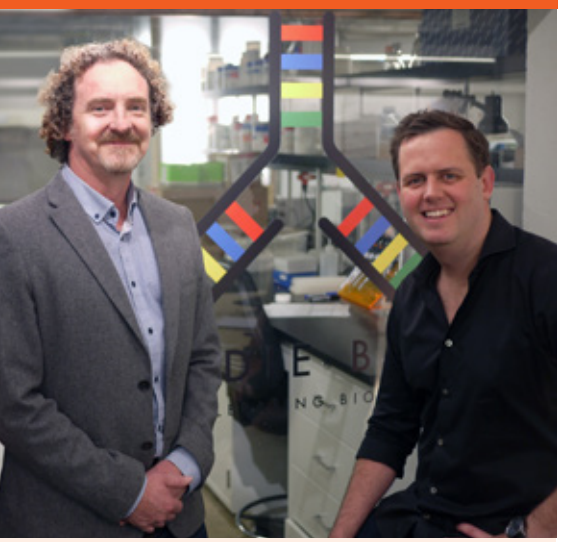
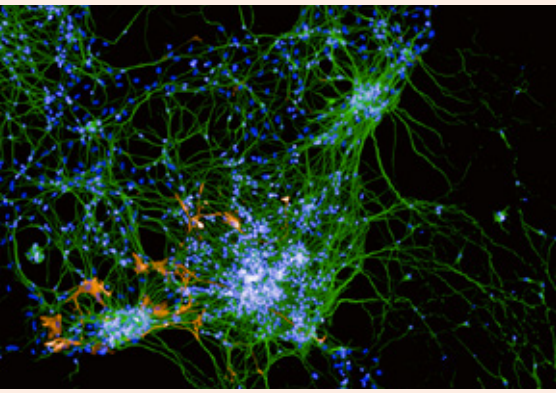
At a glance

By pairing biology with engineering, two research groups are developing innovative ways to understand what happens in diseases associated with brain function.



Professor Justin Cooper-White and Dr Drew Titmarsh

Professor Ernst Wolvetang and team



Miniaturised stem cell laboratories

The need

There are more than 400 neurological conditions that can affect the human brain during development or in adulthood. They can be common, such as Alzheimer's (affecting approximately 300,000 Australians) or extremely rare, such as Ataxia Telangiectasia (affects 1 in 50,000 births). These many, variable conditions have one thing in common: they have few treatment options and no cure. Their cumulative impact on society, in terms of lost quality of life, reduced income and costs to the healthcare system are immeasurable – and on the rise given an ageing population. There is an urgent need to improve our understanding of these diseases and identify treatments. Stem cells can help.

The projects

At the University of Queensland, Professors Ernst Wolvetang and Justin Cooper-White are applying biological and engineering approaches to address this issue.

In the Wolvetang lab, millions of brain cells are growing in the lab. Some are being used to examine what happens in conditions such as Down's syndrome or motor neurone disease. Others are used to understand the ageing process. Each batch of cells has been made using induced pluripotent stem (iPS) cell technology, where a patient's cell is made into stem cells and then turned into neurons that display the characteristic of the patient's condition. Currently, the Wolvetang group is developing 3D brain organoids, structures that mimic the developing brain, to study how these cells interact.

As an engineer, Cooper-White's research is aimed at solving problems associated with how stem cells are grown and used in the lab. By looking at the microenvironment that regulates stem cell behaviour, his team devises scaffolds and automated or robotic systems to improve stem cell performance in the lab. As outlined in a 2016 paper, his micro-bioreactor technology contains 8,100 culture chambers in a space about the size of a credit card, making it possible to optimise culture conditions or screen drugs with extreme time and cost efficiency.

The impact

In combination, these approaches open up an array of possibilities for understanding brain disease and ageing, as well as testing for drug effectiveness or likelihood of harm. The Wolvetang lab is currently screening molecules that may inhibit the progression of Alzheimer's disease in collaboration with the company InterK Peptide Therapeutics. Cooper-White and team member Dr Drew Titmarsh used this technology as the basis of a start-up, Scaled Biolabs, that in June 2017 was awarded a US $700,000 discovery grant from CIRM, California's stem cell agency. In 2016, Wolvetang and Cooper-White teamed up with colleagues at the University of Queensland to form StemCARE, a centre focused on studying the ageing process and on engineering innovative clinical solutions in support of healthy ageing.