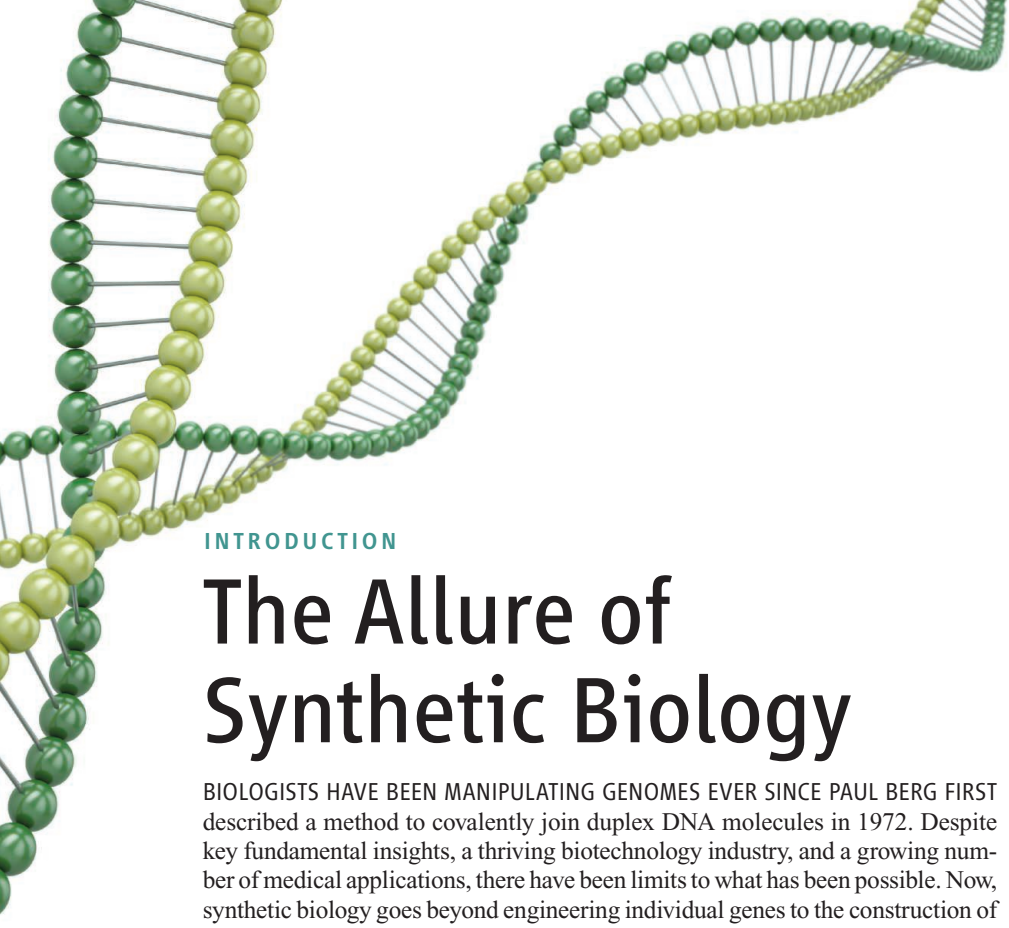

INTRODUCTION

The Allure of Synthetic Biology

BIOLOGISTS HAVE BEEN MANIPULATING GENOMES EVER SINCE PAUL BERG FIRST described a method to covalently join duplex DNA molecules in 1972. Despite key fundamental insights, a thriving biotechnology industry, and a growing number of medical applications, there have been limits to what has been possible. Now, synthetic biology goes beyond engineering individual genes to the construction of DNA-encoded circuits that can be programmed to control cell behavior.

This emerging field brings together biologists, physicists, chemists, and engineers who seek both to understand life and to build new biological functions. For example, Harvard's George Church wants to redesign the genetic code (p. 1236). The potential of synthetic biology has also attracted artists who want to critique it and make use of its techniques (p. 1242), as well as do-it-yourself biologists, some of whom have set up community labs (p. 1240).

Nandagopal and Elowitz (p. 1244) describe how building circuits and studying their behavior in cells can provide insight into biological design principles. Initially, the focus was on creating autonomous circuits, but recently there has been a move toward integration of endogenous and synthetic circuits. This can allow the "rewiring" of cellular circuitry to control biological processes—a goal not only of scientists who seek to understand these processes but also of biotechnicians and clinicians who would like to direct cell behavior to their advantage. Ruder, Lu, and Collins (p. 1248) discuss specific constructs that highlight the potential for moving toward clinical applications. They envision synthetic circuits that detect unhealthy cellular phenotypes and take corrective action. Service (p. 1238) covers progress in algal biofuels, for which synthetic biology has helped to make possible rapid improvements that may ultimately make algae a viable alterative fuel source.

In these examples, the assembly of the synthetic systems is within an existing organism. Schwille (p. 1252) paints a more radical view of synthetic biology, envisioning cells built entirely from synthetic modules. Here, the question is not how a biological system actually functions, but rather what minimal set of elements would support function. With the application of synthetic biology come ethical challenges. Erickson *et al.* (p. 1254) present the industry point of view about the potential of synthetic biology and a possible regulatory framework. This special section, together with the three related research Reports and the profile in *Science* Careers, captures the range of expertise now entering this field and highlights how the construction of new biological systems might be harnessed to serve humanity.

– VALDA VINSON AND ELIZABETH PENNISI

Synthetic Biology

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See also Editorial p. 1200; Reports pp. 1292, 1307, and 1315; Science *Careers content, plus* Science *Podcast p. 1197 and www.sciencemag.org/special/syntheticbio*

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