Multi-chamber culture insert for connected neuronal aggregates

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Client: Dr. Jason Brant
Advisor: Prof. Mehmet Orman

Team:

Greta Mahlke	gmahlke@wisc.edu (Co-Leader)
Eli Von Holtum	evonholtum@wisc.edu (Communicator)
Sam Brandt	sdbrandt@wisc.edu (Co-Leader)
Safia Syed	ssyed23@wisc.edu (BSAC)
Sri Krishnan	skrishnan32@wisc.edu (BPAG)
Sophia Mazer	smazer@wisc.edu (BWIG)

Problem statement

Common devices used in biological research, including well plates and petri dishes, are readily accessible, provide easy platforms for addition of cells, media, and reagents, and allow for observation using standard laboratory microscopes; however, they fail in their ability to model the complex physiological environments of the human body. In recent decades, there has been a large push toward the development of microphysiological systems used for research, for example, the Organ-on-a-Chip platforms. The ability to model complex tissue environments is incredibly important for the study of the auditory pathway because of its dynamic environment. 2D systems completely isolate cells from the complex physical forces, specialized microenvironments, and 3D neural networks that are vital to the transduction of sound to the brain. The multi-chamber culture insert device provides a more dynamic platform to study the growth and interactions of neuronal cell bodies on a 3D platform. The device allows for growth and interaction of neuronal cell aggregates in a structured manner. The device separates a well plate chamber into distinct sections each holding a neuronal aggregate. The device allows for growth of neurons between chambers, but separates the media in each chamber, allowing for independent treatments of aggregates.

Brief status update

The team has been continuing to test and modify the design based on results. The team met with clients this week to give them a plate to test on and give feedback on.

Difficulties / advice requests

- N/A

Current design

Final Design: Milled 384 Well Plate

Three culture wells connected by an ECM-filled channel at the plate base

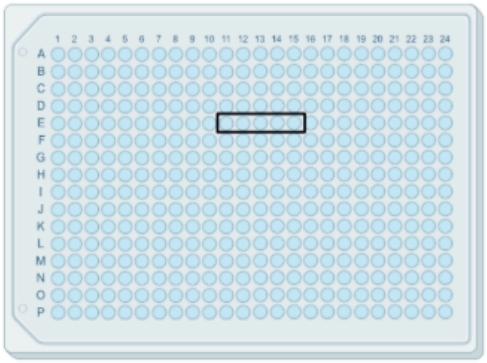


Figure 10: Plate location of culture configuration

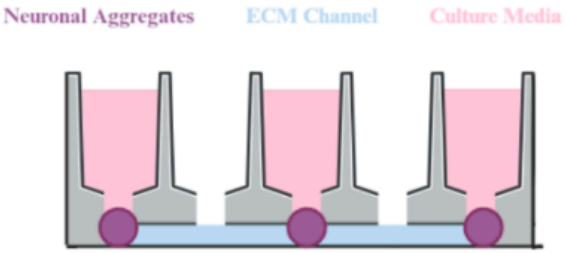


Figure 11: Culture configuration

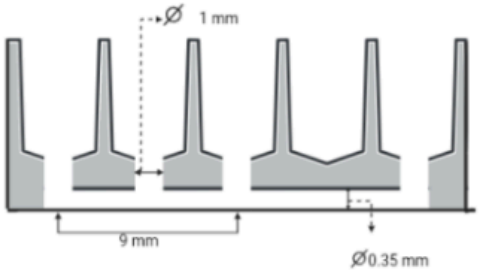


Figure 12: Fabrication geometry

Materials and expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Category 1										
									$0.00	
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$0.00**	

Major team goals for the next week

1. Conduct diffusion testing
2. Finalize funnel design

Next week's individual goals

- Greta
  - Conduct diffusion testing
  - Conduct research into centrifuging aspect of design
- Eli
  - Conduct diffusion testing
  - Print funnel
- Sam
  - Conduct diffusion testing
  - Look into non-cytotoxic glue
- Safia
  - Continue testing and fixing design as needed
  - Finalize funnel design on Fusion, and determine how to fabricate and with what material/
- Sri
  - Continue with testing and design modifications
  - Look into non cytotoxic glue and other methods to prevent tape usage
- Sophia
  - Continue testing
  - Look more into funnel insert designs
  - Look into well-extensions to hold extra volume of liquid

Timeline

Task	Sept				Oct					Nov				Dec	
	4	11	18	25	2	9	16	23	30	6	13	20	27	4	9
Project R&D															
Empathize	X	X	X												
Background & Research	X	X	X	X	X	X	X	X	X						
Preliminary Designing				X	X										
Final Design Prototyping						X	X	X	X	X					
Testing										X					
Deliverables															
Progress Reports		X	X	X	X	X	X	X	X	X					
Product Design Specifications			X												

BME Design: 200, 300

Design Matrix				X											
Prelim presentation & Selection of Final Design					X										
Show and Tell									X						
Final Poster															
All Deliverables Due															
Meetings															
Client			X	X						X					
Advisor	X	X	X	X		X	X	X							
Website															
Update	X	X	X	X	X	X	X	X	X						

Filled boxes = projected timeline

X = task was worked on or completed

Previous week's goals and accomplishments

- Greta
  - Conduct diffusion testing
  - Conduct research into methods of spinning the aggregates down into place
- Eli
  - Continue design iteration
  - Conduct diffusion testing
- Sam
  - Consider show-and-tell feedback
  - Work on design iterations
- Safia
  - Conduct diffusion testing
  - Finish designing negatives for funnel insert on fusion
- Sri
  - Pursue further testing and use feedback from mentor and show-and-tell to make adjustments necessary
  - Continue research to fill gaps in design that are evident
- Sophia
  - Continued testing
  - Looked into funnel insert designs/geometries

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (
Greta	11/2	Made modifications to well plate design and tape file	0.5	3.25	43.25
	11/3	Milled well plate and cleaned it	1.5		
	11/5	Assembled device for client	0.25		
	11/5	Met with client	1		
Eli	11/4	Looked into adhesion techniques other than tape	0.5	2	36.25
	11/4	Cut tape	0.5		
	11/5	Met with client	1		
Sam	11/5	Researched non-cytotoxic glues	1	1	35.5
Safia	11/5	Researched material for the funnel	1	2	36.5
	11/5	The team met with the client to show well	1		

		plate design.			
Sri	11/4	Looked into other glue alternatives and UV treating resin	1	2.5	34.5
	11/5	Looked into autoclaving methods to make resin non toxic, researched other potential options to fix the tape issue	1.5		
Sophia	11/4	Looked into potential well-extension options and materials	1.5	2.5	34
	11/5	Looked into funnel design with well-extensions	1		