ACS SyntheticBiology

Editorial

pubs.acs.org/synthbio

Synthetic Biology

Synthetic biology aims to improve the process of genetic engineering. It looks to a future where the design of genetic systems and the idiosyncrasies of DNA are decoupled, and one can compose living systems by mixing-and-matching genetic parts. At its core, this will require a multidisciplinary approach and significant communities have sprouted in nearly all engineering disciplines, including biological, chemical, and electrical engineering as well as fields in basic science such as chemistry, biology, mathematics, and biophysics. The objective of this journal is to provide a home for the research that, while spread across these fields, shares a common goal.

ACS Synthetic Biology has adopted a broad definition of the field and invites the submission of research in all areas that aid genetic engineering. Some areas of particular interest are outlined below, and these areas are well represented by the Associate Editors and the Editorial Advisory Board. We are pleased to note that research articles, which will be published in the first few issues of the journal, are representative of nearly all of these areas.

- *Genetic Programming.* The ability to program a cell will enable control over the conditions, dynamics, and coordination of cellular functions. Genetic programs consist of integrated genetic circuits that collectively perform a computational operation. Much work needs to be done to design circuits that are robust to genetic and environmental context and can be easily connected.
- *Biomolecular Engineering.* This refers to the *de novo* design or optimization of individual molecules or intermolecular interactions, including proteins, RNA, DNA, or small molecules. Methods involving directed evolution and computational design are encouraged, including underlying biophysical models.
- *Metabolic Engineering.* The goal of metabolic engineering is to increase the production of a molecule produced by the cell (e.g., an industrial chemical or pharmaceutical) by manipulating its biochemical network. This requires the identification of new enzymes that can perform desired transformation, their integration into a hererologous host, and the manipulation of flux through the network. Many innovative computational tools have been developed to aid this process, including metabolic flux analysis.
- *DNA Synthesis and Assembly.* The physical construction of DNA currently limits the ability to rapidly test design. New methods are being developed to synthesize and assemble DNA. These include approaches that will enable the rapid assembly of complex designs by liquid handling robots at high fidelity.
- *Computer Aided Design (CAD).* The scale of genetic engineering is increasing and managing megabase designs is daunting with current techniques. New methods will have to be developed and integrated for each aspect of cellular design (e.g., electrical engineering methods for integrating genetic circuits and kinetic models of metabolic flux). Further, algorithms need to be developed to optimize DNA synthesis/assembly pipelines. Finally, the ontological representation of genetic parts and their associated characterization data is a nontrivial problem.
- *Cell State Analysis.* A limitation in debugging is the lack of understanding of how a synthetic genetic design impacts the living host cell. We encourage submissions of experimental methods, and supporting computational tools, that enable the determination of the cell state, including protein and mRNA levels. These methods could include approaches from proteomics, mass spectroscopy, NMR, ChIP-seq, and next-generation sequencing.
- *Systems Biology and Bioinformatics.* Many of the tools from these fields support efforts in synthetic biology. For example, methods from systems biology to measure and model cell dynamics can be reapplied for engineering purposes. Genomic techniques also enable the impact of synthetic design on host processes to be determined. Bioinformatics tools are particularly relevant in part mining efforts, where genes and regulatory parts are identified from the sequence databases, optimized and constructed via DNA synthesis, and screened for activity. Bioinformatics can also be used to scan designs for errors and unwanted functions.
- *In vitro Biochemistry and Artificial Life.* Living cells are complex systems that often pose a challenge to deconvolute an effect from a web of interactions. Understanding biological systems in the abstract, whether it be the impact of lipid chemistry on the membrane or ATP concentration on a signaling pathway, will require the artificial reconstitution outside of a living cell.

There are no limitations regarding organism. We expect to publish everything from *in vitro* work and viruses through bacteria to mammalian cells, plants, and animals. Research can range from pure theoretical/computational work to experimental research. There will be papers describing new science and engineering achievements, as well as methods papers and technical reports.

As a journal, *ACS Synthetic Biology* has several notable features. First, since the journal will be published by the American Chemical Society, you can expect the high-quality features provided to all journals of the Society as well as the support of other divisions of the Society. Second, as a multidisciplinary journal, we equally encourage the submission of novel as well as useful research. Third, there are no page limits or publications charges imposed on authors: authors can describe their work in necessary detail. Special Perspectives from researchers in companies will serve as a resource for students interested in the synthetic biology industry. Fourth, ACS offers *ACS AuthorChoice*, an innovative option for authors

Received: January 3, 2012
Published: January 20, 2012

   dx.doi.org/10.1021/sb300001c | *ACS Synth. Biol.* 2012, 1, 1−2

who wish or need to sponsor open access to their published research articles [Link: http://pubs.acs.org/page/policy/authorchoice/press-release.html]. Lastly, in addition to some of the standard article types such as Articles, Letters, and Reviews, we will be publishing Perspectives, Tutorials, and Technical Notes, including those from researchers in academia and industry, who are engaged or interested in synthetic biology.

Together with the Associate Editors and Editorial Advisory Board, I invite you to send your best research to *ACS Synthetic Biology*. We look forward to publishing the exciting content in the journal that will drive the field.

Christopher A. Voigt, Editor-in-Chief, *ACS Synthetic Biology*

dx.doi.org/10.1021/sb300001c | *ACS Synth. Biol.* 2012, 1, 1−2