PROPOSAL FOR A EUCROCORES THEME PROPOSAL IN THE AREA OF SYNTHETIC BIOLOGY

Proposal name: Synthetic Biology: Engineering Complex Biological Systems
Proposal Acronym: EUROSYNBIO

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Abstract (300 words)
EUROSYNBIO:
Synthetic biology unites multidisciplinary efforts directed at the design of complex biological systems to obtain useful novel properties and activities based on the exploitation of well-characterized, orthogonal, and re-utilizable building blocks. It aims to adopt the design structures that are well established in classic engineering disciplines, such as a hierarchy of abstractions, system boundaries, standardized interfaces and protocols, and separation of manufacturing and design, for biotechnology. Synthetic biology is predicated on the notion that successful design of a biological system from scratch is the ultimate proof of understanding, and concomitantly the most powerful way to advance biotechnological solutions to challenging global problems in bioenergy, biomedicine and bioremediation. Synthetic biology thus represents a sea change from the current practice of simplistic small scale adaptation of poorly understood natural systems towards often incompatible goals. Synthetic biology thus requires advanced strategies for the design and implementation of autonomous parts or minimal functions, subsystems, and finally complex systems into suitable chassis. To realize this, synthetic biology has to address significant conceptual challenges in the design of complex systems, in particular those posed by orthogonality and evolution.
These experimental strategies have to be intimately supported by computational tools that employ computational interchange standards, ontologies, and collaborative environments, help to mine the design-relevant data from literature, and provide the required computational frameworks to address complex molecular and systems design tasks.
In addition, we must advance the current synthetic laboratory infrastructure to a system-level scale through both novel bioengineering strategies, and the adaptation of existing strategies through miniaturization and parallelization. A fundamental advance in synthetic capacity, encompassing *de novo* DNA synthesis, analysis, and system assembly, will ultimately allow us to overcome significant current hurdles in biosystems design.
Finally, synthetic biology must be implemented in a broad societal context that will require explicit research into the ethical, legal, safety, and security ramifications of these powerful new technologies.

Key words
Complex systems; parts; devices; gene and genome assembly, orthogonality; orthogonality; engineering design; computational tools; social context