

1014-92-25

Michael Savageau*, University of California Davis, Department of Biomedical Engineering, and Microbiology Graduate Group, Davis, CA 95616. *Function, design, and evolution of gene circuitry.*

The physical basis for complex phenotypes is the context-dependent expression of the organism's genome. The context is provided by the life cycle of the organism; the molecular mechanisms of gene regulation interpret that context and orchestrate appropriate responses. The regulation of many gene systems has been studied in detail, and the results have revealed an enormous diversity of molecular elements and circuits. We are just beginning to understand the functional implications of such variations in design and to grasp the factors that have influenced their evolution. The relationship of these variations in design to the phenotype of the organism is even less clear. A quantitative systems approach is required to elucidate these relationships, for without it our understanding will remain descriptive and lack predictive value. This talk will focus on such a theory that relates molecular mechanisms of gene control to the organism's natural environment. Three aspects will be emphasized: mathematical methods for characterizing and comparing the function of gene circuits, biological design principles that have been revealed by such an approach, and implications for the evolution of a specific, well-studied gene circuit. The results provide surprising predictions concerning the organism's phenotype and habitat. The lessons learned provide a deeper understanding of intact biological systems in their natural environment. They also provide guidance as we attempt to re-engineer gene circuits with the intent of correcting pathologies through rational treatment or of producing useful products through biotechnology. (Received June 02, 2005)