

C3S2

The Clarkson Center for Complex Systems Science

Caitlin Hult, Gettysburg College

Will present a talk entitled:

“From neutrophils to the nucleolus: Mathematical modeling of the spatiotemporal dynamics and organization of complex biological systems”

Abstract: Mathematical models, data analytics, statistical analysis, and visualization techniques are valuable tools in the effort to determine the mechanisms that drive the spatiotemporal dynamics and organization of complex biological systems. In the first part of this talk, I will discuss how mathematical modeling enhances understanding of the immune response to human infection with the bacteria *Mycobacterium tuberculosis* (Mtb), which results in the formation of unique, emergent lung structures called granulomas. Due to the duration and dynamic nature of this immune response (years to decades), as well as the involvement of processes that occur over tissue, cellular, and molecular scales, we take a multiscale and mechanistic computational modeling approach. We build a hybrid agent-based model through which we generate simulated granulomas whose range of spatial configurations reflects the heterogeneity observed experimentally, and we investigate how the behavior of neutrophils influences Mtb pathology (e.g., dissemination events). In the remainder of this talk, I will present a coarse-grained, entropic polymer chain model for the genome in living yeast cells, a highly dynamic system where entropic interactions and nuclear confinement drive the formation of domains of high chromosomal interaction, known as topologically associating domains. Specifically, I will show that enrichment of dynamic chromosomal crosslinks drives phase separation of and substructure within the nucleolus. Through our work, we hope to advance understanding of these systems -- broadly, the immune response to infectious disease and the eukaryotic genome -- beyond current experimental capabilities.

Bio: Dr. Hult did her undergraduate studies in Mathematics and English Literature at Hamilton College. She went on to earn her Ph.D. in Mathematics from the University of North Carolina at Chapel Hill. A mathematical biologist, she then spent three years as a postdoctoral research fellow at the University of Michigan Medical School, where she was advised by Dr. Denise Kirschner in the department of Microbiology & Immunology and Dr. Jennifer Linderman in the department of Chemical Engineering. Dr. Hult is now an assistant professor of Mathematics and an affiliate in Biochemistry & Molecular Biology at Gettysburg College, where her current research focuses on mathematical modeling with applications to immunology and chromatin dynamics.

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Friday, September 16, 2022

12:00 pm