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# Report on the Mathematics Workshop for the Genomes to Life Program

## Executive Summary

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### **The Mathematics of Genomes to Life**

On March 18 and 19, 2002, a group of mathematical, computational, and biological scientists met in Gaithersburg, Maryland, to identify long-term mathematics research needs in biological areas represented by the Genomes to Life (GTL) program under development by the U.S. Department of Energy. Several speakers gave overviews of different ways in which applied and computational mathematics are expected to play an important role in this program. The remainder of the workshop was spent in smaller-group discussions on specific topics, with the goal of designating key areas of mathematics research that will contribute to GTL.

The workshop focused on computational mathematics techniques to identify and characterize the molecular machines of life and characterize gene regulatory networks and the

functional repertoire of complex microbial communities in their natural environments at the molecular level. Effectively modeling these complex biological processes will require substantial developments in many areas of computational mathematics involving discrete, continuous, and stochastic processes. This report summarizes workshop findings in regard to a broad range of mathematical and computational topics and techniques that will be expected to play a role in the long-term research program envisioned for GTL. These topics and techniques include the study of hybrid systems of differential, discrete, and stochastic equations modeling processes with multiple spatial and temporal scales; generalized dynamical systems; statistical modeling; and processes involving noise and uncertainty, differential geometry and topology, graph theory, and mesh generation, among others.