Introduction and Objective

- After a myocardial infarction, or heart attack, the formation of scar tissue disrupts tissue alignment and increases extracellular matrix (ECM) stiffness.
- Effects of matrix stiffness and alignment on performance of cardiac tissue, especially energy metabolism, aren’t well understood.
- Our objective is to miniaturize constructs used for “Heart-on-a-Chip” to be compatible with a Seahorse Extracellular Flux Analyzer.
- We use PDMS (polydimethylsiloxane) to mimic the stiffness of cardiac ECM.
- PDMS 184 is stiffer, not gel-like.
- PDMS 1:20 is softer, stickier, more gel-like.

Methods and Skills Learned

Development of Micro-Thin Discs (MTD’s) for Tissue Alignment

- We use PDMS (polydimethylsiloxane) to mimic the stiffness of cardiac ECM.
- PDMS 184 is stiffer, not gel-like.
- PDMS 1:20 is softer, stickier, more gel-like.

PDMS MTD Fabrication

- 22x22mm glass coverslips with nine 6.5 mm circles etched by Epilog laser engraver. Source: Jezell Lee.

Micro-contact Printing

- Patterning: micropattern MTD’s with fibronectin to induce tissue alignment.
- Attachment: plasma treat the XF24 cell culture plate; peel MTD off coverslips; press down with tweezers.
- Cell culture: Seed plate with neonatal rat ventricular myocytes and perform Seahorse metabolic measurements after 4-5 days. Source: Megan L. McCain.

Results

Successful Implementation of MTD’s

- (left) Seahorse XF24 plate with MTD’s and cell media. Source: Jezell Lee.
- (below) well schematic and four photographs. Source: Davi Lyra-Leite.

Schematic of Seahorse Cell Culture Plate

- PDMS MTD
- Cells
- Media
- Drug Injectors
- OCR Sensor

Mitochondrial Respirometry

- Visited a lab at Cedars-Sinai to measure Oxygen Consumption Rate (OCR) using a Seahorse Extracellular Flux Analyzer.
- Visiting with PDMS 184 stamps made using a medium petri dish and wafer. Source: Jezell Lee.

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Relationship With STEM Coursework

- Biomedical Engineering: Biology, chemistry, physics.
- Prior knowledge of heart anatomy and basic mitochondrial function from my Advanced Placement biology class improved communication with my mentor and the rest of the interdisciplinary research team.
- Placement biology class improved communication with my mentor and the rest of the interdisciplinary research team.
- The placement biology class improved communication with my mentor and the rest of the interdisciplinary research team.

Future Steps

- My research has convinced me to study biomedical engineering instead of cell biology in college.
- I would love to conduct research as an undergraduate student.
- As a girl with a family history of hypertension and heart-related problems, I hope to combat this pattern by:
  - chasing knowledge
  - reproducing living tissues in vitro to replace scarred tissues
  - ultimately making a profound impact on the field of science and greatly enhancing the daily lives of those affected by said diseases.