Synthetic Biology Writing Competition Strange Nature

There are a multitude of definitions affiliated with Synthetic Biology. According to the Scientific Institute of Public Health, it is a "multidisciplinary and rapidly evolving field. It can be summarised as the rational design and construction of new biological parts, devices and systems with predictable and reliable functional behaviour that do not exist in nature, and the re-design or existing, natural biological systems for basic research and useful purposes." However, there is a vast array of definitions dissimilar to this that can also be applied to Synthetic Biology as a young concept in the very midst of our epoch.

A wide range of recent advancements have been made in Synthetic Biology, nevertheless I found the creation of the 'explosive' Escherichia coli cell to be a most promising and 'explosively' radical achievement of scientists working in the field. To elucidate, scientists working in the field of Synthetic Biology have manifested an Escherichia coli cell which—upon contact with particular pathogens—explodes, demolishing both the pathogen and itself.

Bioengineer Chueh Loo Poh of Nanyang Technological University in Singapore says the project was "inspired by nature", most especially by 'quorum sensing'. Quorum sensing generally pertains to the ability of certain bacteria to sense the number of microorganisms within their overall environment. Basically, when pathogenic Pseudomonas aeruginosa detect other species impeding on their space and nutrients, they communicate with affiliates of their own species using chemical signals and cooperatively begin releasing a bacterial toxin called 'pyocin', which eradicates the rival. These communication and defence abilities combined allow Pseudomonas aeruginosa to generate largely confined layers known as 'biofilms'. Biofilms are able to cause respiratory tract infections in humans and are significantly harmful to cystic fibrosis patients.

In order to infiltrate Pseudomonas aeruginosa, Poh and his university colleague—chemical engineer Matthew Wook Chang—decided to find a way for the pathogen's attack system to backfire against itself, utilising Escherichia coli cell as the carrier. Together, the researchers tweaked the genes that enable Pseudomonas aeruginosa to sense other members in its species and placed this synthetic genetic code into Escherichia coli cell's genome. In addition, they also armed Escherichia coli with a gene that constructs modified pyocin, which is toxic to Pseudomonas aeruginosa. As a result of connecting the pyocin gene to the sensing genes, the researchers ensured that when Escherichia coli detected Pseudomona aeruginosa whilst it remained close by, it will fill itself with vast quantities of pyocin. Consequently, it becomes a 'biological grenade' prepared to explode.

Finally, the researchers provided Escherichia coli with another highly crucial synthetic element. It is known as a "suicide gene" that triggers as soon as the pyocin has been provided sufficient time to build up, causing the cells to burst and release their toxin. It is interesting to note that when Chang and Poh bred these "synthetic Escherichia coli cells in a dish with Pseudonoma aeruginosa, the 'explosive' biological time bomb managed to destroy 99% of

the Pseudonoma aeruginosa cells", according to the researchers when they reported in Molecular Systems Biology.

Nonetheless, this new breakthrough in the field of Synthetic Biology poses as a threat to the notion of ethics. Synthetic biologist Richard Kitney of Imperial College London states "the system would also have to undergo a lot of work before it can be considered for utilisation in human beings—including, perhaps, replacing Escherichia coli with another delivery system. Exposing people to Escherichia coli is not a good thing," Kitney says, "as the bacteria are toxic outside the gut. The team would also have to show that pyocin is effective at destroying Pseudomonas aeruginosa that have already formed a biofilm."

In response, Poh and Chang proclaim that they plan to test the exploding bacteria in mice infected with Pseudomonas aeruginosa. They claim that it is not certain whether pyocin is dangerous to mammals, however other natural bacterial toxins are currently accepted for application as food preservatives. Furthermore, they aspire to tweak the synthetic system in order for it to sense and respond to signalling molecules released by other species of pathogenic bacteria that are responsible for—exempli gratis—water-borne diseases.

In essence, the contemporary advancement of 'exploding Escherichia coli cells' is most promising in the field of Synthetic Biology as it proves to be a highly effective and imperative breakthrough in the prevention of numerous diseases caused by pathogenic bacteria.