QUANTITATIVE & SYSTEMS BIOLOGY SEMINAR:
Epithelial Cell Jamming in Development, Asthma and Cancer

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Date:
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Time:
2:30 PM-3:45 PM

Location:
Please contact snsgradstaff@ucmerced.edu for the Zoom information.

About The Speaker:

My laboratory investigates physical processes expressed by the eukaryotic cell, such as its deformability, contractility, malleability, and motility. We turned attention more recently from the single cell in isolation to the cellular collective as it might pertain, for example, to disruption of the bronchial epithelial layer in asthma or tumor invasion in breast cancer. To probe these physical processes at the levels of the single cell and the cellular collective, we developed a series of novel microscale technologies that now include magnetic twisting cytometry, Fourier-transform traction microscopy, monolayer traction microscopy, and monolayer stress microscopy.

Using this suite of technologies, we were first to show that cells comprising an epithelial collective can jam much as do coffee beans that become jammed a chute. Or instead, they can unjam and migrate, invade and spread. Taken together, this body of work has illuminated relevant but poorly understood physical processes that underlie asthma, wound healing, development, and cancer. I have served on the scientific advisory committee of the Parker B. Frances Foundation, as a full time member on three standing NIH study sections (RAP/RIBT, program project HLBP, T32 institutional training mechanism NITM), and on two NIH committees (NSF/NIH interagency panel on Research at the Interface of Life and Physical Sciences; and the Study Section Boundary Team, Pulmonary Sciences IRG). I also have significant experience in mentoring trainees for transition to academic independence.

Abstract:

The last decade has seen a surge of evidence supporting the existence of the transition of the multicellular tissue from a collective material phase that is regarded as being jammed to a collective material phase that is regarded as being unjammed. The jammed phase is solid-like and effectively 'frozen', and therefore is associated with tissue homeostasis, rigidity, and mechanical stability. The unjammed phase, by contrast, is fluid-like and effectively 'melted', and therefore is associated with mechanical fluidity, plasticity and malleability that are required in dynamic multicellular processes that sculpt organ microstructure. Such multicellular sculpturing, for example, occurs during embryogenesis, growth and remodeling. Although unjamming and jamming events in the multicellular collective are reminiscent of those that occur in the inert granular collective, such as grain in a hopper that can flow or clog, the analogy is instructive but limited, and the implications for cell biology remain unclear. Here we ask, are the cellular jamming transition and its inverse — the unjamming transition— mere epiphenomena? That is, are they dispensable downstream events that accompany but neither cause nor quench these core multicellular processes? Drawing from selected examples, here we suggest the hypothesis that, to the contrary, the graded departure from a jammed phase enables controlled degrees of malleability as might be required in developmental dynamics. We further suggest that the coordinated approach to a jammed phase progressively slows those dynamics and ultimately enables long-term mechanical stability as might be required in the mature homeostatic multicellular tissue.

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