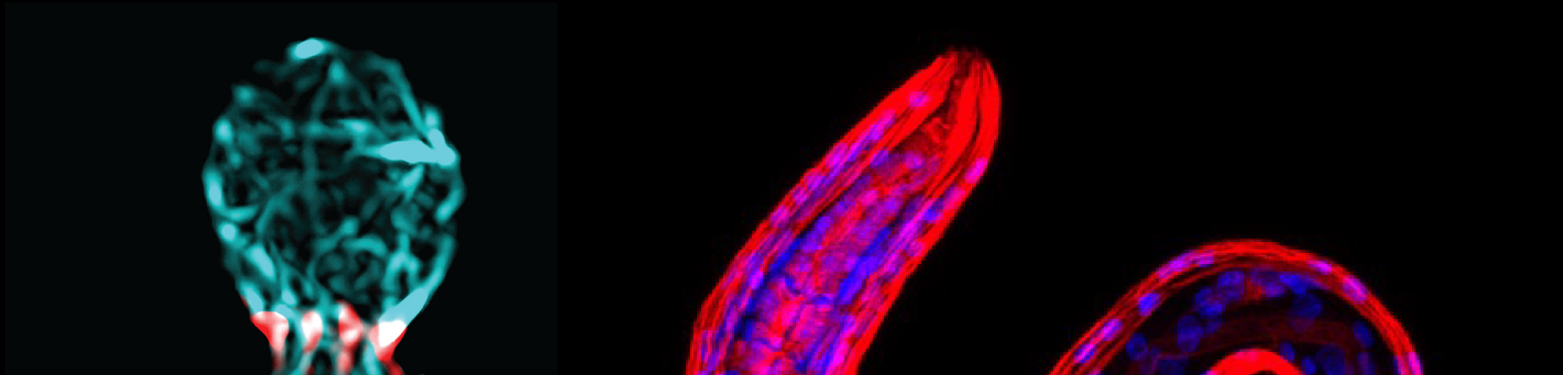
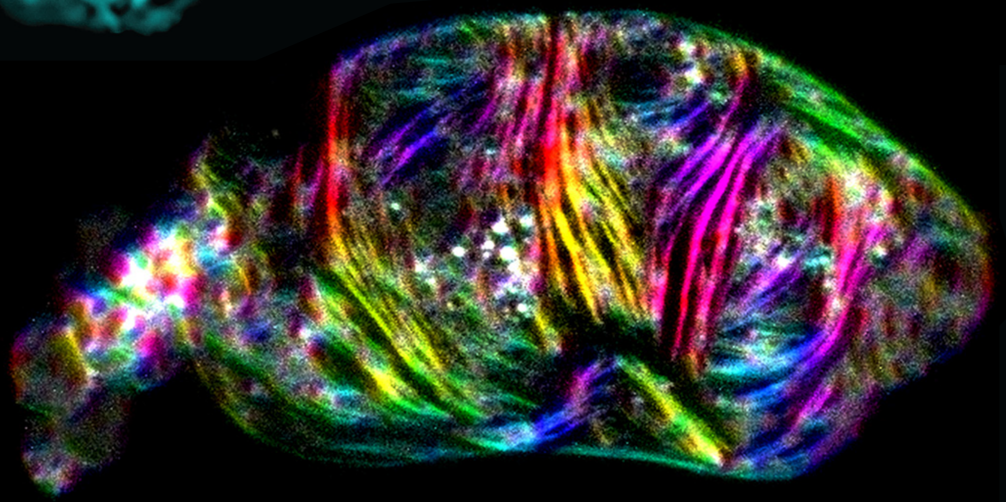


How Cells Build Protein Networks that Drive Cellular Movement and Determine Cell Shape, and How these Networks are Co-opted by Pathogens

Spring 2024 - 7.343 Advanced Undergrad Seminar
Thursday 2-4 pm (tentative) First class Feb 8th

Instructor: Alison Wirshing (wirshing@mit.edu)



Course Description: Cells come in all shapes and sizes and can dynamically change their shapes in response to environmental cues. How is cell shape determined and regulated? In short, intricate intracellular networks of protein polymers, that constitute the cytoskeleton, provide a rigid structure that determines cell shape. These cytoskeletal networks are dynamic and can generate forces that push or pull against cell membranes, producing protrusions or invaginations. Individual cells use protrusions to drive cell migration, to “feel” the surrounding environment, and to make contacts with neighboring cells. Invaginations are used to engulf extracellular molecules and objects and to remodel the plasma membrane. The cytoskeleton determines the shapes of whole tissues and organs by producing the forces that hold neighboring cells together and fold tissues. In cell-walled organisms (plants, fungi, and bacteria), rigid cell walls demarcate cell shape, and the cytoskeleton directs the deposition of new cell-wall material, shaping the cell wall and orienting cell growth. In short, across the tree of life, the cytoskeleton drives cell movement and determines cell shape. Because the cytoskeleton plays a central role in cellular structural integrity, it is commonly targeted by pathogens, including Chlamydia trachomatis, Vibrio cholera, Listeria monocytogenes, and Rickettsia rickettsia. Each of these pathogens has evolved mechanisms to hijack and weaponize the host cytoskeleton to facilitate host cell invasion and spread to neighboring cells. In this course we will discuss the primary research literature to answer questions such as: How is a single polymer assembled? How are polymers arranged into networks? How are the same components partitioned to build multiple distinct networks within a cell? How do pathogens co-opt elements of the cytoskeleton during infection? During the course students will gain valuable skills, including how to plan, interpret and critique experimental protocols and data, all while discovering the design principles and amazing capabilities of the cytoskeleton. This course will include a field trip to research laboratories at Brandeis University, where students will have the opportunity to see first-hand how cytoskeletal research is conducted both at the level of single proteins using in vitro assays and at the organismal level through genetics and live-cell imaging. In addition to learning about cytoskeletal research this field trip will allow students to meet fellow scientists, both peers and potential future mentors.