

PREFACE

The 21st century is widely heralded as the century of biology. Building on the fundamental understanding achieved in the second half of the last century, revolutionary advances are expected to improve many aspects of our lives, from clean energy and targeted, safer medicines to new industries. Prominent among emerging technologies is "synthetic biology," which aims to apply standardized engineering techniques to biology and thereby create organisms or biological systems with novel or specialized functions to address countless needs. This book examines the Presidential Commission for the Study of Bioethical Issues review on the developing field of synthetic biology which researches and identifies appropriate ethical boundaries to maximize public benefits and minimize risks.

Chapter 1 - PCSBI approached this task through inclusive and deliberative engagement with ethicists, scientists, engineers, and individuals in faith, business, and non-profit communities. We held three public meetings, both in and outside of Washington, D.C., created an open forum for dialogue, and heard many diverse voices. The Commission found that synthetic biology offers extraordinary promise to create new products for clean energy, pollution control, and medicine, to revolutionize chemical production and manufacturing, and to create new economic opportunities. With this promise comes a duty to attend carefully to potential risks, be responsible stewards, and consider thoughtfully the implications for humans, other species, nature, and the environment. PCSBI concluded that synthetic biology is capable of significant but limited achievements posing limited risks. Future developments may raise further objections, but the Commission found no reason to endorse additional federal regulations or a moratorium on work in this field at this time. Instead, the Commission urges monitoring and dialogue between the private and public sectors to achieve open communication and cooperation. The Commission recommends that the government, through a coordinated process or body within the Executive Office of the President, lead an ongoing review of developments, risks, opportunities, and oversight as this field grows. This review should be in consultation with relevant scientific, academic, international, and public communities, and whenever possible its results should be made public. We also recommend that reasonable risk assessment should precede any field release of synthetic organisms. We suggest support for public engagement, education, and dialogue to ensure public trust and avoid unnecessary limitations on science and social progress. You gave the Commission a rare and exceptional opportunity to be proactive and forward looking in this first study. The Commission is grateful for the opportunity to serve you and the nation in this way. We would be happy to brief you if you have any questions about our recommendations.

Chapter 2 - The term “synthetic biology” is used and defined in a variety of ways within the scientific community. Indeed, the dynamic nature of science all but ensures that a precise definition of “synthetic biology” will remain elusive and will evolve over time. The power of synthetic biology, as more broadly envisioned, reflects the possibility of synthetic biological systems that are programmable, self-referential, and modular. The ability to reformat the modules (e.g., the use of altered genetic codes or unnatural amino acids) leads to increased information content and vastly expanded possibilities for new function. Functionally, two disparate experimental approaches can be used to describe synthetic biology: “top down” and “bottom up.” The goal of both is to create novel biological structures with predictable properties and functions. The top down approach is related to classical recombinant DNA approaches and involves the re-engineering of existing organisms or genomes for a defined purpose. Increasingly powerful methods for DNA synthesis and assembly have significantly accelerated re-engineering capabilities, however. The bottom up approach entails the assembly of biological components in a variety of novel ways. This approach attempts to assemble systems (both living and nonliving) that perform desired functions in a predictable manner. Additionally, synthetic biology can be viewed even more broadly to include several emerging areas of study (e.g., nanotechnology, biocomputation), and we note that the biosecurity risks and dual use potential of new technologies and scientific information, regardless of their fields of origin, will remain important considerations for all areas of science.

Chapter 3 - This is a statement of J. Craig Venter, President, J. Craig Venter Institute.

Chapter 4 - This is a testimony of Dr. Jay Keasling, University of California at Berkeley.

Chapter 5 - This is a testimony of Dr. Drew Endy, Stanford University.

Chapter 6 - This is a testimony of Gregory E. Kaebnick, The Hastings Center.

Chapter 7 - This is a testimony of Dr. Anthony S. Fauci, Director, National Institute of Allergy and Infectious Diseases, National Institutes of Health.