



BME 200/300: Tissue Biopsy Dissociation

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Overview

- Problem Statement
- Client Overview
- Background
- Summary PDS
- Designs and Design Matrix
- Future Work
- Acknowledgments



Problem Statement and Client Overview

Dr. Sameer Mathur conducts asthma research and frequently obtains small lung tissue biopsies from patients

Current device being used for tissue dissociation are designed for larger scale specimens of tissue

Small biopsies are not compatible with this device-cells do not dissociate

The team's task: develop a smaller scale device to successfully dissociate a smaller tissue specimen

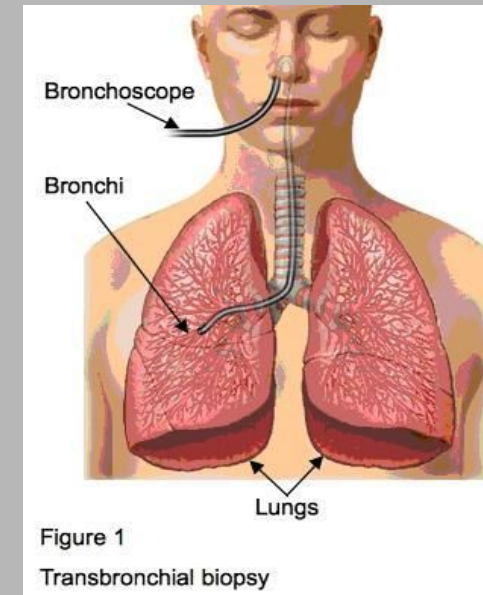
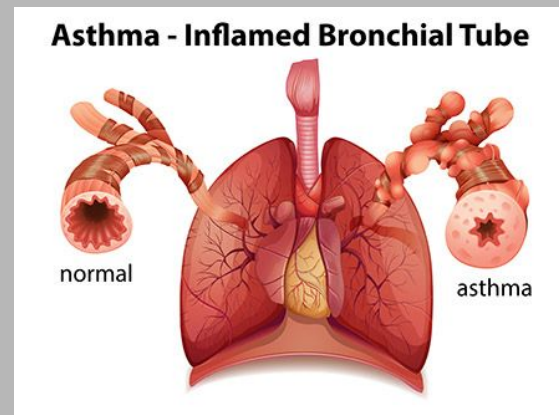
Asthma & Lung Biopsies

What is asthma caused by?

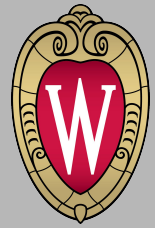
- Airborne allergens
- Inflammatory response led by T-helper type lymphocytes [1]

How are lung biopsies performed?

- Needle, thoracoscopic, transbronchial, open [2]
- Client does bronchoscopies
 - fiberoptic bronchoscope through airways
 - 1-2 mm tissue



Tissue Dissociation



Why dissociate?

- Compare tissues before and after asthmatic reaction
- Flow cytometry [3]
- Eosinophils and lymphocytes

How?

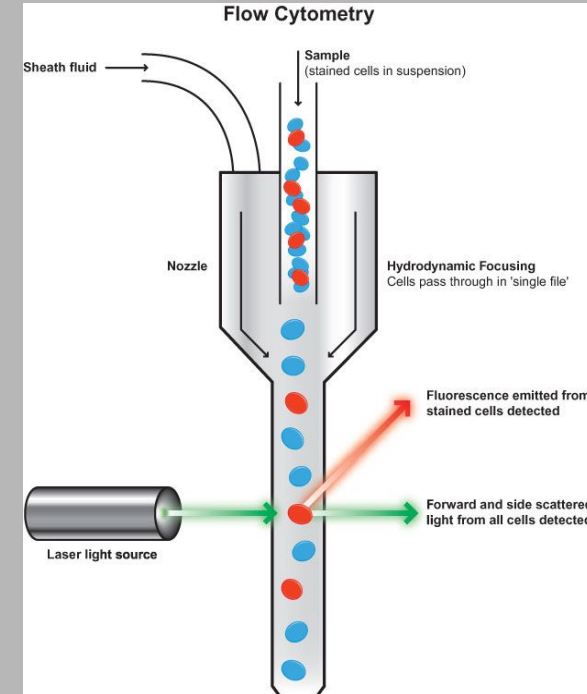
- Mechanical and chemical methods
 - Shouldn't lyse cells
- Enzyme: Collagenase G
 - Need to disturb ECM



Lymphocyte



Eosinophil



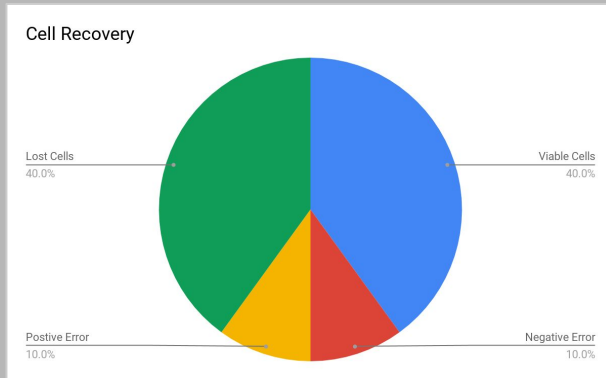


Summary PDS

Performance requirement:

- 50% cell recovery with a margin of error of +/- 10%
- Design must produce viable cells through many rounds of testing.

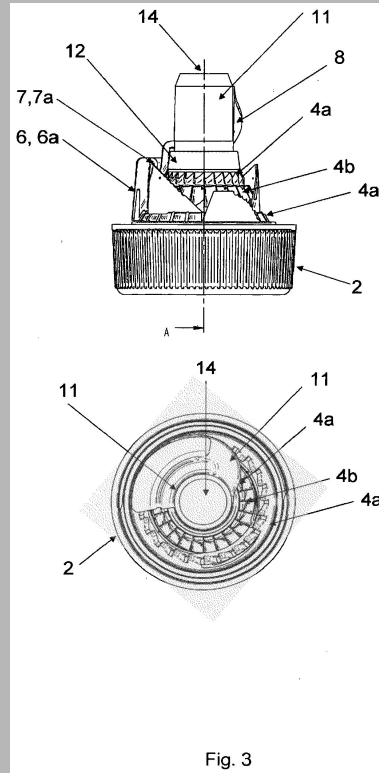
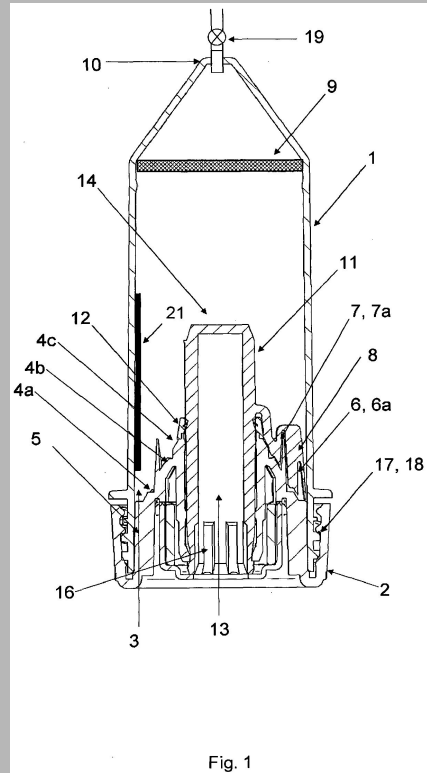
Target cost: \$5-\$10 per use



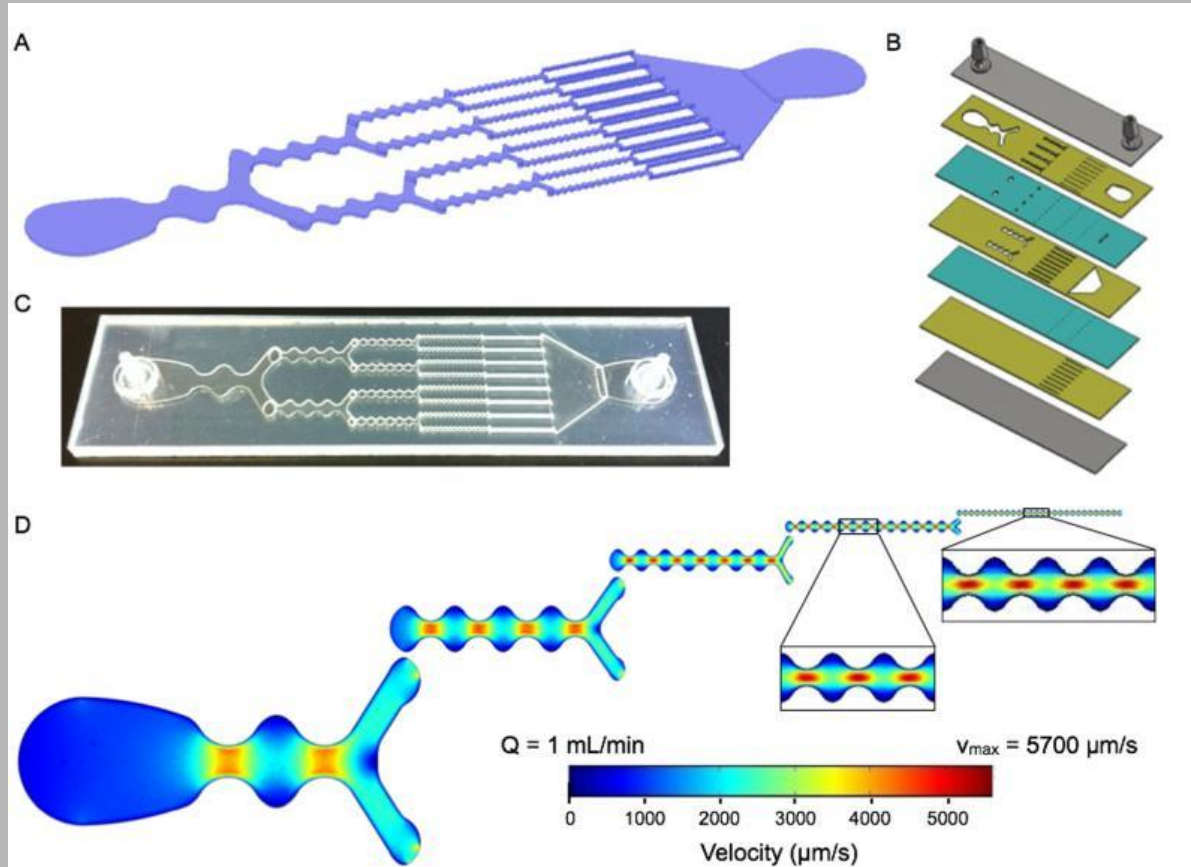
Miltenyi GentleMACS Device



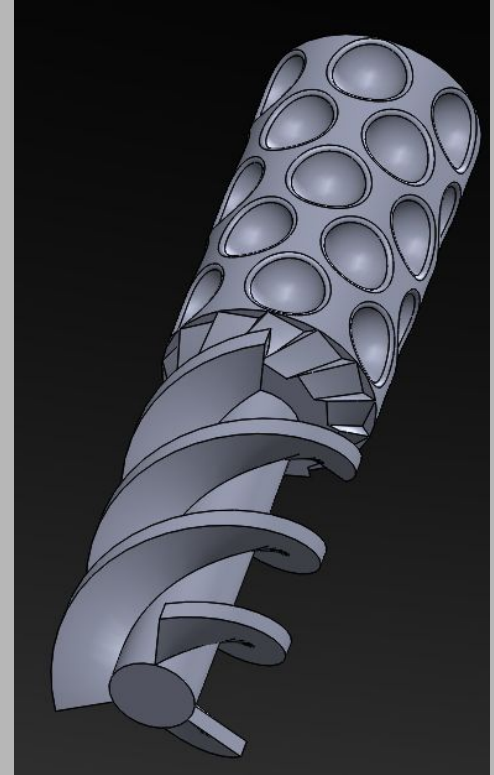
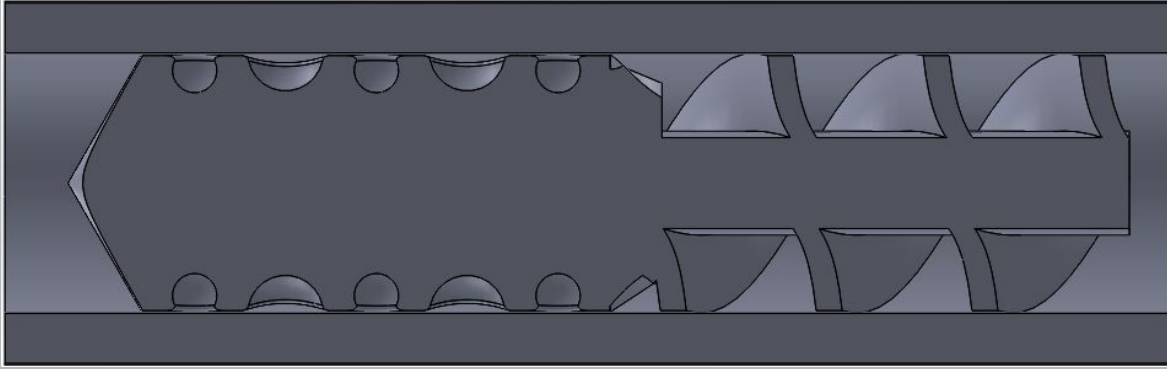
Design 1



Design 2


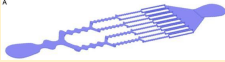
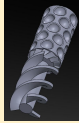


Design 3



Design Matrix

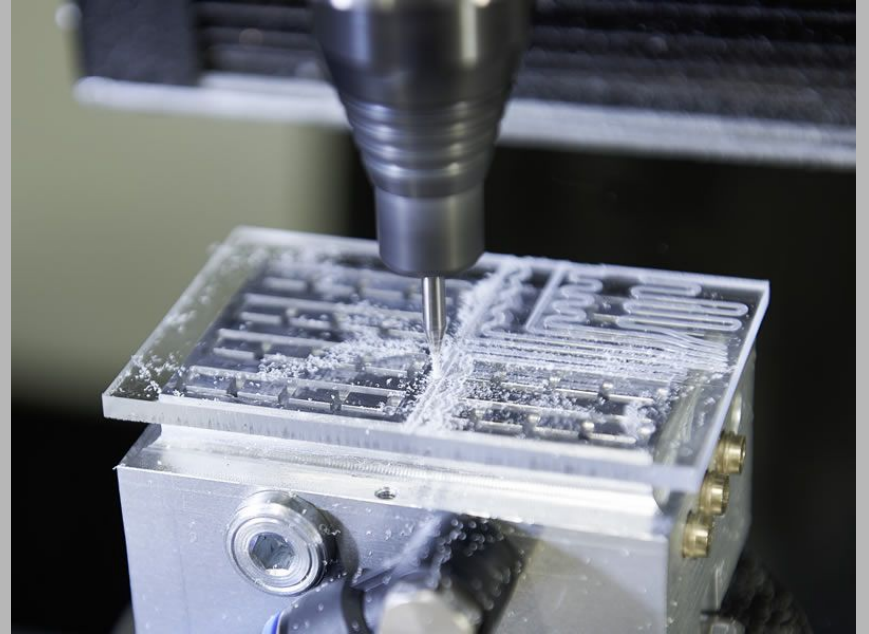


Design Idea:	Modification of current design 	Microfluidic 	Mechanical 
Performance (40)	24 (3/5)	32 (4/5)	24 (3/5)
Ease of fabrication (25)	10 (2/5)	20 (4/5)	15 (3/5)
Cost/usage (20)	12 (3/5)	20 (5/5)	12 (3/5)
Ease of use (15)	15 (5/5)	9 (3/5)	12 (4/5)
Total (100)	61	80	63



Future Work

- Solidworks
 - Calculations from cell physiology
 - Shear Forces
 - Channel Size
- Fabrication
 - 3D Printing
 - Laser Cutting
 - Micromilling
- Testing
 - Procedures
 - Channel Designs
 - Enzymes
- Analyzing data
 - Optimize procedure based on results



Acknowledgements

Dr. Sameer Mathur

Professor Wan Ju Li



Questions?

References

- [1] J. R. Murdoch and C. M. Lloyd, “Chronic inflammation and asthma,” *Mutation Research*, 07-Aug-2010. [Online]. Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2923754/>. [Accessed: 05-Oct-2017].
- [2] “Lung Biopsy,” *Lung Biopsy* | *Johns Hopkins Medicine Health Library*. [Online]. Available: http://www.hopkinsmedicine.org/healthlibrary/test_procedures/pulmonary/lung_biopsy_92,P07750. [Accessed: 05-Oct-2017].
- [3] “Introduction to flow cytometry,” *Flow cytometry introduction* | *Abcam*, 06-Oct-2017. [Online]. Available: <http://www.abcam.com/protocols/introduction-to-flow-cytometry>. [Accessed: 05-Oct-2017].
- [4] Dr. R-P. Peters, Dr. E. Kabaha, W. Stoters, G. Winkelmayr and F. Bucher, “Device for fragmenting tissue,” European Patent Specification #EP2540394B1, May 05th, 2016