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EDITORIAL

Enabling the new biology of the 21st century

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Systems biology is an integrative science that aims to bridge the individual behavior of biological components with a collective behavior of the system. Synthetic biology, a technological counterpart, borrows key hierarchical and modular concepts from systems biology. Novel pathways, cell-like systems and multicell communities are constructed from a library of standardized biological parts. The shared goals of systems biology and synthetic biology are to gain a fundamental understanding of cellular processes and create new cell circuits using a combination of experimental, theoretical and computational methods. To meet the growing need of scientific community, a new journal *Systems and Synthetic Biology* has been launched. The journal will provide an open access, peer reviewed, scientific and scholarly digital content covering theoretical, experimental and technological aspects of these disciplines.

A cell is an evolvable and self-replicating molecular machine. From a hydrogen atom to the level of a cell and then an entire organism, biology manages information over many magnitudes in size and number of components. The topological complexity of biological systems is far greater than that of rationally designed artificial systems. Furthermore, complexity introduced by weighted networks, feedback loops, reversibility of reactions, transient networks and cooperative interaction demands novel ways of data acquisition, analysis, integration and hypothesis generation. The grand challenge in systems biology is to build a complete and high-resolution description of molecular topography and connect molecular interactions with physiological responses (Nurse 2003; Dhar et al. 2004; Westerhoff and Palsson 2004). Systems biology will realize its fullest potential once individual contributions of components are tied to variations in the system level behavior.

Synthetic biology combines knowledge from various disciplines including molecular biology, engineering, mathematics, and physics to design and implement new cellular behaviors. The new behaviors are achieved through a variety of bioengineering efforts that include the construction of novel proteins, genetic circuits, signaling cascades, and metabolic networks. Through the *de novo* construction of elements and circuits, the goal of synthetic biology is both to improve our quantitative understanding of natural phenomenon as well as to foster an engineering discipline for obtaining new complex cell behaviors in a predictable and reliable fashion. Recent achievements include the development of sophisticated non-native behaviors such as bi-stability, oscillations, customizable biosensing proteins, metabolic networks optimized for drug synthesis, and coordinated behavior of cell populations (Gardner et al. 2000; Elowitz and Leibler 2000; Basu et al. 2005). Future advancements in this field will require a variety of improvements in many areas such as DNA synthesis, mathematical modeling tools, standards and abstractions for the construction of complex circuits, and the ability to manipulate different aspects of the complex biochemical machinery of cells. *Systems and*

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Synthetic Biology will publish research articles that either advance this field as an engineering discipline or use synthetic biology to improve our scientific knowledge of existing phenomenon. The journal aims to publish original research articles in experimental and theoretical aspects of systems and synthetic biology, methodological developments, reviews and commentaries. The aim is to disseminate information and stimulate the development of these disciplines.

Both systems biology and synthetic biology have been recently recognized as specialized disciplines and require a dedicated platform to bring together publications that currently find destinations in diverse journals. The journal will provide a unique home for experimental systems biologists and synthetic biologists while providing adequate coverage for theoretical work. *Systems and Synthetic Biology* has a distinguished board of scientists from experimental, theoretical, computational, mathematical, engineering fields.

Over the last several years, the open access philosophy (Varmus et al. 2000; Wadman 2004; Gannon 2004) has practically rewritten the *first principles* of electronic publishing. Springer offers a unique Open Choice model that offers an option of choosing the traditional publishing model or open access. In the Open access option authors would retain the copyright to their work and are free to place a copy of their article on their individual or institutional website. All the articles will be peer-reviewed and available in both print and electronic versions via SpringerLink. In addition, every article will be registered in CrossRef and included in the appropriate Abstracting and Indexing services. Authors may also want to incorporate additional non-text files such as sound or video in the electronic edition. All submitted papers will be subjected to rigorous peer review, which will be closed and strictly confidential.

Summary

The emerging fields of systems biology and synthetic biology represent new biological disciplines of the 21st century. *Systems and Synthetic Biology* journal has been launched to lead a directed evolution of these disciplines.

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