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Synthetic biology - a review

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Abstract
Synthetic biology, as a multidisciplinary field that includes biology, computer science, and engineering, has the aim to crate/modify current biology systems or other organisms such as enzymes, genetic circuits, and cells. In comparison to the conventional genetic modifications, synthetic biology has an aim to develop functioning devices, systems, and organisms. What makes synthetic biology special is how scientists from different areas share their ideas and collaborate on how to expand their knowledge and innovations. Throughout this review, diverse applications of synthetic biology are explained, including methods used in medicine, specifically in observation of human well-being, to the novel treatment of infectious diseases, diabetes, or the production of vaccines. However, the fast expansion of this discipline gives rise to various benefits, as well as numerous ethical concerns. The benefits of synthetic biology are vast, though it can change many aspects of everybody's life, while on the other hand, it poses a risk to the environment, the difference between life and non-life, or general alterations to genes.

Keywords: Synthetic biology; DNA; cells; bioparts; biological systems; Chassis

1. Introduction

The intersection of biology and engineering has led to the development of a multidisciplinary field known as synthetic biology in the context of scientific study and engineering [1]. By the first definition, synthetic biology (SB) is a scientific discipline that employs science and technology to create or modify current systems of biology or other organisms, such as enzymes, genetic circuits, and cells [2].

When it comes to the complexity of organisms or systems built by scientists, synthetic biology differs greatly compared to traditional genetic modification methods [2]. The purpose of synthetic biology is to develop and construct functioning devices, systems, and organisms with established, practical, and unique features that are not present in the environment, employing concepts from engineering to genetics through the DNA code [3]. Along these definitions, key events of SB are termed as the creation of novel biological components, tools, and systems, the practical modification of already-existing, natural biological systems, and the use of science, technological advances, and engineering to develop, produce, and/or modify biological material in living organisms more quickly and easily [4]. As already mentioned, SB differs from conventional biology in that conventional biology explores the interior of organisms, while SB, on the other hand, uses molecular building blocks to create linked biological circuits and pathways, regardless of the origin of the building blocks [5]. Additionally, the primary distinction between synthetic biology and traditional biology is the fact that in synthetic biology, scientists can modify organisms' DNA by changing its architecture or functionality. In classical biology, scientists may only conduct studies on the organism's current architecture [6]. By using those methods and DNA synthesis, it has provided several practical benefits in numerous fundamental industries [5]. Additionally, it has forced academics from a variety of fields to collaborate and to create international networks of individuals who share knowledge and collaborate cooperatively [7]. In the same way that synthesis revolutionized chemistry and the development of chips transformed computers, biologists have used developments to convert biology from a scientific field to an engineered subject. When hardware engineers create novel integrated circuits and microprocessors according to the physical characteristics of resources, biologists are able to develop syn-bio systems that enable corporations improve their goods, procedures, or both [3]. Enough advancements in the underlying technology were required for the discipline to become established. Through the Human Genome Project of the 1990s, the method for sequencing DNA evolved. The area of systems biology, that has adopted a "complete" approach towards comprehending the way cells and organisms' function—that is, looking at connections of relationships or systems in their entirety instead of focusing on a few parts—has advanced alongside mathematical modelling and the "omics" tools, such as transcriptomics, proteomics, and metabolomics [7]. Synthetic biology has the power to transform many sectors while solving several of mankind's urgent issues [6]. This review will explain the history of synthetic biology, its application in various areas of human's everyday life, the basis of synthetic biology, current projects and future, and its benefits, ethical risks, and threats.

2. History of synthetic biology

Waclaw Szybalski, a prominent geneticist, initiated the word back in 1970. Throughout the 1970s, basic research was conducted that would set a path for the growth of DNA sequencing and synthesis methods. From that point, it only got more expensive. Two gene-synthesis companies were founded in the 1990s: GeneArt (also known as a subsection of Thermo Fisher Scientific), along with Blue Heron Biotech. The first-ever synthetic biology meeting took place at MIT. It represents the first time that the world of science has given significant thought to the vitality of this discipline. Shortly thereafter, the BioBricks Foundation emerged. BioBricks is an organization for nonprofit purposes that classifies synthetic biology components, creating an asset library for those in the field, particularly those focusing on developing an artificial biological system [8]. Back in 2013, the sixth synthetic biology symposium was held in London, bringing together researchers and entrepreneurs from all over the globe. Only three years after that, in 2016, a team of prominent researchers suggested an enormous synthetic biology work, giving rise to Human Genome Project-Write (HGP-Write). That has resulted in the birth of a massive number of genome synthesis initiatives [9]. Not anything in science has sparked a greater degree of scientific, intellectual, administrative, and business curiosity than the double helix and recombinant DNA breakthroughs. This particular topic has resulted in a sufficiently wide range of secondary sources regarding the way it might affect every aspect [10]. Furthermore, in 2016, synthetic biology resulted in the identification of a unique immunologic cell engineering approach that increased the recovery percentage in life-threatening blood malignancies by almost 50%. The procedure is successful in individuals who have breast cancer that has advanced [11].

3. Synthetic biology development

What characterizes synthetic biology, and what is so special about it, is that SB is the result of joint work and synthesis of concepts from various disciplines. This science has various distinguishing characteristics, which include the representation of novel strategies for biological research, the use of methods from engineering to manipulate systems of living, working with informal frameworks for innovation and research, and the understanding of the significance of community variables in the progress of the subject [12]. The idea of genetic engineering is essential to synthetic biology, in which experts change the DNA of living organisms to add or alter certain genes. This allows for the generation of new species as well as the improvement of the ones already present. Synthetic biologists attempt to design novel features and capacities in biological systems by manipulating the key components of existence, including DNA, RNA, and proteins, resulting in advancements in a variety of fields [13]. On the other hand, SB was guided by some major innovation boosters that have greatly assisted in its development and explosive growth. They include computational modelling, DNA sequencing, and DNA synthesis.

In computational modeling, synthetic biology follows the engineering phase in the construction of artificial biological systems. This design's modeling, which aims to predict its efficiency before the manufacturing step, is critical in the field of synthetic biology. The modeling of complete biological systems is done in the discipline of systems biology to improve understanding of this complexity for use in analysis. Exact means, structure, modeling, and assessment of computerized biological techniques and systems are strongly reliant on reliable assessment of biological data [14][15].

DNA sequencing, the method of "reading" or sequencing DNA, is another important innovation that has made synthetic biology achievable. DNA contains four bases. These are always in combinations of two main categories: T is coupled with A, and G is associated with C. The whole genome sequencing of numerous species has yielded a wealth of information on the chassis that synthetic biologists hope to use as a functioning mechanism. (Chassis are the habitats that are employed for storing synthesized DNA) [16]. Moreover, sequencing is used to validate the precision of designed parts of DNA or even entire organisms. Finally, rapid and low-cost sequencing can aid in the discovery and identification of novel organisms and systems. Altered DNA synthesis is an important method for facilitating synthetic biology. In one case, bioparts previously registered in a parts registry and freshly developed bioparts designed especially for the device are able to be merged to form a synthetic biology device. On the other hand, instead of constructing a bioparts combination from bioparts, they could potentially be produced directly as a distinct sequence of DNA [17]

4. The relationship between system biology and synthetic biology

Systems biology investigates entire natural biological systems, often emphasizing biomedical contexts, by integrating experimental data with computational modeling and simulation. The field aims to elucidate how interactions among genes, proteins, and metabolic pathways generate complex biological functions and emergent system-level behaviors. In contrast, synthetic biology centers on designing and constructing novel biological parts, devices, and networks, as well as re-engineering existing biological systems for targeted practical applications [7].

Despite differing objectives, systems biology and synthetic biology are highly complementary disciplines. Systems biology offers quantitative frameworks and predictive models to characterize biological complexity, whereas synthetic biology utilizes this knowledge to engineer controllable and reliable biological systems [3]. Collectively, these fields establish a feedback loop in which biological insights inform design, and engineered systems subsequently test and refine biological models.

5. Basis of synthetic biology

The inclusion of engineering concepts in biology is what characterizes synthetic biology. It facilitates logical building for industrial purposes by employing engineering concepts such as standardization, modularity, and abstraction [3]. A biological part, or "biopart," is made up of DNA fragments. Biological systems are formed by the integration and fusion of biological equipment. The design phase is the first stage in creating a new biological system. This might require constructing a detailed computer model and doing thorough in silico testing of the system. More information can be gathered from the differences between what is observed and what is predicted throughout the Test phase (the Learn phase). With the newly acquired information, the model can be refined and modified in a new Design stage. It could require numerous runs of this process to obtain the necessary new biology. The Synthetic Biology Open Language (SBOL) information norm was developed to promote the exchange of concepts and material among those in the synthetic biology profession [18].

Biological patterns can be modeled in silico with the assistance of this collection. The goal is to improve the efficiency of sharing information between scientists. A cell's surroundings are required for various bioparts, technologies, and biological systems to operate properly. The cell is particularly necessary to organize outside stimuli and deliver energy to the biopart. The cellular surroundings in synthetic biology may be built from a freely accessible common element termed the chassis [7]. Under the field of synthetic biology, synthetic DNA is thought of as software, and the chassis as hardware. E. coli represents the most common and widely used chassis. Yet alternative chassis are frequently employed in the project. *Escherichia coli, Bacillus subtilis*, mycoplasma, yeast, and *Pseudomonas putida* are examples of natural chassis [19]. The genomes and biochemical pathways of chassis are well-known, allowing for the quick generation of platform strains.

6. Tools in synthetic biology

To give cells autonomy, genetic circuits are frequently built to be orthogonal to the host, guaranteeing that the control components driving these genetic circuits aren't found in the host's signaling systems. Induction of genetic circuits - a lot of the initial research in synthetic biology relied upon the idea that genetic circuits may be built by assembling gene regulation fragments for reprogramming cells. LacI and TetR, both bacterial repressor proteins, represent two such instances [20]. By attaching such regulatory proteins to transcriptional regulatory areas, they were transformed into effective gene expression regulators in mammalian cells.

Since synthetic biologists are proceeding to enhance their methods for controlling cell behavior, many are looking to typical transcriptional networks inside cells to learn the way cells regulate these pathways, as well as intrinsic inducers that trigger genetic circuits. Zinc finger proteins (ZFs) and transcription activator-like effectors (TALEs) represent two forms of DNA-targeting proteins that identify and attach to DNA to change transcription in host cells [21]. ZF proteins have about 30 amino acids and bind to 3-4 base pairs of DNA with varied affinity. Combining numerous ZF protein domains allows the creation of synthetic ZF proteins that identify 9-18 DNA base pairs in size, enabling particular sequences in the genome to be addressed. By linking the TALE DNA-binding repeat domains, TALE proteins may be engineered to attach to 7-34 base pair DNA sequences. The continuing development of synthetic transcription factors indicates a new era in synthetic biology. Synthetic transcription factors have extended the toolkit's capabilities for disrupting, rewiring, and mimicking natural networks [22]. Such synthetic components are crucial for the construction of genetic circuits that track and respond to endogenous variations in natural transcription that govern cell and tissue integrity.

a. Cellular computation and memory

Cells contain an automatic capacity to detect a variety of signals in their surroundings, carry out calculations, maintain details, and conduct actions according to this data. Numerous synthetic biologists are working to exploit these characteristics with the goal of gaining biological oversight of cells for future medicines, testing, and biological production purposes [23]. Synthetic biologists might be capable of following a range of biological processes at the level of molecular structure if they could turn transient molecular signals that a cell receives into genome-encoded memory. Multiple techniques were used to create synthetic memory, involving genetic switches with feedback loops and memory states that correlate to the prevalence of one [24]. Scientists are employing synthetic memory in cells to transform transient cellular actions into identifiable memories stored in the genome in order to more accurately discover how minor variations in cellular phenotype, such as cell fate decisions and molecular changes throughout the disease's development and time frame, may be explained for the transformations in cellular phenotype [25].

7. Application of synthetic biology

The potential of individualized treatment and customized therapeutics is offered by synthetic biology. Researchers are working on creating synthetic microbes that may generate medications like insulin or anticancer chemicals more efficiently and cheaply [26]. This strategy has an opportunity to change the pharmaceutical sector by increasing the availability of vital pharmaceuticals among individuals all around the globe.

Furthermore, using synthetic biology, scientists want to increase agricultural productivity, generate plants immune to diseases, and decrease agriculture's effect on the landscape. Genetically modified crops, for example, may be bred to tolerate dryness or provide more caloric content, guaranteeing adequate nourishment despite the needs of an increasing worldwide population [27].

Additionally, synthetic biology offers novel approaches to addressing issues related to the environment. Microbes may be created for degrading contaminants, sanitize the leaks of oil, or trap carbon dioxide from the air, all of which help to combat changes in the environment. Furthermore, the invention of environmentally friendly biofuels using renewable sources can lessen the demand on fossil fuels while also reducing carbon dioxide output [28].

Moreover, synthetic biology has the potential to change the way industries operate by substituting existing chemical factory procedures with safe and bio-based replacements. Microorganisms can be genetically engineered to create useful substances, enzymes, and biofuels, allowing safer and better production techniques. PODS technology, for instance, significantly optimizes the manufacture of proteins while lowering the expenses associated with manufacturing

a. Application in medicine

Synthetic biology for medical testing enables continuous surveillance of human well-being and the accurate assessment of disease intensity by changing the genomes of cells or microbes, establishing them with the ability to recognize abnormal cells and abnormalities inside the human system. The CRISPR-Cas9 technology, for instance, may be utilized to build biological circuits inside cells that selectively detect critical protein molecules in intracellular cancer signal networks, allowing for more exact assessments of cancer cell location and condition development [29]. As an application in immunotherapy*,* cancer immunotherapy serves as one of the many interesting possibilities for the transplantation of cells. Tumor investigations reveal that immune cells, particularly T lymphocytes unique to tumor-derived peptides, infiltrate the tumor. During the first research, scientists separated, grown, stimulated, and injected tumor-infiltrating lymphocytes (TILs) into individuals, but results were inconsistent. This technique has been improved by targeting patient-derived cells with tumor-specific T-cell receptors (TCRs) with increased impact to boost anticancer efficacy. Chimeric antigen receptors (CARs), which are made up of high-affinity binding domains that attach to tumor antigens on cell surfaces and signaling domains that trigger T-cell antitumor capabilities, demonstrated improved effectiveness if injected into individuals' T cells and utilized to treat malignancies [30]. Another application of SB in medicine is the HEK-β cells used for diabetes treatments. Within pancreatic islets, beta cells generate and release insulin. Being the major location of insulin production in mammals, β cells monitor blood sugar levels via a signal transduction route that includes glycolysis and the stimulus-sensing-secretion coupling mechanism [31]. The next stages comprise the release of insulin. The blood sugar is carried to β cells and processed by glycolysis within the cell, leading to cell membrane depolarization, production of energy, and the closure of K+ATP channels, which trigger the calcium channel Cav1.3 and promote calcium influx along with the release of insulin granules. Increased blood sugar levels in individuals with diabetes are caused by a lack of insulin-producing cells in the form of type 1 diabetes or a lack of insulin responsiveness in body cells in type 2 diabetes. Xie et al. modified human kidney cells HEK-293-β to monitor blood sugar levels for insulin release utilizing a synthetic biology-based multi-screening method. In diabetic medication, the layout integrates automatic diagnostic and medication [32]. Overexpression of Cav1.3 offered a mechanism for the formation of a -cell-like glucose-sensing course in somatic cells, according to the scientists. The pairing of Cav1.3-controlled calcium and a synthetic Ca2+-inducible promoter enabled sugar concentrations to be monitored in vivo via a regulated transcriptional reaction. The cell line HEK-293-β for glucose-response insulin generation, which retained the equilibrium of glucose for more than 3 weeks upon placing the cells through the abdomen in mice, additionally auto-corrected diabetic high blood sugar levels throughout 72 hours in T1D mice in the present research [33]. The benefits of HEK-293-β cells are obvious. HEK-293-β cells proved more effective than primate pancreatic islets in regulating postprandial glucose metabolism in T1D mice.

Furthermore, HEK-β cells are easier to cultivate in vitro. It is believed that the engineered cells from humans will be generated readily, economically, and effectively, in accordance with up-to-date pharmaceutical industry standards and norms, enabling the development of prepared-for-use advertisements with excellent attributes for product simplicity, security, and excellence. This very inventive synthetic cell offers the idea of deliberately reprogramming any kind of cell to obtain specific skills, like managing blood sugar levels [34].

According to a 2015 study, synthetic biology can be applied to the treatment of infectious diseases. As antibiotic resistance increases, bacteriophages are being revisited as antibacterial tools. Biofilm formation is a major mechanism of bacterial resistance to drugs and host defenses. Engineering the E. coli–specific T7 phage to express dispersin B enabled biofilm degradation and significantly reduced biofilm cell numbers compared to non-enzymatic phages. In another study, the M13 phage was engineered to overexpress the SOS repressor LexA3, enhancing antibiotic effectiveness. This modification increased quinolone bactericidal activity in vitro and prolonged survival in infected mice in vivo [35].

Additionally, in the United Kingdom, studying at Imperial College has resulted in the engineering of designer cells that might be helpful in the advancement of illness therapy. Researchers in the Departments of Chemical Engineering and Chemistry invented a method for engineering artificial cells that respond similarly to biological cells when exposed to external variations. This may have profound effects regarding the comprehension of biology, disease treatment, and the administration of drugs. A group of synthetic biologists has discovered a mechanism for imitating the dynamic properties of natural sub-compartments in engineered cells, which may be present whether within or outside the cell [36].

Numerous medications are produced spontaneously by plants. Synthetic biology might be applied to produce yeast, to manufacture pharmaceuticals more effectively and cheaply on an extensive basis. Artemisinin, a malaria medication, was the first medicine synthesized in this manner. It is naturally generated by sweet wormwood, pharmaceutical corporation Sanofi has established the biochemical route that produces artemisinin's precursor, artemisinic acid, in Saccharomyces cerevisiae. The output of artemisinin was increased by redesigning yeast cells to include the genes required for the mechanism [7]. Dr. Collins, an MIT professor, believes that synthetic biology will soon be recognized as one of the most significant discoveries of the twenty-first century. It is a fantastic chance to present individuals with novel therapeutic alternatives, possibilities for which they have been hoping for quite a while.

b. Application of synthetic biology in vaccination

Synthetic biology has actually discovered uses in the biopharmaceutical corporation, such as vaccine enhancement and advancement in molecular diagnostics and innovative medicines, such as those made from live cells and organisms [37]. Vaccinations constitute an essential part of the healthcare system, helping to reduce mortality and death from a variety of illnesses. The basic objective of teaching the human immune system how to react strongly to a pathogen despite triggering serious sickness entails two key stages: (a) choosing an antigen and (b) getting it into the body. Present vaccines employ complete (deactivated or live attenuated) microorganisms or viruses or chosen portions that are administered into the body by different means [38]. COVID-19 synthetic RNA vaccines (Pfizer-BioNTech, Moderna) - The nucleoside-modified RNA that encodes for the spike protein antigen and is coated in lipid nanoparticles forms the basis of synthetic RNA vaccines for SARS-CoV-2. The plasmid vector into which an entirely synthetic SARS-CoV-2 S gene had been cloned provided the template for the in vitro production of the RNA vaccine. The pattern of the translated protein was altered to maintain it in the prefusion form [39].

c. Application of synthetic biology in genetics

Improve stability of genes using synthetic biology - Blazejewski et al. developed a computational tool, Constraining Adaptive Mutations using Engineered Overlapping Sequences (CAMEOS), that can restrict and shield synthetic biology structures against mutations. CAMEOS considers both point mutations and indels, which influence protein coding and mutations that alter long-range connections. It emphasizes the overlapping nature of genes and analyzes whether a mutation may be handled by several proteins generated from the same sequence statistically. This is significant since host cells possessing a mutation in the synthetic gene design can expand and overwhelm the population, resulting in an alternate or less productive ultimate product. Although gene flow can enhance genetic diversity, if the synthetic gene intersects with an important gene, the identical mutation will die off rather than taking over the population [40]

d. Application of synthetic biology in biofuel production

It has sped strain engineering to the extent where sample strains that may be evaluated for industrial usage have been generated, heavily advancing biofuel manufacture. Considering it has a long history of manufacturing biofuel, especially ethanol, plus has been fitted with different synthetic biology approaches, yeast *S. cerevisiae* is a commonly used chassis that has been explored for the bioproduction of a number of chemicals. The synthetic biology design stage for the production of biofuel includes model development, data mining, synthetic promoter, terminator, and enzyme sequence design, metabolic pathway and metabolism design, and cell production and fermentation process design [41].

Approaches for producing first-generation biofuels rely on oilseed crops to produce triacylglycerols, which can then be chemically changed to biodiesel, or else they rely on agricultural crops as biomass to produce sugar or starch from corn, wheat, or barley, which is then fermented and distilled into ethanol.

Instead of food crops, synthetically designed replacements, or second-generation biofuels, rely on the changed microbial cell as the foundation of biofuel production [42]. Additionally, the investigation of several possible organisms is expected to enhance research on the manufacturing of synthetic biofuels considerably. Cyanobacteria appear to be encouraging at the beginning. Because cyanobacteria can convert carbon dioxide and solar energy into biofuel particles, they may serve as an exceptionally efficient organic system for the manufacture of biofuel. *Synechocystic sp.* PCC 6803 represents one such bacterium [43]. In general, SB is expanding novel opportunities for biofuel production by developing unique "cell factories" that may generate energy from a variety of resources, as well as improving conventional plant-based technologies [44].

8. Benefits of synthetic biology

The medical and health sectors are projected to benefit greatly from synthetic biology, while agriculture has a chance to make a substantial impact on the farming industry, with annual earnings of up to $1.2 trillion by 2030. With synthetic biology, goods might be personalized to a person's exact demands. This could be applied to ancestry evaluations, genetic therapy, and aged skin therapies. Synthetic biology might also be employed to boost renewable energy sources and biofuel manufacturing effectiveness. Microalgae, for instance, are being "reprogrammed" to provide pure energy at affordable prices [45]. Researchers can use synthetic biology to expand the present frontiers of illness therapy further [46]. Generally, the outcomes might be straightforward, like enhanced protein or metabolite synthesis, or sometimes complicated, such as regulated immunological responses [47]. This field will transform the way we detect illness, manage getting older, and feed ourselves. This rapidly expanding industry that employs machines to edit or rewrite genetic code has produced innovative, game-changing technologies that include mRNA COVID vaccinations, IVF, and lab grown hamburger that look identical to actual hamburgers. It provides choices for dealing with fundamental problems such as environmental transformation, nutritional shortages, and energy availability. The COVID-19 epidemic ushered in a completely new production world. Attempts to design and manufacture in large quantities a SARS-CoV-2 vaccine compelled businesses to seek quicker, more effective processes for manufacturing [48]. The mRNA COVID-19 vaccines were developed using synthetic biology, making them among the initial vaccinations to employ synthetic biology on such an extensive basis [49]. Synthetic biology, including computers, aims to influence practically every aspect of creativity and humanity, but the industries that are most likely to be significantly touched are the agricultural sector, production, healthcare, computer science, the field of robotics, and sensing [26] No matter the individual use, the utilization of synthetic biology demonstrates the rapid speed of technical discovery and acceptance through extremely fruitful collaborations between academics and industries [38]. Despite the many advanced aims advancement society's aims having been successfully met, much effort remains to be accomplished regarding rapid, certainty, and the price for human resources.

9. Ethical risks of synthetic biology

According to some, synthetic biology has disrupted the fundamental border between life and nonlife, altering the purpose, basic terms, worth, and relevance of conventional "life" [50]. Certain philosophers of ethics are concerned that synthetic biology will result in the easier creation of harmful species that will be unleashed consciously. But synthetic biology may assist in reducing bioterrorism threats through enabling researchers to design an arguably less harmful variation of a microbe that can surpass an aggressive viral infection or bacterial type, but on the other hand, changing the genes and transmitting them into individuals has a number of threats. Furthermore, if a designed organism, like those employed in gene drives, goes out into the environment, would it outcompete other organisms in an environment and expand uncontrollably [51].

10. Synthetic biology today

According to the report published in May 2023, several companies are making a mark in the symbio world today. Those are Asimov, Evonetix, Kiverdi, Mammoth Biosciences, Ribbon Biolabs, and Upside Foods. The Asimov company has created software that models genetic processes in numerous cell types. The semiconductor technology developed by Evonetix facilitates DNA synthesis by thermally controlling the synthesis regions. Kiverdi intends to deliver answers that revitalize the soil, turn plastics into biodegradable materials, and develop fishmeal substitutes. Furthermore, the synthetic biology organization has devised an approach for producing meat from air. Mammoth Biosciences of California intends to employ revolutionary CRISPR technology to identify illnesses and produce cures. Ribbon Biolabs focuses on the construction of whole genomes, CRISPR libraries, and the development of DNA-based devices. Upside Foods is a California-based startup centered on an emerging utilization of synthetic biology - the creation of cell-cultured meat. Besides companies focusing on SB applications, some current projects include the creation of liquid silk through a fermentation method by yeast, sugar, and water to produce proteins like spider silk proteins [52]. The second current project is the production of plastics from thin air, followed by climate-friendly cement, and synthetic jellyfish that clean instead of stinging.

11. Synthetic biology in future predictions

Regarding the future predictions of synthetic biology, it is believed that by 2030, every person will have consumed, worn, implemented, or received treatment with something that was derived from synthetic biology. Also, it is expected to make a great contribution to the world, as seen by the enormous amount of funding it has received in recent years. According to reports, the industry got over $7.8 billion in funding in 2020 from both the public and private sectors. This is more than twice as much money as the industry received in 2019 and 2018. Moreover, it is projected that the value of the worldwide synthetic biology industry will surpass $14 billion by 2026 [7]. Current economic studies predict that the synthetic biology sector will increase from around $10 billion in 2021 to about $37 billion and $100 billion by 2030.

12. Conclusions

The intersection of biology and engineering has caused a rise to a multidisciplinary field that combines science and technology to create or modify biological systems, organisms, enzymes, genetic circuits, or cells, with the purpose of constructing functional devices with established and functional features that are not present nowadays. This field is known as synthetic biology. While employing several different fields of study, it has also forced academics and scientists internationally to share knowledge and to collaborate. Considering its benefits in terms of giving opportunity to many diverse fields, synthetic biology can be applied in health care, medicine, agriculture, food production, and environmental industry, as being only a few examples. While being applied to medicine and health care systems, scientists discovered how to continuously observe human health and how to accurately assess diabetes by changing the genomes of specific cells or microbes. Besides that, they have also found the purpose of using HEK-β cells for diabetes treatments, or how cancer immunotherapy may be used in the transplant of cells using synbio methods. Additionally, synthetic biology can be utilized in the treatment of the infectious diseases, or as the not that long ago, COVID-19 pandemic led to the boost in the vaccination industry, since several vaccines, Pfizer-BioNtech and Moderna, were made using such techniques As a last, but not the least application mentioned in this study, using yeast*, S. cerevisae* or Cyanobacteria, synthetic biology aids the production of biofuel. As can be seen so far, synthetic biology can provide the answers and solutions to many fundamental questions and problems today. Speaking only about its benefits, synbio has its pros and cons, as with any other field. In terms of risks, it is believed that it can disrupt the limit between life and nonlife, hasten the creation of harmful species, or, by altering the genes, can lead to serious threats towards environmen. From today's point of view, many industry companies are turning to the methods of synthetic biology, and are trying to make innovations in diverse areas, including the food industry, making the environment greener and safer, or simply using traditional biology methods for creating novel ones. As a conclusion from today to the future, it is believed that the industry sector will have much more funding and will increase a lot more than it has been until now.

Declaration of Competing Interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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