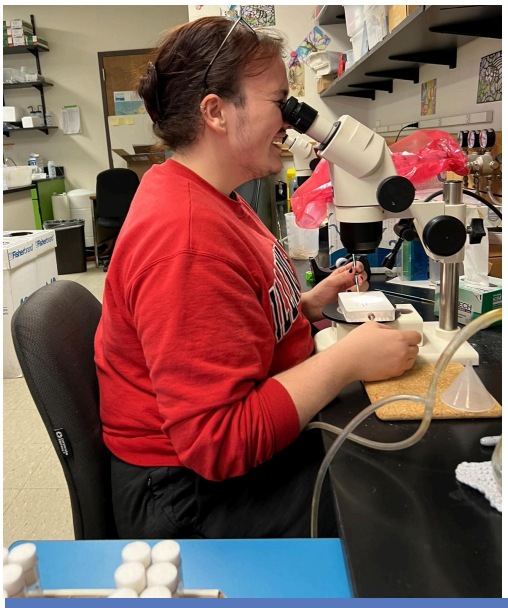
Augustana Physics, Engineering, and Astronomy Seminar

Computational Techniques for Quantifying Epithelial Morphogenesis during Drosophila Gastrulation and Axis Elongation

Liam Russell, Graduate Research Assistant
Molecular and Cellular Biophysics
University of Denver

During early development of multicellular animals, modulating from a single-cellular fertilized egg to an adult organism with specialized tissues and dramatically altered body shapes is a non-trivial task known to be regulated by mechanical and biochemical cues at various spatiotemporal scales. Epithelial cells during development are driven by local molecular forces to contract and expand, buckle and bend, and generally increase their apparent complexity as they differentiate and exhibit the diversity of forms displayed in mature organisms. The biophysical requirements for successful morphogenesis of these complex tissues have long been an interest of developmental biologists, and in more recent years, bio- and soft matter physicists. In the era of computer vision and artificial intelligence, more and more questions in the field are being answered through quantitative computational methods. Gastrulation and associated convergent extension in the early fruit fly embryo is an excellent system for such computational techniques; the four-dimensional microscopy datasets required to visualize morphogenetic events in embryonic epithelia often comprise of hundreds of volumetric images, which are incredibly time-consuming to analyze manually. In this seminar, I will discuss roadblocks and best practices for bulk analysis of fluorescent microscope datasets, as well as new and upcoming machine-learning tools for biomedical image processing. I will also share some preliminary data from my thesis project, wherein the aforementioned analytical techniques are helping us better understand the mechanical impacts subcellular organelles like the nucleus have on epithelial remodeling processes.



My name is Liam Russell, I'm a 3rd year PhD candidate in the Molecular and Cellular Biophysics program here at the University of Denver. I graduated from Augustana with my bachelor's degree in 2021, where I majored in Physics and Chemistry and minored in math. At the time, I was convinced I'd go a quantum/nuclear physics route in grad school, but after applying to the University of Denver where I now attend, I was recruited into the biophysics program by my now advisors Todd Blankenship and Dinah Loerke, as they felt my undergrad coursework would be a good fit for their growing program. Since I had a little bit of undergrad coding experience, I was able to smoothly shift into my current workflow, which consists of lots of fluorescent microscopy and computational image analysis, even with very little biology background. I greatly enjoy grad school and am super glad I've found a home here in the growing world of biophysics!

Tuesday, April 30, Hanson 128, 4:15-5:00 pm