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Systems Biology of Mammalian Cells: The Dynamics of Pathways and Networks

Kwang-Hyun Cho

College of Medicine and Bio-MAX Institute, Seoul National University, Seoul 151-742

The principal goal of Systems Biology is to understand the nature of the organization and dynamics of living systems. This can be achieved not by just cataloguing and characterizing the constituent physical components but by unraveling the interactions of the components which are mostly nonlinear. To this end, we employ mathematical modeling and computer simulation of the information-flow in 'pathways and networks' that are the result of interacting components. Pathways are a fundamental concept by which scientists describe processes and relationships in biomolecular systems. Mathematical modeling and simulation of cellular dynamics based on the concept of pathways has gained a renewed interest in the area of systems biology. In this presentation, dynamical analysis of signal transduction pathways is to be used as a guide for discussion on what the challenges are if we are to study pathways as dynamic systems. While acknowledging the enormous complexity of such systems, the lack of reliable, accurate and sufficiently rich data sets, and the inadequacies of our methodologies, we find that even simple simulations and the modeling process itself can provide the life scientist with useful information and new insights into the complex nonlinear behavior.