Scientists create the smallest known genome to support a living cell

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Researchers in the United States have designed and created a synthetic cell which is able to survive and replicate itself with just 473 genes, potentially leading to the development of innovative new drugs, antibodies and fuels.

In a landmark for biological understanding, the scientists based at the J Craig Venter Institute of La Jolla, California, whittled away the genes of the bacterial Mycoplasma chromosome until they reached a minimum set required for life and replication. They then re-synthesised the genes into a single strand of DNA and 're-booted' a genetically empty cell until it sprang into life once more.

The synthesised cell, officially named JCVI Syn3.0 (or 'Syn3.0' for

short), with its 473 genes and 531 000 DNA bases, is smaller than the smallest known natural genome of a related bacterial species called M genitalium, which has 525 genes and 600 000 DNA bases. Syn3.0 is also able to double in volume every three hours, instead of the several weeks that it takes M genitalium to double in size.

The research team refer to the new cell as a 'minimal bacterial cell', stressing the indefinite article due to the fact that the minimum number of genes needed depends on both the environmental circumstances and metabolism of the organism.

Unlocking the secrets of life

The discovery, which has been published in the journal *Science*, could help shed light on one of the most prominent questions that has puzzled humanity for millennia: what is life? More specifically, the creation of Syn3.0 could provide insights into the story of life's evolution in the primal oceans more than three billion years ago.

Dr Craig Venter, who led the research team, has argued that although the ability to 'speed read' the DNA code had been stepped up a billionfold in the last 25 years, no single cell could be explained in terms of all of its functions. Dr Venter himself is a pioneer of DNA research, and led one of the two scientific teams that managed to sequence the human genome by June 2000.

In 2010, Dr Venter and his long-term collaborator, Clyde Hutchison, managed to create the first synthetic microbe from an artificially manufactured microbial chromosome from one Mycoplasma species, which was used to 're-boot' the empty cell of another Mycoplasma species. This synthetic microbe was officially called JCVI-Syn-1.0 and was the direct predecessor of Syn.3.0.

Commercial prospects

There is also much excitement about Syn3.0's commercial value. Its creators have now filed for a patent application on the genetic information, and they hope to use it as a test vehicle for more basic biological research, and as the launchpad for the development of highly advanced and high-precision biochemical products.

'Our long-term vision has been to design and build synthetic organisms on demand where you can add in specific functions and predict what the outcome is going to be," said Dan Gibson of Synthetic Genomics, a partner in the research. 'So we believe these cells would be a very useful for many industrial applications from medicine to biochemical, biofuels, nutrition and agriculture.'

Although the discovery has been described as a 'great leap forward', it will take some time for the commercial potential of Syn3.0 to be fully realised. Dr Venter and his team have only been able to identify the function of two thirds of Syn3.0's genes, with the other third remaining a mystery. Although a major milestone, geneticists still have some way to go to getting to the bottom of what really makes life tick.

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