



Informing tissue engineering design

TakeAIM Winner 2017:
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Fancy trying some sustainably produced lab grown meat? Swapping animals used in toxicological testing with artificial human tissue? Or how about reducing the long wait for transplants? Of the 7,000 patients on the UK's list, 30% have been waiting more than two years.

Tissue engineering, the creation of functional tissues, holds the hope of providing solutions but the methods need refining in order to deliver. The three key ingredients are cells, bioactive molecules, to encourage growth, and a scaffold, to provide structure and support. Once combined, the cells grow and divide, covering the scaffold and forming the tissue, ready for implantation or other application.

With technologies such as 3D printing, a whole range of scaffold structures can be created. Designs vary from Swiss cheese to stacked lattice constructions, but are typically highly porous. The interconnected gaps of the structure are essential, allowing nutrient-rich fluid to be pushed through the scaffold, supplying the cells, enabling life and growth. Using a technique known as multiscale homogenisation, we have derived an effective model to describe the growth of the tissue and the flow of nutrient, which captures the effect of the chosen scaffold geometry.

Using computational models to test out potential scaffolds allows the most promising possibilities to be identified, saving time and money spent in the lab. Through aiding the design of more successful methods for growing tissue we can better produce rejection proof tissue and organs, improving the lives of their recipients, as well as unconventional burgers for the BBQ!

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The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the TakeAIM competition in 2017 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to undergraduate and postgraduate students working in the mathematical sciences. First prize was £1,250 of Apple vouchers, second prize £500 of Apple vouchers and six runners-up each received £150 of Amazon vouchers.