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Agilent Helps Researcher Tackle Fundamental Challenges In Synthetic Biology

Matthew Chang is working to transform biology into a technology that can benefit everyone on the planet.

The best way to do that, he and other biologists believe, is to set the same sort of standards that allow electrical engineers to assemble whole computers from off-the-shelf components.

Instead of assembling computers, however, biological engineers hope to assemble cell-based factories to produce valuable chemicals and medicines. Better yet, they hope to engineer therapeutic cells to treat cancer, diabetes, and other disorders.

“What excites me most right now,” Chang says, “is the possibility of being able to make synthetic biology more systematic and cheaper and more efficient.”

At the National University of Singapore (NUS), Chang teaches biochemistry and leads an interdisciplinary research program called NUS Synthetic Biology for Clinical and Technological Innovation (SynCTI), which comprises 60 researchers (chemists, biologists, clinicians, medical doctors) from 15 countries. His team’s current projects involve reprogramming microbes to address various challenges in human health, environmental remediation, and biochemical production.

Chang’s lab employs a range of Agilent instruments—gas chromatographs and high-performance liquid chromatographs in tandem with cutting-edge mass spectrometers—to ensure that these new microbial systems deliver exactly what they are designed to produce.

> **“Agilent in my view has world-leading expertise in this space,” says Chang, who has long collaborated with the company’s scientists.**

Testing is the final stage in the workflow Chang would like to see standardized throughout the worldwide community of scientists doing research in synthetic biology.

“One of the problems this community faces is that there are just too many choices,” he says. “If you look at 10 labs, probably all 10 use a different standard.”

Chang notes that researchers in this field don’t always use the same procedures or even describe what they do in the same terms.

“That makes it extremely hard for people from different labs and different disciplines to share information,” he says.

Consider, for example, the first step in biological engineering: cutting a fragment of DNA from one organism in order to transfer it to another. Researchers can choose from a plethora of cutting enzymes to do the job. What Chang and many other biologists want to do is narrow the options to just a handful.

> **“We are trying to encourage all biologists to choose a standard set of cutting enzymes. By using the same standards, we can share a lot of information and bring the speed of biological engineering to the next level. We also believe that, in this manner, we can bring down all of the associated costs of various research projects.”**

To Chang, electrical engineering provides an apt analogy for what synthetic biology could become.

“Our understanding of physics—the fundamental basis of electrical engineering—has become standardized and generalized so that it can be effectively used to construct the many different electronic devices that we use on a daily basis,” he says.

Consider what goes into the making of a mobile phone: transistors, semiconductors, circuit boards, microphones, speakers, amplifiers, memory chips ...

“In this endeavor, we are talking about many different kinds of experts, but the people who are assembling all these parts don’t have to fully understand the underlying physics of each part,” he says. “In the same way, biology is extremely complex, but can we abstract away some of the complexity involved in biological engineering? Can we come up with layers of processes to mask some of the complexity?"

By adopting standards for synthetic biology, Chang says, researchers should be able to build a library of well-characterized biological parts—similar to the array of off-the-self parts used in electronics.

"In this manner," he says, "we can effectively, down the road, just mix and match components from the library to construct new and different biological systems."

It would mean that Chang's international team, and others like it, could accelerate the development of new biological systems to address disease states and other pressing issues.

Related Information

Metabolic engineering of Saccharomyces cerevisiae for the overproduction of short branched-chain fatty acids.
Yu AQ, Pratomo Juwono NK, Foo JL, Leong SS, Chang MW.
Metab Eng. 2016 Mar;34:36-43.

Engineering transcription factors to improve tolerance against alkane biofuels in Saccharomyces cerevisiae.
Ling H, Pratomo Juwono NK, Teo WS, Liu R, Leong SS, Chang MW.
Biotechnol Biofuels. 2015 Dec 30;8:231.

Reprogramming microbes to be pathogen-seeking killers.
Hwang IY, Tan MH, Koh E, Ho CL, Poh CL, Chang MW.
ACS Synth Biol. 2014 Apr 18;3(4):228-37.

Microbial engineering strategies to improve cell viability for biochemical production.
Lo ™, Teo WS, Ling H, Chen B, Kang A, Chang MW.
Biotechnol Adv. 2013 Nov;31(6):903-14.

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