



Microscope Cell Culture Incubator

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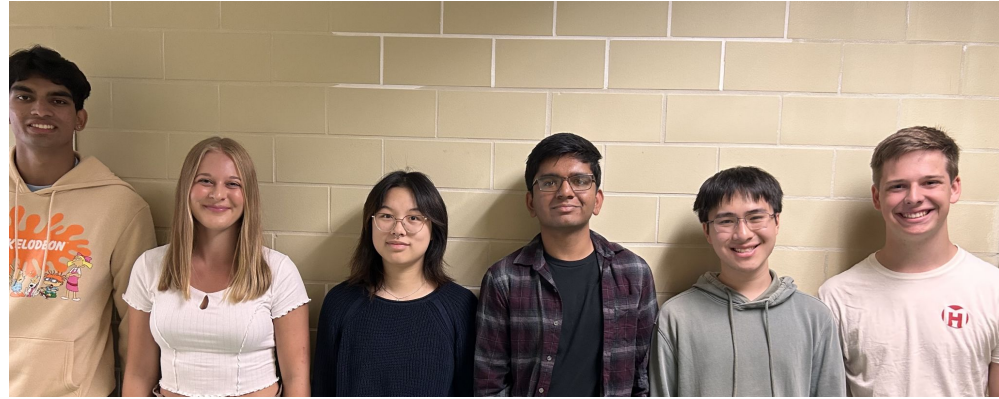
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Advisor: Professor Joshua
Brockman

Client: Professor John Puccinelli

Overview

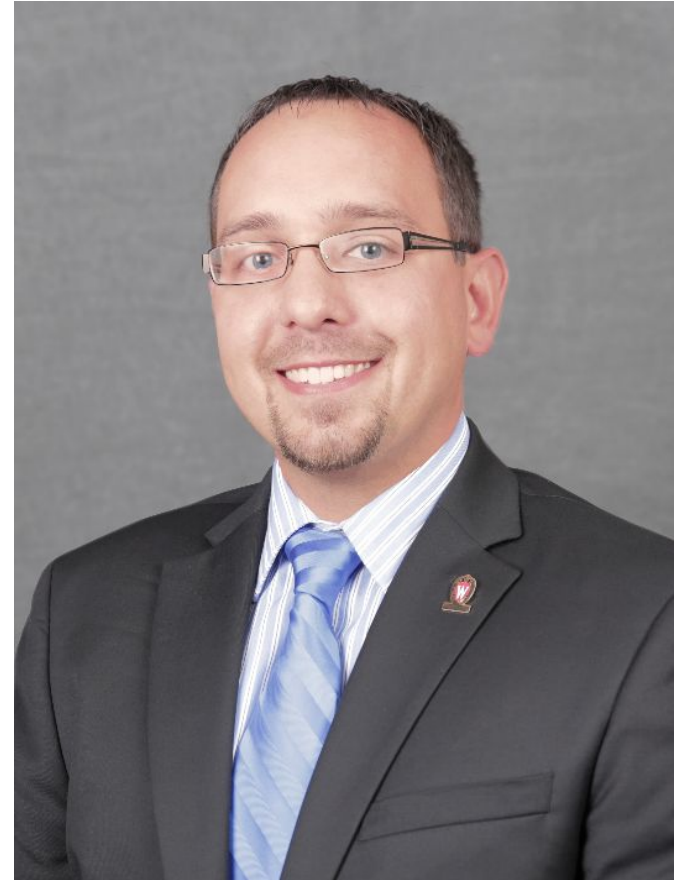
- Client Description
- Problem Statement
- Background
- PDS
- Designs
- Design Matrix
- Future Work





Client Description

- Course Coordinator for BME Design and BME course instructor
- Has multiple ongoing design projects.
- Projects often involve designing new equipment or improving equipment for the department.



Cherry

Problem Statement

- Develop a low cost cell incubator
- Work with an inverted microscope
- Maintain stable biological conditions
- Current solutions are too expensive/cumbersome
- Inexpensive to manufacture

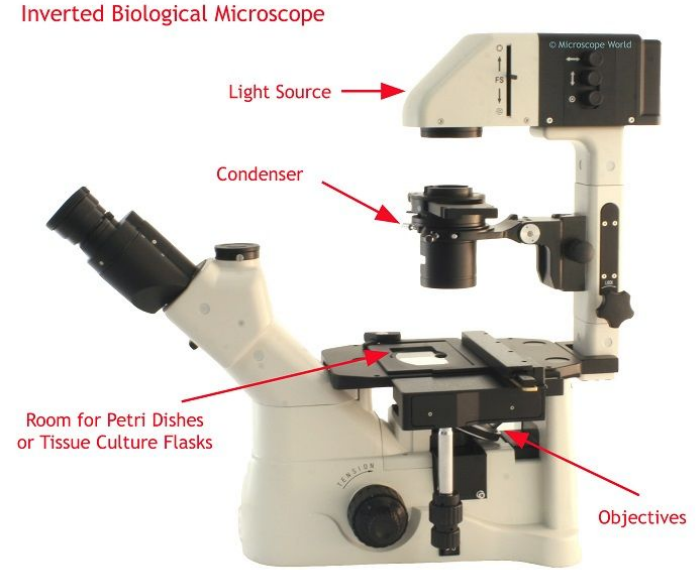


Figure 1. Common Inverting Microscope [1]

Background Information

- Uses:
 - Incubator is being used for BME Tissue Engineering Lab
 - To be used with microscopes in ECB Lab
 - Up to 2 weeks per year
- Biology:
 - Cells are particular
 - CO₂ is used to balance the concentration of oxygen and maintain pH [2]
- Problems with past devices:
 - Unregulated CO₂ [2]
 - Condensation

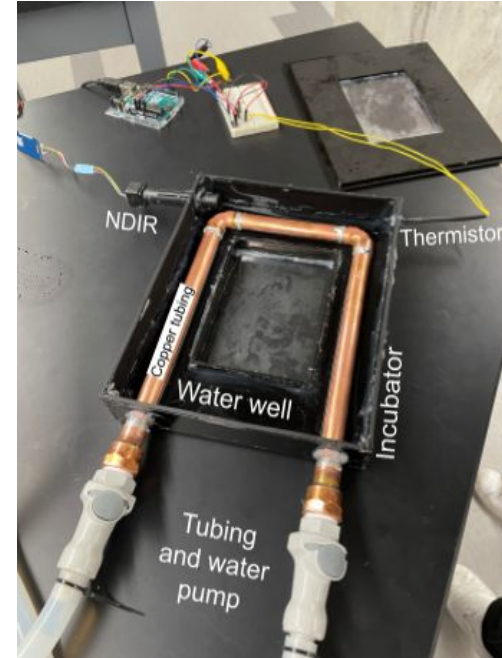


Figure 2. Previous Design

Competing Designs

- Current inverted microscope incubators and standard incubators are priced from around \$500-\$40000.
- Ergonomically challenging
- Large in volume
- Designed for large scale operations
- Many come with microscope



Figure 3. Common microscope cell culture incubator [2]

Keleous



Product Design Specification

The Device Must Be:

- Cost effective
 - <\$100
 - Multiple uses
- Durable and reusable
 - Cannot leak
 - Easily sterilized
- Accurate and reliable
 - $37^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$, humidity > 95% .
CO₂ levels must be $5\% \pm 0.1\%$
 - But be able to maintain these conditions for 2 weeks
- Size
 - Must fit and work with inverting microscope
 - ~ maximum size of 310x300x45mm

Design 1

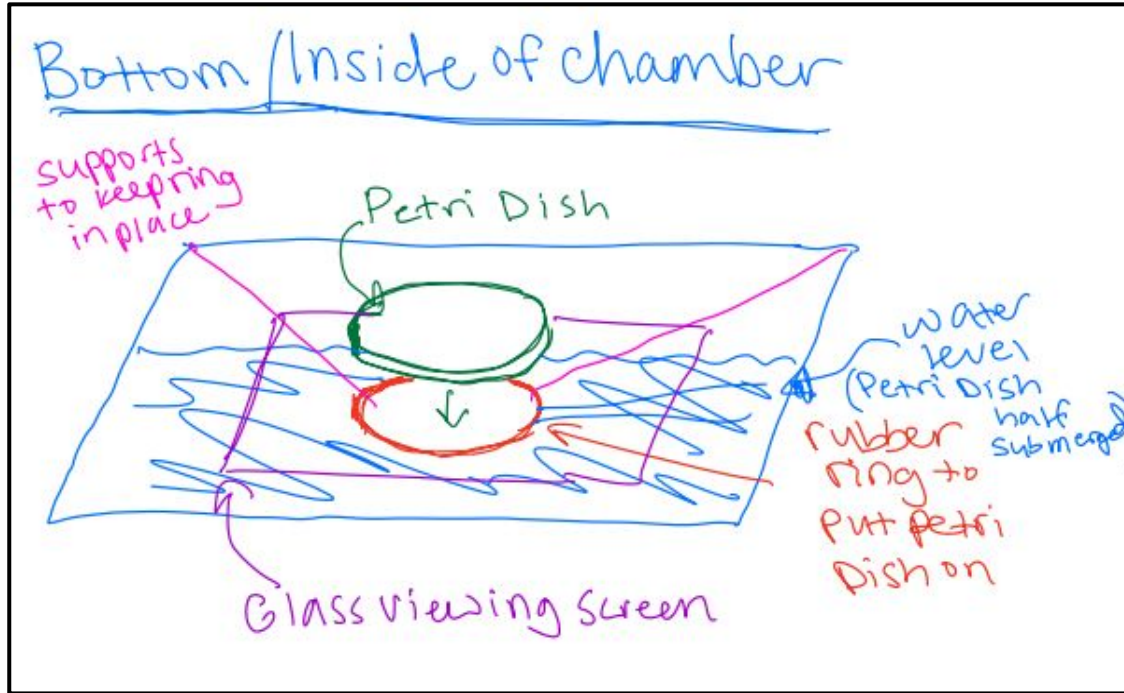


Figure 4. Proposed Water Well Design 1

Design 2



Figure 5. Proposed ITO Film Design 2

Design 3

Wires attached to heat source and Arduino to monitor temperature

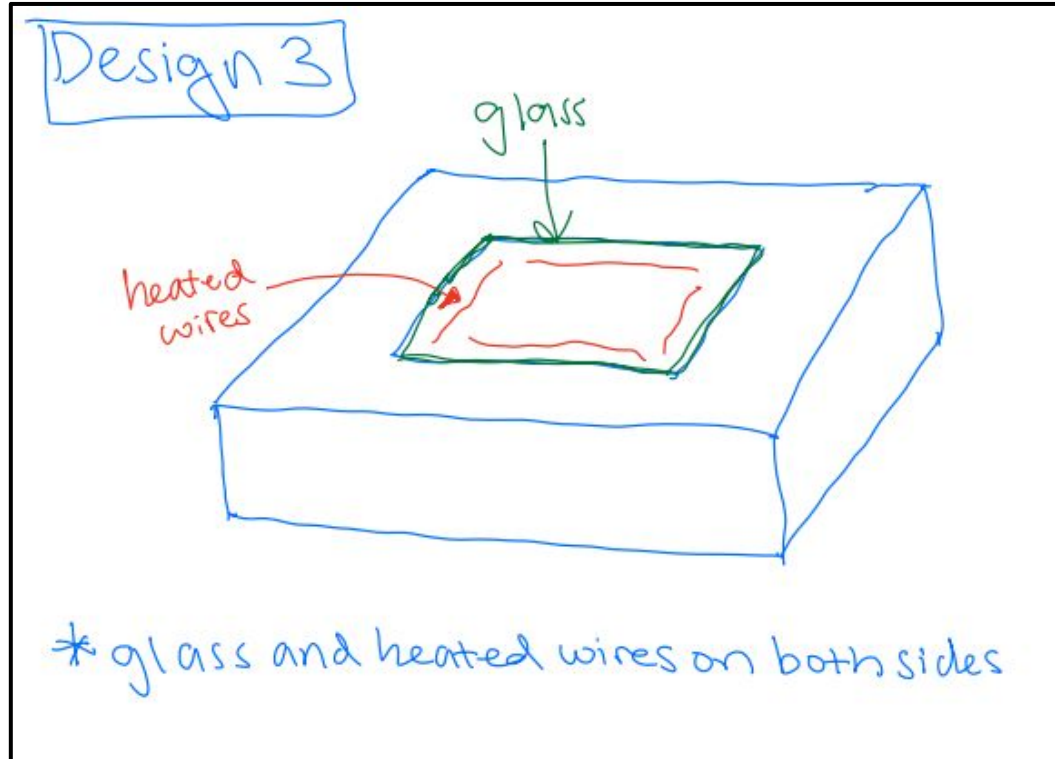


Figure 6. Proposed Heated Wire Design 3

Design Criteria

This incubation chamber must be able to maintain an internal environment of

- Temperature: 37 C
- CO2 Level: 5% ,
- Humidity: 95-100%

Additional criteria

- Must be able to see clearly through microscope
- Cells must survive and be able to proliferate
- Phase shifts must be visible
 - No additional light sources

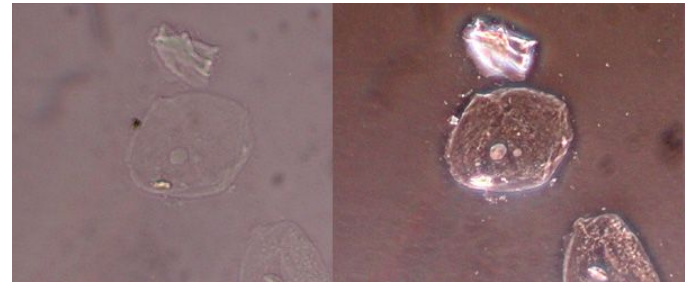


Figure 7. Phase Contrast example [5]



Design Matrix

Criteria	Weight	Design 1		Design 2		Design 3	
		Layer of water + glass on bottom		ITO Film + Glass (maintain constant temp)		Heated Wire Design + glass on both sides	
Reliability	40	4/5	32	5/5	40	2/5	16
Cost	25	4/5	20	2/5	10	5/5	25
Durability	10	3/5	6	3/5	6	2/5	4
Ease Of Fabrication	10	3/5	6	3/5	6	5/5	10
Ease of Use	10	3/5	6	4/5	8	5/5	10
Safety	5	5/5	5	4/5	4	3/5	3
Total	100	75		74		68	

Figure 8.
Design Matrix

Future Work

- Attempt designs listed in the Design Matrix
 - Currently focusing on the issue with condensation
 - Additional potential designs
- Alternate heating method
 - Moving away from water-heating based heating
- Uncluttering Wiring
 - Multitude of wires complicates design

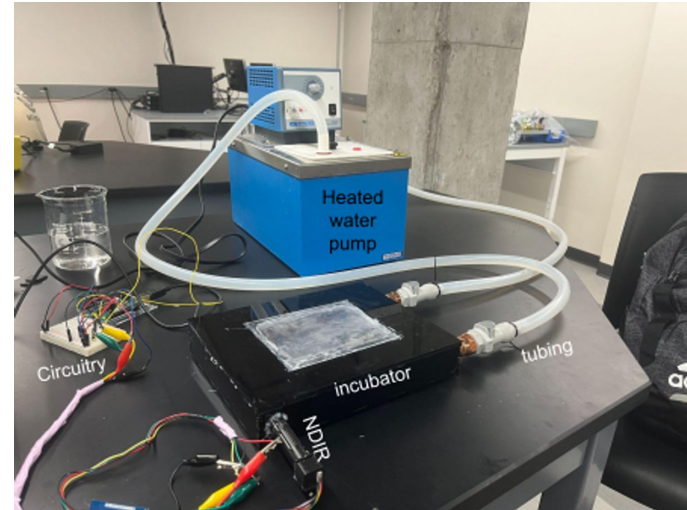


Figure 9. Previous team's set up



Acknowledgements

Thank you to our advisor Dr. Joshua Brockman and to our client Dr. John Puccinelli.



References

[1]

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[2]

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[3]

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[5]

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