

Progress Report 1: January 22 – January 28

Title: Device to monitor/control differentiation of stem cells to pancreas (Spring 2008)
Client: Victoria Browning Ph.D.
Advisor: Naomi Chesler Ph.D.
Team Members: Dhaval Desai (Team Leader, Communications)
Tim Pearce (BSAC)
Jon Baran (BWIG)
Tess Rollmann (role to be determined soon)

Problem Statement

Embryonic stem cells (ESCs) have the capacity to differentiate into every cell type in the body, and therefore can theoretically be used to generate cells and tissues to cure a variety of diseases. Our client in the Odorico Lab (Department of Surgery) has derived foregut-committed cell lines from ESCs (which correspond to progenitor cells of the gut region that develops primarily into pancreas) and would like to differentiate these ESCs into insulin-producing pancreatic beta-like cells. These cells could replace or supplement transplanted donor beta cells. The mechanisms required to differentiate ESCs into these pancreatic cells is currently unknown, and this device would aid in researching such mechanisms. Our client would like to test a large number of growth factors for their ability to affect conversion of these precursor cells to mature insulin-secreting cells. In addition, a recapitulation of the 3-dimensional embryonic environment to prompt cells to adopt a pancreatic cell fate, perhaps using a Matrigel substrate, is desirable. A small scale cell culture using microfluidics to set up growth factor gradients is one approach that could be successful.

Restatement of Team's Goals

- Meet with Dr. Browning (Kyle, Tim, Jon, Dhaval)
- Determine team roles (Dhaval, Tim, Jon, Tess)

Summary of Team Accomplishments

- We met with Dr. Browning and Dr. Kahan on December 18 to discuss the progress of the project at the end of last semester. They liked our design idea and the results we obtained with Texas-red labeled Dextran. However, Dr. Kahan insisted that instead of using a 3D setup (cells suspended in Matrigel within our device), we should focus on a 2D setup. Further considerations include:
 - Instead of placing our device on a glass slide, place it on a tissue-culture treated slide, which would allow proper adhesion of the feeder layer of cells
 - First introduce feeder layer of cells, allow time for the feeder layer to adhere to the surface, remove the media from the device
 - Then add stem cells (which are suspended in media) into the device, allow time for the stem cells to attach to the feeder layer, and then allow time for the stem cells to multiply. This may require the addition of fresh media periodically.
 - Then setup concentration gradient of a given growth factor.
- Upon further discussions, we all agreed that major emphasis at the beginning of spring semester should be placed on cell viability in our device as poor cell viability will require design modification(s).
- Tim created a design on illustrator that would allow us to create the channel, the source, and sink from the same piece of PDMS. Previously our source and sink were generated using an extra layer of PDMS.
- Kyle will not continue with the project; he has decided to take up a co-op position. Dhaval will take on the Team Leader position.
- Tess Rollmann has decided to join our group.

Statement of Team's Goals

- Meet Monday, January 28th, to determine team roles and update PDS as necessary.
- Figure out time(s) that all of us can meet as a team and work on the project.
- Plan out next course of action.

Project Schedule

September 7	Form team, select project, contact client, email team roles to advisor
September 14	Background and research on project, create problem statement, begin PDS
September 21	Brainstorming, begin developing designs
September 28	Brainstorming
October 5	Finalize three alternative designs
October 12	Work on mid-semester presentation (oral and power point)

October 19	Mid-semester presentations
October 25	Submit design notebooks for advisor review
October 26	Design on final design
November 2	Work on design
November 9	Work on design
November 16	Work on design
November 23	Thanksgiving break
November 30	Work on poster presentation
December 7	Final poster presentation, put poster presentation on team web site by 10:00am
December 12	Hand in written report and notebook to advisor
December 14	Final meeting with advisors
January 25	Assign team roles, create timeline
February 1	Cell viability tests, growth factor diffusivity coefficient calculations, modify device
February 8	Cell viability tests, growth factor diffusivity coefficient calculations, modify device
February 15	Cell viability tests, growth factor diffusivity coefficient calculations, modify device
February 22	Cell viability tests, growth factor diffusivity coefficient calculations, modify device
February 29	Test design, work on midsemester presentations
March 7	Midsemester presentations
March 14	Test design
March 21	Spring Break
March 28	Test design
April 4	Distinguished Entrepreneurship Lecture in Tong
April 11	Test design
April 18	Test design, work on poster
April 25	Test design, work on poster and final paper
May 2	Final Poster Presentations
May 7	Hand in paper and design notebooks, update website, final client meeting.
May 9	Final Meeting with Advisor

Project Difficulties

- Setting up a maintainable gradient on such a small scale could be very challenging, and all of the possible methods are considerably complicated and will require significant research
- Getting the Matrigel into the channel using passive pumping is difficult, but doable.

Activities

- **Dhaval (Team Leader, Communications)**
 - Design course introduction – 2 hrs
 - Team Meeting (1/28) – 1.5 hrs
 - Progress Report – 1 hr
 - Total: 4.5 hrs
- **Tim (BSAC)**
 - Design course introduction – 2 hrs
 - Team Meeting (1/28) – 1.5 hrs
 - Total: 3.5 hrs
- **Jon (BWIG)**
 - Design course introduction – 2 hrs
 - Team Meeting (1/28) – 1.5 hrs
 - Total: 3.5 hrs
- **Tess**
 - Design course introduction – 2 hrs
 - Team Meeting (1/28) – 1.5 hrs
 - Total: 3.5 hrs
- **Total Team Hours for this Week: 15 hrs**
- **Running Total for Each Member:**
 - Dhaval – 4.5
 - Tim – 3.5
 - Jon – 3.5
 - Tess – 3.5

Project Timeline (next page)

Task	Jan	February					March				April			May	
	25	1	8	15	22	29	7	14	21	28	4	11	18	25	2
Preliminary Steps															
Assign team roles															
Meetings															
Meeting with client															
Tuesday team meetings															
Meetings outside of class															
Design															
Cell viability testing															
Growth factor diffusivity coefficient testing															
Deliverables															
Progress Reports															
Project Design Specification															
Mid-semester presentation															
Final presentation															
Final paper															
Other duties															
BSAC meetings															
Updating website															
Contacting client/suppliers															

Key:		Tess		Dhaval		Tim		Jon		All
		Holiday(s)								

Only individual tasks are indicated with special gradients

Expenses

All other material donated from Browning, Berthier, Williams, Beebe.