STAT REPORTS

Understanding synthetic biology, featuring 10 companies to watch

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Introduction

Synthetic biology is not a new field. But it's moving, to use a popular phrase as of late, at warp speed.

At its core, synthetic biology is the bold effort to reimagine and reengineer nature from scratch, using the most basic of biological building blocks — RNA and DNA — as tools to program life. Scientists are using microscopic biological structures to build what is, in essence, organic machinery. In doing so, they may just help change the face of medicine.

Synthetic biology or synbio, as it's fondly called, is rocketing forward thanks to advances in machine learning, artificial intelligence, and automation. It combines systems biology with bioinformatics, and attempts to map out life's most basic bits with a high level of precision.

It also has applications far beyond medicine. Synthetic biology is being used to reshape the food sector, the environment, and materials science, among other fields. This report will touch on some of them. But mainly we're interested here in the potential of synthetic bio to help revolutionize the life sciences.

It's also a particularly good time to survey the landscape. In the wake of the coronavirus pandemic, synthetic biology is sweeping the globe, with its tools helping to develop vaccines, therapeutics, and diagnostic tests for Covid-19.

The reason? There's so much potential.

"Synthetic biology's engineering design principles allow us to reprogram the living world," said Michael Christopher Jewett, a professor of chemical and biological engineering at Northwestern University. "What makes me excited: There's the potential with synthetic biology tools to build a global, equitable bioeconomy."

Science is often a matter of trial and error — and fervent hopes for a eureka moment. Synthetic biology, on the other hand, relies keenly on the basic engineering cycle of design-build-test-learn. It's a matter of being able to manipulate biology, or the tools of biology, in very precise ways.

"There's a lack of predictability in biology," said James Collins, a bioengineering professor at Massachusetts Institute of Technology and a pioneer in the field of synthetic biology. "Synthetic biology tries to inject some predictability into biological systems."

Jason Kelly, the CEO of Ginkgo Bioworks, which engineers bespoke cells, likens synthetic biology to computer science. The base pairs of DNA operate in a manner similar to the binary code in a computer. That's not to say it's a perfect comparison, Kelly acknowledged. A cell doesn't run like a computer. Instead, he said, it's a "squishy mess, with millions of molecules bumping into each other."

But it's programmable.

"Programming is digital, as is biology," Kelly said. "The premise of synthetic biology is to make the programming of cells a lot closer to the programming of computers. So the question is: How far can we push that analogy?"

The market for synthetic biology is expanding quickly — as are investments in companies working in the field. According to SynBioBeta, synthetic biology companies received $7.8 billion in private and public financing in 2020 — nearly 2 1/2 times the amount poured into the industry in 2019 and nearly twice as much as in 2018.

This report seeks to help you develop a deeper understanding of synthetic biology, by looking to its past but also, importantly, looking to its future. In addition to discussing important definitions and distinctions, and laying out key tools used in synthetic biology, the report takes a closer look at 10 companies in the field and how they are, to varying degrees, building life.

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