UNIVERSITY OF DELAWARE

CENTER FOR BIOINFORMATICS & COMPUTATIONAL BIOLOGY

BIOINFORMATICS SEMINAR

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Optogenetics for intracellular codebreaking: how ERK dynamics control gene expression and cell fate

Every cell exists in a complex and changing environment. To deal with their complex surroundings, cells have evolved diverse systems to sense external cues and create an internal representation of this information. However, we are still largely in the dark about how external information is stored in patterns of protein activity, and how this information is decoded into specific cell fate decisions. I will talk about our efforts to overcome these challenges using cellular optogenetics: the delivery of precise spatial and temporal activity patterns to a signaling protein of interest. We have developed a suite of optogenetic tools to precisely control MAP kinase (MAPK) signaling. Combining optogenetics and live-cell biosensors enables us to dissect how signaling dynamics are "read out" into target mRNA and protein levels. Applying these tools in the Drosophila embryo further revealed how a model cell fate choice - differentiation into posterior midgut endoderm - is controlled by specific patterns of MAPK activity.

BIOGRAPHY

Jared Toettcher is an Assistant Professor of Molecular Biology at Princeton University. Originally from California, he graduated with a B.S. in Bioengineering from UC Berkeley in 2004. He completed his graduate studies at MIT in Biological Engineering in 2009, working with Bruce Tidor (MIT) and Galit Lahav (Harvard Medical School) on the relationship between mammalian cells' surveillance of DNA damage and decision to undergo cell cycle arrest. Dr. Toettcher then completed a Cancer Research Institute postdoctoral fellowship under Wendell Lim and Orion Weiner at UC San Francisco, where he developed new tools to control mammalian cell behavior by engineering optogenetic inputs to the signaling pathways controlled by Ras and PI 3-kinase.

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