Interested in projects at the interface of engineering, cell biology and medicine?

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Fluorescence microscopy image of a cell migrating on glass. The cell is about 50 microns big and is responsible for wound healing. However, in cancer, this cell will get reprogrammed and will drive cancer metastasis. The fibers here are structures called the actin cytoskeleton. They are the engines that power cell locomotion by dynamically assembling and disassembling Want to learn more about this image, how to take it and what actin does? Read below and contact us!

Cells in our body exist not only in a rich biochemical environment but also in a highly complex and dynamic mechanical environment. Whether it is the flow of blood in capillaries, the expansion of the lungs during breathing, the contraction of the heart or the matrix that surrounds cells everywhere else, this environment is critical for most important functions in life. Starting from embryogenesis, tissue development and differentiation to immune, cardiovascular, musculoskeletal and brain function, the mechanical environment plays an important role by interacting and regulating cellular functions. Breakdown or mis-regulation of the relationship between cells and their mechanical environment results in developmental defects, immune disorders, cardiomyopathies and cancer.

To understand how the mechanical behavior affects normal health and disease, one must first understand how cells in our body interact with this mechanical environment. This question lies at the heart of the **Swaminathan lab at BMC D14**. We use combination of engineering tools, biophysical approaches and state of the art light microscopy and cell biology to quantitatively decipher how cells sense and respond to physical forces. We want to then extend this knowledge to understand how in cancer, this interaction is hijacked leading to cancer metastasis and poor patient outcome. We have 2 projects which will look at these questions and will train students in comprehensive interdisciplinary approaches to biomedical problems.

Project 1:

Regulation of cell migration by changes in physical properties of the extracellullar matrix: Here, we will ask a simple question, how does changes in mechanical properties of the environment, such as stiffness and topography effect behavior of cell migration. Cell migration is a critical cellular process which results in immune response, wound healing and tissue formation. We know that physical properties of the environment affect cell migration, but we still lack the fundamental knowledge of how this occurs. Here, the student will learn how to do cell culture, microscopy, image analysis as well as build tools to change the mechanical environment on which cells migrate.

Project 2:

Misregulation cell-matrix interactions in cancer*:* One place where cell migration gets affected is during cancer metastasis. It is thought that the same mechanisms that cells use to sense their environment is hijacked or mutated in cancer cells which then migrate in an uncontrolled manner. This process, by which cancer cells migrate out of the primary tumor and attack secondary sites is called metastasis and results in poorer patient outcomes in cancer. In this project, students will work with different cancer cells and using the same approach as above, quantitatively understand the mechanisms that are awry in these systems.

In both projects, training will include basic molecular biology and cell biology, cancer cell biology, microscopy, image analysis, mechanics of materials, instrumentation and optics.