

Faculty of Engineering

Summer Research Program 2023-2024

Project Title: Using biomaterials to control stem cell metabolism

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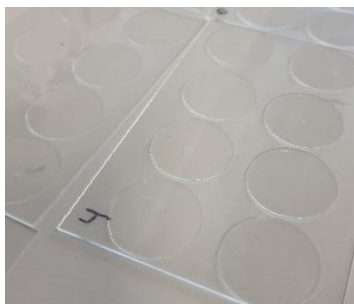
Objective

The goal of this project is to determine how the metabolism of stem cells from different tissues sources varies when they are cultured on biomaterials with different mechanical properties.

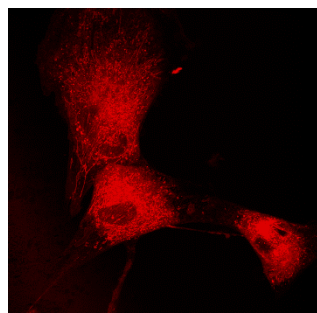
Project Details

The metabolism of stem cells helps to determine their regenerative potential and ability to heal wounds. We know that this can vary between cells from different tissue sources and based on the materials on which we grow them. It is possible that changing the mechanical properties of cell culture materials will affect stem cell potential by helping them maintain or recover metabolic function. In this project, the metabolism of mesenchymal stromal cells (MSCs) from different sources (bone marrow, adipose tissue, umbilical cord, and MSCs generated from induced pluripotent stem cells) will be compared using image-based techniques and biochemical assays. The project will also test the effects of culturing the cells on biomaterials with varying mechanical properties (stiff vs soft) and architectures (fibres, pores, micro- and nano-scale structures).

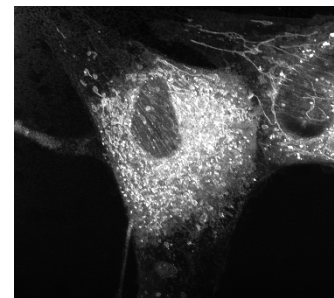
Fluorescent staining and confocal microscopy will be used to image mitochondria within the cells and 3D image analysis will be used to quantify mitochondria number. Assays to measure mitochondrial activity will also be used. The student will have the opportunity to learn how to culture, image and compare stem cells, how to make biomaterials (eg. hydrogels) with varying mechanical properties (eg. stiffness) and perform lab-based and computational analyses of the effects of these materials on stem cell behavior.



Stiff and soft hydrogels being made between glass slides



Mitochondria stained and imaged using a confocal microscope



3D reconstructions of mitochondrial networks which can be quantified using computational analysis

Prerequisites

An interest in Biomaterials, stem cells and tissue-engineering. This project would also suit students taking a dual-degree with Biomed.