Chez Pierre

Presents ...

Thursday, February 5, 2009
1:15pm
MIT Room 4-331

Nick Buchler

The Rockefeller University

"From genes to dynamics: Combinatorial logic and thresholds in molecular networks"

Cells are controlled by molecular networks capable of sophisticated functions and dynamics. For example, cells receive a wide variety of cellular and environmental signals that are integrated combinatorially at the level of gene expression. Using a thermodynamic model of gene expression and invoking only specific protein-DNA interaction and weak "glue-like" interactions between regulatory proteins, the first half of my talk will demonstrate how regulatory logic functions of increasing complexity can emerge.

Molecular networks in cells also exhibit important dynamical behaviors, such as bistability and oscillation. Threshold or `all-or-none' gene expression is a necessary feature for the emergence of such dynamics in gene networks. In biology, many regulatory molecules are titrated by an inhibitor into an inactive complex. Using an experimental approach in budding yeast, we demonstrate that molecular titration generates tunable, all-or-none thresholds in gene expression. These results suggest a mechanism for the rapid evolution of bistable switches (e.g. memory) and oscillators (e.g. clocks) in molecular networks.