

ABSTRACT

Many biological processes that underlie human health, an abundant and high quality food supply, a healthy and sustainable environment, and a renewable energy supply are complex, with multiple intertwined feedback loops. Systems biology uses mathematics and mathematical models as the key enabling technology to capture this complexity in predictive computer models that allow the efficient design of control strategies, such as the development of new drugs for a variety of human, animal, and plant diseases. There is considerable need for mathematical scientists trained in the development and application of mathematical algorithms for systems biology, and this project focuses on meeting this need. The program takes advantage of a unique research environment that brings together several ongoing programs to develop and implement mathematical algorithms for modeling, simulation, and control of molecular networks. It provides a 10-week, in-residence, intensive summer research program for U.S. citizen or permanent resident undergraduate students from around the United States and Puerto Rico. It will provide participants with a broad view of available career opportunities for mathematical scientists in academia, industry, and government. Participants will have the opportunity to expand their professional network of peers and mentors. The award is supported by the Division of Mathematical Sciences (DMS) in the Directorate for Mathematical and Physical Sciences (MPS) and the Division of Biological Infrastructure (DBI) in the Directorate for Biological Sciences (BIO).

Modeling and simulation is a key technology for systems biology. The focus is on biological systems that might be organized into gene regulatory, signaling, or metabolic networks, maybe linked with spatial processes, such as translocation of molecules across cellular compartments. Various intertwined feedback and feedforward loops might be involved in the regulation of the system, linking the molecular with the systemic level. Mathematical models of various kinds are indispensable tools in the effort to understand these systems. There is a clear need for mathematical scientists whose expertise can address these complexities in innovative and rigorous ways. Career opportunities for mathematical scientists with expertise in the biosciences are plentiful in both academics and in industry, in particular in the health care field.