Synthetic Genomics: The Future of Human Evolution

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The Human Genome Project was a great feat in genome engineering and modern science. In deciphering the genetic blueprint to life, biologists greatly enhanced their knowledge of the fundamentals of life as we know it. Now, scientists have set their sights on artificial gene synthesis. As a sequel to the Human Genome Project, now called GP-Read, molecular biologists, ethicists, lawyers, industry experts, and government officials have all joined together to launch GP-Write, short for Genome Project Write.

Knowing what our genetic code stores is fundamental to molecular biology research. However, knowing a story is not as great as being able to tell one. Similarly, scientists have sought out to write genetic sequences for a myriad of purposes.

During the Human Genome Project, the cost of genome sequencing declined rapidly ($3 billion in 1987-2004 to $1,000 in 2015). Indeed, reading the human genome was truly a scientific masterpiece. The next step in understanding our genetic blueprint involves writing a genome. Now, the Center for Excellence in Engineering Biology created the GP-Write program, which seeks to develop technology to synthesize the genome.

GP-Write is Now Receiving Funding

In 2016, a group of biologists, industry experts, government officials, and lawyers, received private invitations to discuss the possibility of writing genomes. Out of this meeting came an outline of what the human species hoped to accomplish: writing a full-length genome! Virginia Cornish and Harris Wang were two authors on this manifesto, which called for the creation of the GP-Write project.

This effort to write a human genome has received initial funding, however, it requires more funding to reach its goal**.** Moreover, the project officially seeks to reduce the cost of generating genomes by 1000-fold within ten years. By developing such technology, scientists will seek to use these genomes to engineer human, bacterial, yeast, and plant cell lines. For example, modification to the genomes of microbes in the gut could be used to fight obesity and chronic stress. Meanwhile, a change in plant genomes could be used to develop plants that could detect explosive chemicals.

Possible Barriers to Success

With the exciting prospects of synthesizing genomes come several sobering realities. First, funding is short. The group announced a goal of raising $100 million, however so far they have only received $250,000 in funding from one private group, Autodesk. Furthermore, DARPA granted scientists involved in the project need $500,000 to study prototrophy in mammalian cells.

Currently, the costs of synthesizing a genome would be prohibitively expensive—approaching $100 million dollars! It would require a massive improvement in technology. However, this isn't impossible, as the Human Genome Project helped to massively reduce the costs of genome sequencing. Already, a San Diego based company is using a non-template based method of DNA synthesis to accomplish this goal.

Additionally, the ethical and social implications are profound. Indeed**,** when the project first met in 2015, the proceedings were secretive (member only), which triggered public outcry. This upset some project members, who raised concerns over the public perception of geneticists and molecular biologists. While human genetic engineering is still far from possible, some consider the public declaration that GP-Write seeks to "synthesize a human genome" is actually inevitable anyway, which is a provocative and engaging way to both generate, support, and create enemies.

Perhaps the greatest barrier to success is simply that the science itself is incredibly challenging. Will the public have an appetite for funding research in a controversial area over a sustained period of time? This may be the greatest obstacle GP-Write faces.

Impact in Life Science Research

As a biologist, one may wonder what this means for research in the life sciences. More opportunities and funding for research may develop out of this project! Scientists have

made it clear that they seek to develop vaccinations against all possible infectious agents that target mammalian cells. This would greatly improve workflow in the industry, since generating a cell line that is immune to all viruses would prevent contamination. Furthermore, this research project would provide better DNA manipulation tools for basic science research.

As the Human Genome Project facilitated the development of new technologies for the world, so too can synthetic genomics generate novel data and tools for molecular biologists. With the genetic blueprint well assessed through GP-Read, humanity has now set its sights on genome engineering and has launched GP-Write to accomplish this goal.

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