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## Mechanobiology of Breast Cancer Cells

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# *Mechanobiology of Breast Cancer Cells*



Shea Thompson

***IN OUR GRIT, OUR GLORY™***



# Overview

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- **Background**
- **Scientific Question**
- **Methods**
- **Design Process**
- **Results**
- **Future Research**

# Background

## **Mechanobiology**

Cells response to mechanical loading

## **Mechanical loading includes**

Shear flow

Stretching

Compression



Breast cancer spreads to other tissues of the body.

Breast cancer cells are exposed to flow upon leaving the tumor site.

Cells move through a 3-D space in the body.

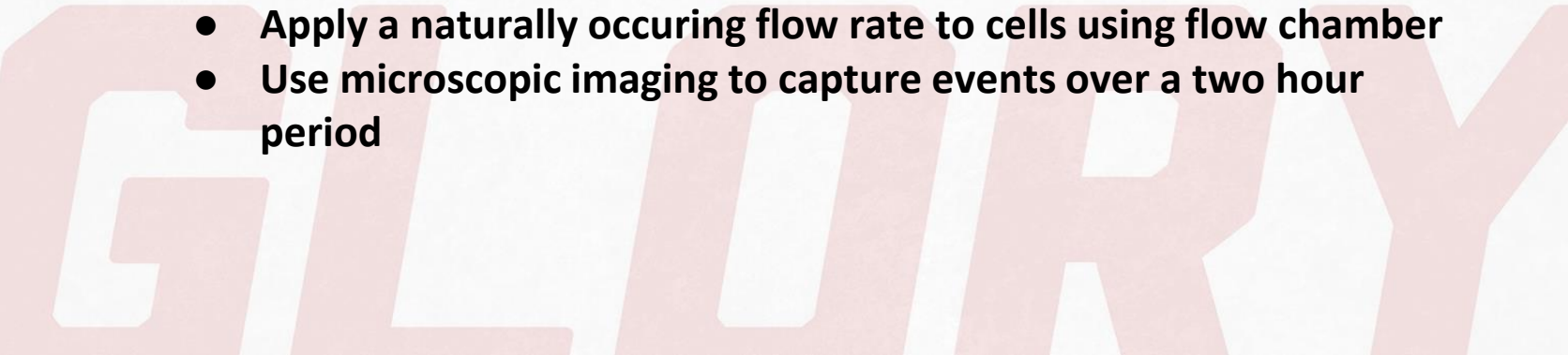


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How does shear flow effect breast cancer cell migration in a three dimensional space?

# Methods

- **Convert a Parallel Flow Chamber to a Three Dimensional Flow Chamber.**
- **Test three different cell lines twice. One trial without flow and one trial with flow.**
  - MDA-MB-231; very aggressive breast cancer
  - MDA-MB-468; less aggressive breast cancer
  - MCF-10A; healthy cells
- **Apply a naturally occurring flow rate to cells using flow chamber**
- **Use microscopic imaging to capture events over a two hour period**



- **Analyze images to find the speed, the arrest coefficient, the cell group displacement, and the individual cell displacement.**
- **Compare to the control trial of the specific cell line to determine whether shear flow promoted migration or not.**





# Design Process

- **Needed to convert a 2D flow chamber into a 3D flow chamber.**

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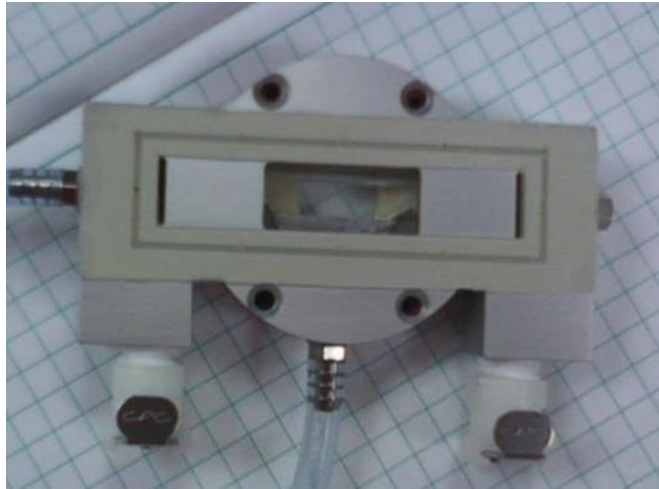


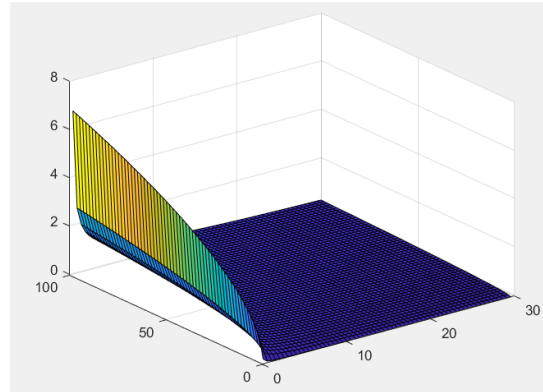
Fig. 1 Parallel Flow Chamber

**Needed to design a device that would have interchangeable parts for future research ideas such as;**

- **How do cells move in a maze?**
- **Does flow improve the effect of chemotaxis?**
- **How will cells migrate when the direction of the flow and the direction of chemotaxis are opposite?**



- **Applied SolidWorks knowledge to design my device**
- **Determined ideal thickness of the flow chamber using MATLAB to simulate different parameters**



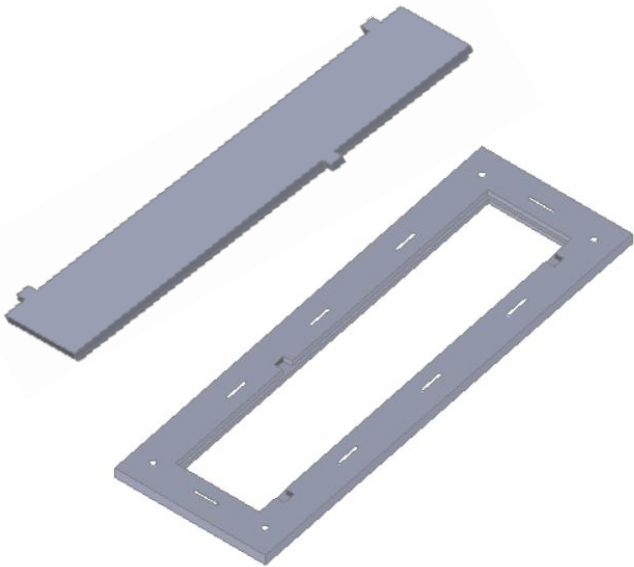
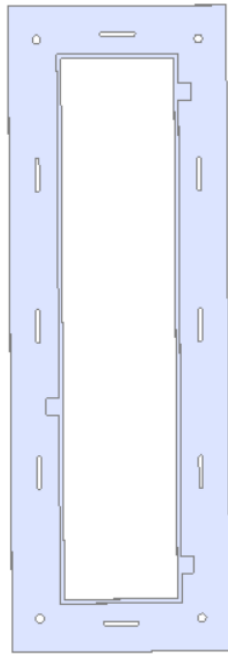
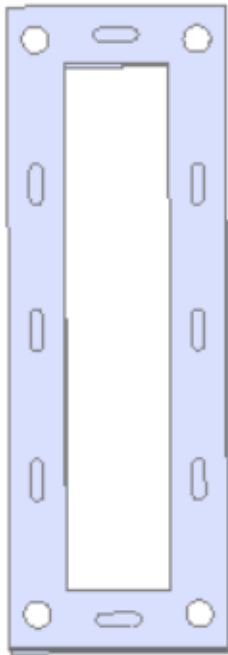
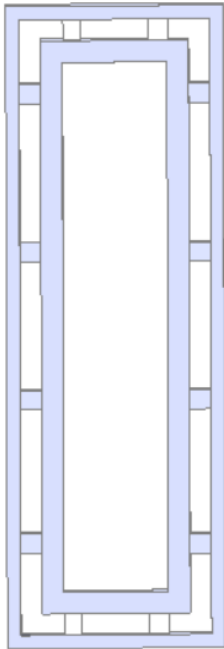
- **Received training for the Stratasys Objet 500 Connex3 3D printer to manufacture the final design**





# Evolution of my design

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- **The first three trials ended in failure due to a leakage in the vacuum seal.**
- **In an effort to improve the vacuum seal, I sanded all surfaces of the device. It improved the seal, but it was still not suitable.**
- **By combining the sanded surfaces and a parafilm-silicon glue gasket, a successful seal was created.**

# Results

**By going through the engineering cycle, I was able to successfully convert the Parallel Flow Chamber into a Three Dimensional Flow Chamber.**

**At this point, I have no results due to the COVID-19 outbreak.**



# Future Research

Understanding how breast cancer migrates is essential to preventing the spread of cancer. While other chemical means have been investigated, mechanotransduction is relatively unexplored.

**Next step:**

**Mechanobiology of breast cancer cells moving through a maze**

Cells have to move around extracellular matrices and other obstructions to travel through the body. My research will study how flow affects their movement.





- **Dr. Lim**
- **Brandon Riehl**
- **Dr. Qian**

**GLORY**