**A Window into Cellular Processes**

Cells are the fundamental unit of life. The goal of the Cellular Dynamics Theme is to visualize, quantify and model dynamic cellular processes with the goal of understanding, preventing and treating disease. We use novel bioimaging approaches and diverse cell types to address fundamental issues of cell based processes.

### Quantitative Microscopy
- Single Molecule mechanics and kinetics
- Novel Imaging probes & Optogenetics
- TIRF Microscopy of cells and molecules
- Fluorescent DNA based sensors
- Super-resolution microscopy

### Cell Growth
- Force measurements in mitotic cells
- Mitotic spindle assembly
- Stem Cell Differentiation
- Stem cell induced tumors
- Outer segment renewal in retina
- Motor protein function in cell division

### Cellular Dysfunctions & Disease
- Human retinal degenerative disease
- Stem cell induced tumors
- Heart failure
- Muscle dysfunction
- Genetic Cardiomyopathies
- Chromosome segregation errors & birth defects

The Cellular Dynamics Research Cluster seeks to understand fundamental cellular processes and gain insight into the dysfunctions that result from defects in these processes. Areas of expertise include: cell division and chromosome segregation; molecular motor proteins; cytoskeleton regulation and dynamics; cell growth and renewal; cancer cell biology. Examples of current work include: response of Drosophila gut tumor cell growth to chemotherapy drugs; mechanisms of outer segment renewal and its disruption in retinal degeneration; error correction during chromosome segregation; mechanics of myosin in muscle fatigue and heart failure.

The Fritz-Laylin Lab examines the evolutionary roots of cell locomotion using a wide range of cells including neutrophils, amoebae, and fungi. The high-speed locomotion shared by these diverse organisms is critical for the rush of immune cells to sites of infection, as well for the migration of parasites into and through host tissue. Image shows the surface of an actively migrating neutrophil.
Debold Lab uses single molecule biophysical approaches to understand the root molecular basis of muscle dysfunction including heart disease and fatigue.

Image shows the single molecule laser trap assay used to assess the mechanics and kinetics of a single actomyosin protein-protein interaction.

The Sun Lab uses synthetic substrates to promote differentiation of human pluripotent stem cells, which may be used to treat degenerative diseases like ALS.

The Markstein Lab studies how stem cells interpret and respond to natural and synthetic chemicals in the environment. The fruit fly is used as a model because it enables us to study stem cells in vivo where critical cell-cell interactions that impact stem cell behavior remain intact. Chemical and genetic screens are used to understand basic stem cell biology and its impact on cancer and toxicology.

Cellular Dynamics is on the forefront of exciting collaborative, translational, and product-driven science with a mission to improve human health and well-being. Within the new Life Science Laboratories at UMass Amherst, made possible by a $95-million investment by the Massachusetts Life Sciences Center, IALS houses a vibrant community of interdisciplinary faculty, as well as, state-of-the-art laboratory space and IALS Core Facilities.

The use of Light Microscopy, Biophysical Characterization and Flow Cytometry have been instrumental in the ongoing research efforts of this theme. For more information on the IALS Core Facilities, please visit: umass.edu/ials/core-facilities.