Perfusion Chamber with Elastic and Porous Membrane

Client: *Dr. Donna Peters, UW Medical Sciences Center Department of Pathology*
Advisor: *Professor William Murphy, Ph.D.*
Team: *Holly Liske, Leader*
Laura Piechura, Communicator
Joey Labuz, BWIG
Kellen Sheedy, BSAC

Problem Statement

Dr. Peters aims to test the effects of various drugs on the movement of fluid across a layer of human eye cells. Currently, the eye cells are supported on a silicon membrane that simulates the flexibility of the tissue in vivo. The membrane is placed in an Ussing perfusion chamber that measures the effects of pressure on the cell layer. This experimental system must be redesigned to allow greater control of the experimental conditions. Specifically, the chamber must allow for control of the movement of fluid, easy replacement of cell culture plates, and measurement of fluid pressure with computer-controlled transducers. In addition, a porous elastic membrane that permits fluid flow will replace the silicon membrane of the current system. A successful design will be used to screen for potential treatments of glaucoma.

Week Thirteen

Goals:

- We will further consider asking Dr. Peters whether it would be possible to borrow a fluid injection syringe to better demonstrate the device.
- We will complete all construction work in the shop on Saturday and will finish work Saturday evening or Sunday.
- We will purchase needle ports and Plastidip on Saturday after major construction work has been completed.
- Testing will be performed during construction, and post-construction testing and data analysis will be completed Sunday.
- Any necessary revisions will be completed on or before Monday evening.
- The poster and presentation sections will be completed individually and reviewed and compiled as a group. We plan to submit the poster for printing Tuesday or Wednesday.
- The final presentation will be rehearsed Thursday evening, including practice of demonstrating the device function.

Activities:

Holly:	Construction (21 hr)
	Testing (3.5 hr)
	Device sketch and presentation preparation (6 hr)
Laura:	Construction (21 hr)
	Testing (1 hr)
	Preparation of the poster (15 hr)
Joey:	Construction (21 hr)

Testing (3.5 hr)
Presentation preparation (4 hr)

Kellen: Construction (21 hr)
Testing (3.5 hr)
Presentation preparation (4 hr)

Accomplishments:

- Twenty gauge needles were purchased from the UW Physics shop. Currency was requested in the form of doughnuts from Greenbush Bakery or Kringles from Lang's.
- We completed the majority of construction on Saturday while the shop was open. The bottom and top chambers were milled and threaded for connection. The membrane holder shells were lathed to fit the magnets and o-rings and to be properly sealed between the upper and lower chambers. All cuts were made with soap and water to achieve a smooth, clean cutting surface.
- Plastidip and a 3/8 inch diameter steel rod were purchased. The steel rod will be cut into pieces to be incorporated into the bottom of the chamber for further stability on a laboratory bench. The device will be connected to a number of tubes that could otherwise move the chambers during experimentation.
- Magnets and magnet holders were coated with Plastidip. Several coats were necessary to achieve an even and thorough coat.
- Needle ports were carefully drilled and fitted with 1.5-inch lengths of needle. Sufficient needle length was allowed for connection to syringe and transducer tubing.
- Wells were drilled on the bottom surface of the lower chamber for the steel rod pieces, and the pieces were glued in place.
- Testing was performed in Dr. Peters's laboratory to investigate sealing against fluid leakage and the ability of the device to withstand a range of input rates. Jennifer Faralli, a researcher in Dr. Peters's laboratory, sterilized a membrane to be plated with cells the following morning.
- Testing data was plotted and analyzed, and an appropriate means of representing the results was chosen for the poster presentation.
- A sketch of the completed prototype was made and incorporated into the poster. The poster was completed and submitted for printing.
- Presentation responsibilities of each group member were chosen, and specifics of the presentation were prepared.
- The poster, presentation, and device were reviewed during a group meeting Thursday evening. Demonstration of the device was practiced, and answers to possible questions were discussed.
- Joey obtained permission from Professor David Beebe to borrow a syringe pump during the poster presentation.
- Design notebook requirements were discussed, and Joey asked to borrow a design notebook to review the format and depth of information included.

Difficulties:

- Our design required several difficult cuts to be made in the machine shop. It was very challenging to thread the cast acrylic rods and the lower chambers and to exactly mill the very small dimensions of the prototype. However, cuts were made successfully with the automated equipment in the machine shop and with help from employees of the machine shop.

- Plastidip was difficult to apply in an even and thorough coat. Several trials and coats were necessary to achieve the desired coat.

Week Fourteen

Goals:

- We will present our work at the BME final poster presentation. Design notebooks will be completed and the prototype will be delivered to Dr. Peters's lab. We will plan a final meeting time with Professor Murphy.

Project Timeline

Team Goals	9/7	9/14	9/21	9/28	10/4	10/11	10/18	10/25	11/2	11/9	11/16	11/23	11/30	12/7	12/14
Propose project															
Conduct background research															
Meet with Dr. Peters															
Develop PDS															
Brainstorm design ideas															
Choose design alternatives															
Plan midsemester presentation															
Write midsemester paper															
Choose final design															
Order materials															
Construct prototype															
Test prototype															
Plan final poster presentation															
Write final paper															
Meet with Professor Murphy															

Expenses

We have not been informed of the cost of shipping; however, the total cost of materials ordered was $82.39. This is well below the expected budget of $2,000 to $3,000 dollars and was nearly halved with the decrease in project dimensions.

Additional expenses include $10 for Plastidip spray, $10 for a steel rod, and $4 for sealing glue. Total cost for the project without shipping is therefore $106.39.