Measuring Gelatin Window Thickness for Heart-on-a-Chip Systems

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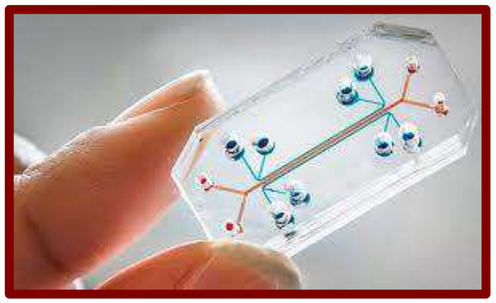
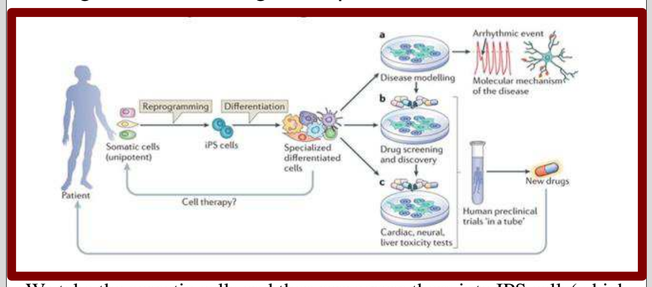
Introduction

I've been mentored by Joycelyn Yip, and have been studying human stem cell cardiac tissues and heart-on-a-chip-systems, in Professor Megan McCain's Lab for Living Systems Engineering.



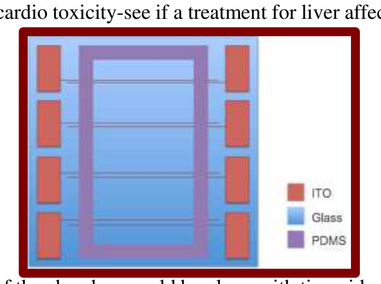
Objective & Impact of Professor's Research

The purpose of the research being conducted is to engineer a physiologically relevant human multicellular "Heart on a Chip" system that would resemble a human heart that could be used for drug testing and screening therapies.



We take the somatic cells and then reprogram them into IPS cells(which can be turned into any type of cell, and for us are differentiated into heart cells and can be used for different purposes:

a. Disease modeling- compare a diseased cell with a healthy cell
b. drug screening-see how a diseased cell will react to a treatment
c. Testing cardio toxicity-see if a treatment for liver affects cardiac etc.

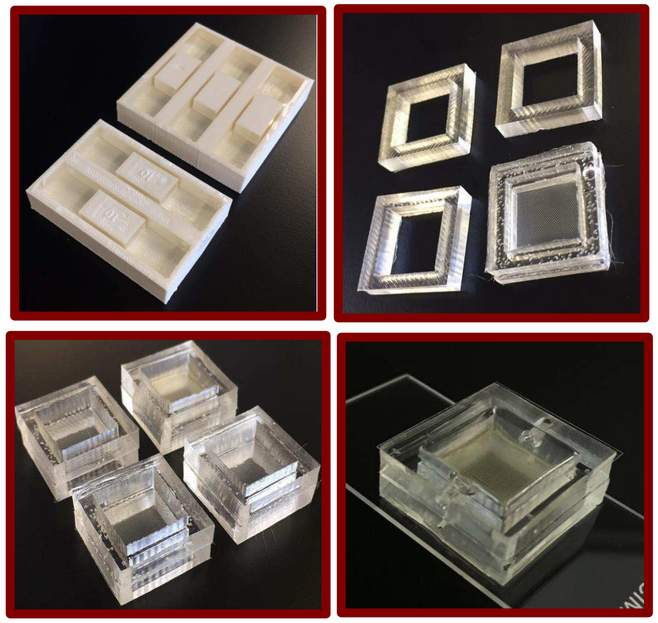


Bottom layer of the chamber would be glass, with tin oxide placed on the glass, so as to conduct electricity. The benefits of doing this is because the tin-oxide would be transparent, which allows the cardio-myocytes placed on the glass to be viewed

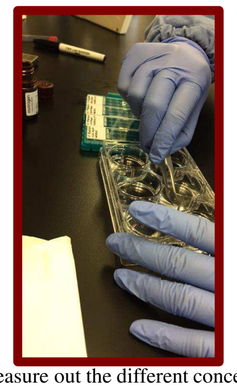
Methods

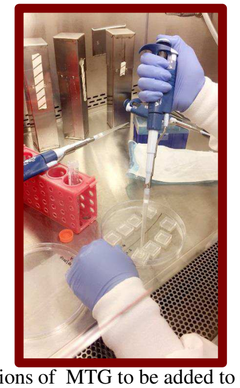
Create a chamber system that can support multiple cell types that better resembles an actual cardiac system. In order to do this, we poured PDMS into a specialized mold, cured the PDMS, which was then cut out of the molds into window frames. A mesh was placed between two of the frames, and sealed with more PDMS.

PDMS Window Frames



PDMS Window frames are made up of two PDMS windows, holding a mesh between them.



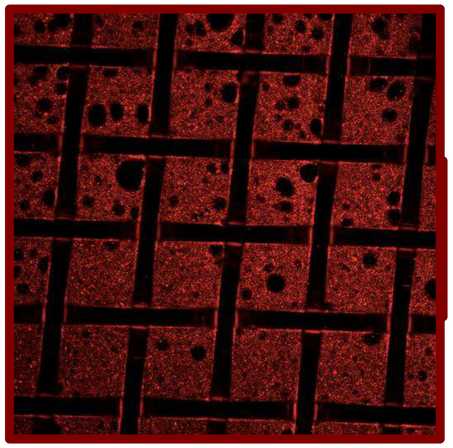


1. measure out the different concentrations of MTG to be added to the 10% gelatin mix, with fluorescent beads added to the mixture to later be used under a fluorescent Confocal microscope to measure the thickness of the membrane.
2. put in the incubator overnight, to cure the MTG, which is an enzyme which connects the collagen molecules, which makes it one solid thing

Results

By using a confocal microscope, the gelatin was scanned vertically to measure its thickness. This was done by scanning each section of the gelatin between the threads, then counting each layer that the fluorescent beads were present in a particular square.

A Slice of Gelatin Taken by a Confocal Microscope

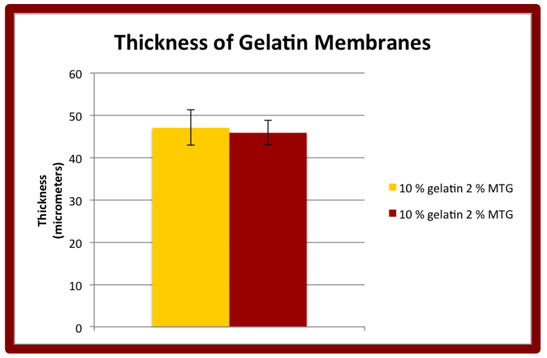


Data

Condition	Thickness (micrometers)	Standard error
10% gelatin 2 % MTG	47.11	4.17
10% gelatin 4 % MTG	45.89	2.88

Each pocket for each frame, was averaged together, and then each frame for each condition tested, was averaged to get an overall average of thickness for each condition.

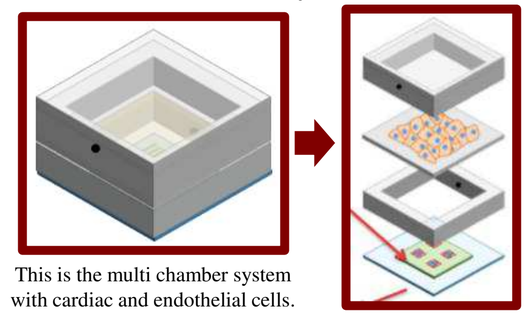
Graph



The error bars displayed are standard error, and
The P value=.8, which means that the data was not statistically different, so therefore changing the percentage of MTG did not change the thickness of the membrane

Future Steps

- Measuring rate of diffusion through membrane
- Growing vascular endothelial cells in culture
- Eventually seeing how endothelial cells grow on membrane
- Adding functional tests, and fluidics
- Build multi chamber system



This is the multi chamber system with cardiac and endothelial cells.

Future in Biomedical Engineering

While working in the Lab for Living Systems, I've been able to shadow my mentor, and assist in her current three projects, which has given me the opportunity to experience how research is conducted. Most importantly, it has given me the chance to explore multiple biomedical fields, being that my ultimate goal is to work at Children's Hospital Los Angeles.

Acknowledgements

I would like to thank Dr. McCain, Joycelyn Yip, Andrew Petersen, and the rest of the Laboratory for Living Systems Engineering, the SHINE program, Dr. Katie Mills, and the rest SHINE cohort, along with my SURE mentor for giving me this opportunity.