SynBio

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Editorial

SynBio: A Journal for Advancing Solutions to Global Challenges

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Synthetic biology is a science that uses engineering principles to design and build new biological systems. Researchers in this field are harnessing the power of "biology" to solve problems in medicine, agriculture, and manufacturing [1,2]. It is a rapidly evolving field that has the potential to address a wide range of global challenges, including 8 out of the 17 United Nations 2030 Sustainable Development Goals [3,4]. The most promising applications of synthetic biology include the items listed below.

(1a) Improving food production:

Synthetic biology is being used to create crops that are more resistant to pests and diseases and that can thrive in harsh climates. This could help to reduce food insecurity and malnutrition around the world. It can also be used to improve the yield, quality, and nutritional value of a wide variety of plants, animals, and microorganisms. Synthetic biology can be used to produce cultured meat by taking stem cells from animals and growing them in a lab. It has the potential to transform the food industry, making it more sustainable and efficient.

(1b) Developing new therapies and tools:

Synthetic biology is used to design and create new drugs, materials, and vaccines that are more effective, less harmful, and more personalized than current treatments. It is increasingly being used to identify drug targets, deliver gene therapies, develop cell-based therapies, improve the properties of proteins, and advance delivery methods. This could help fight diseases such as cancer, neurological disorders, infections, and rare diseases. In addition, new biosensors can be used to create tools for monitoring health, diagnosing diseases, and enhancing human capabilities. Most important, synthetic biology allows us to perform tasks that would be difficult to carry out with non-living alternatives.

(1c) Regulating the environment:

Synthetic biology will be used to create organisms and enzymes that can break down pollutants in the environment (bioremediation). This could help to clean up polluted water, soil, and air. Synthetic biology can also be used to create new materials with specific properties. Gene drives could be used to restore damaged ecosystems by introducing beneficial organisms or removing harmful organisms.

(1d) Generating renewable energy and natural products:

Synthetic biology is being used to create new means of producing energy from renewable sources. This could help to reduce our dependence on fossil fuels and mitigate climate change. Synthetic biology can also be used to improve the production of a variety of natural products and chemicals in industrial settings. Synthetic biology can also be used to store digital information in living organisms.

Many different cutting-edge techniques are being used in synthetic biology. Some of the most common techniques are listed below.

(2a) Genetic engineering and genome editing:

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These techniques are used to alter the genetic makeup of an organism. This can be achieved by inserting new genes, removing existing genes, rewriting nucleotide sequences, or changing the order of genes. The recent state-of-art DNA synthesis methods developed in industry could accelerate the supply of long DNA. Relevant technologies include directed evolution, viral vectors, embryo manipulation, and cell/organoid culture. Synthetic biology is also used to regenerate extinct organisms.

(2b) Informatics, Big data, and artificial intelligence:

This field of study uses computational methods to analyze large biological data. These data can be used to understand biological structures, including genomes, proteins, and multicellular and organismal societies, and devise new ones. Multimodal integration and spatial biology based on single-cell transcriptomics are creating the latest big datasets for understanding multicellular systems and assisting in the design of new biological systems. Emerging artificial intelligence (AI) technologies, including generative AI, hold great promise in this area. AI has already been used to predict the structures of proteins.

(2c) Systems biology and metabolic engineering:

Systems biology studies how different parts of a biological system interact. This knowledge can be used to modify genetic circuits, create new metabolic pathways, and invent new biological systems that are more efficient than natural systems.

(2d) Computational modeling:

This technique uses computer models to simulate biological systems. These models can be used to test new ideas or predict how a biological system will respond to changes. Quantum computers that can store quantum mechanical information could have a major impact on synthetic biology in the future, even though they are not yet practical.

For editorial purposes, here are summaries of the articles in the first issue of *SynBio*, including two Special Issues. Each article has been categorized and tagged according to global challenges (1a–1d) and cutting-edge technologies (2a–2d).

Rodrigues et al. [5] reviewed the synthetic biology of acrylic acid, a chemical with a high market value used in industry (1d, 2a, and 2c). It is currently produced from petroleum derivatives, but there is a need for more sustainable production methods. Engineered microbes are able to convert glucose or glycerol into acrylic acid, but the yields are still low. Synthetic biology and metabolic engineering approaches are being used to improve the production of acrylic acid in industrial settings. Fantinel et al. [6] meta-analyzed the production of biofuel from non-food biomass or waste, which is gaining traction despite criticism (1d, 2b). Synthetic biology is a promising set of technologies for this purpose. This study mapped the scientific knowledge on synthetic biology for biofuels and identified six knowledge clusters. The emerging trends include specific microorganisms, processes, and products such as *Yarrowia lipolytica*, anaerobic digestion, and synthetic promoters. Synthetic biology is a dynamic, interdisciplinary field in the environmentally friendly production of bioenergy. Liang and Zou [7] summarized that cutinases are natural enzymes that can hydrolyze a wide range of esters, including synthetic polyesters and toxic xenobiotics (1c, 1d, and 2a). They can also act as stereoselective catalysts in esterification and transesterification reactions. Cutinases have potential applications in biodegradation, biosynthesis, and synthetic biology. This review summarizes the classifications, properties, and structure–function relationships of cutinases from different sources. It also highlights the uniqueness and advantages of cutinases in biodegradation and biosynthesis and prospects for future application of natural and engineered cutinases in synthetic biology. Maglangit and Deng [8] reviewed phenylnaphthacenoid polyketides, which represent a class of natural products with potent antibacterial and anticancer activities (1b and 2a). Over the last 13 years, more than 100 members of this class have been discovered from different *Streptomyces* species. This article summarizes the current knowledge of their discovery, chemical diversity, and bioactivities. It also highlights cell factories for their production and discusses current challenges and future opportunities.

In the Special Issue "Programmable Proteins in Synthetic Biology", Yamagata [9] reviewed programmable proteins and notes that they are essential for studying recognized targets and the biology that follows (1b and 2a). They can be easily modified to detect, visualize, modulate, or eliminate proteins of interest in vitro and in vivo. The flexibility and modularity of these proteins are currently crucial for synthetic biology and various medical applications. This review proposes an expanded conceptual framework of these proteins based on their programmable principle and target specificity. Mann et al. [10] clarified that synthetic biology tools are becoming increasingly important as we look to nature for biological solutions to complex problems (1a, 1b, 1c, 1d, 2a, and 2c). This review article highlights directed evolution for protein engineering, biosensor design, and biomanufacturing. These techniques can be used to address issues such as food safety and security, pollution, and sustainability.

In the Special Issue "Feature Papers in Synthetic Biology", Do [11] focused on rheumatoid arthritis, a common autoimmune disease that can cause joint destruction and disability (1b and 2a). In this study, Do used plant virus-based expression vectors to produce large quantities of CCP-specific monoclonal antibodies (mAbs). These mAbs were successfully purified and shown to bind to a synthetic CCP peptide antigen. This system provides a rapid strategy for the production of pharmaceutical CCP mAbs in tobacco plants. In contrast, Wang and Chen [12] worked on periodontitis, a chronic inflammatory oral disease (1b, 2a, 2c, and 2d). The current treatments for periodontitis have limitations, such as the limited treatment options, recurrence of disease, and high cost. The authors developed a novel drug design approach using systems biology and deep learning methods. They identified significant biomarkers and drug candidates. A DNN-based drug–target interaction model was used to predict potential molecular drugs. They filtered out four potential drugs based on the drug design specifications. This study provides a new approach to the treatment of periodontitis.

Finally, we are excited to launch this new journal and look forward to receiving a large number of submissions [13]. We are committed to publishing high-quality research in the field of synthetic biology. Given the interdisciplinary and expanding nature of synthetic biology, it can be challenging to classify submissions into specific categories such as biochemical, pharmacological, bioengineering, manufacturing, agricultural, or medical research. This is both a strength and a challenge for the journal. On the one hand, it allows us to publish a wide range of research that would not be possible in more specialized journals. Finding reviewers with the expertise to evaluate interdisciplinary submissions can be difficult. We are working to address this challenge by developing a pool of reviewers with expertise in a variety of areas related to synthetic biology while maintaining our transparent editorial policy. We are grateful for the support of the scientific community and are confident that this journal will play a leading role in synthetic biology for years to come.

Conflicts of Interest: The author declares no conflict of interest.

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