Bone marrow microenvironment culturing system for mesenchymal stem cells

msc_culture

Client: Dr. Wan-Ju Li
Advisor: Dr. Tracy Puccinelli
Team: Taylor Marohl [tmarohl@wisc.edu] (920) 412-8765 (Leader)
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Date: 1/27/17 – 2/2/17

Problem Statement:

Mesenchymal stem cells (MSCs) are widely studied for their valuable multipotent character that could enable tissue regeneration, especially in orthopedic injuries. Unfortunately, the yield of MSCs through extraction from bone marrow is low, and cells must be expanded in culture without the risk of spontaneous differentiation. Current culture methods are variable in their ability to maintain MSCs in a multipotent state, and do not adequately attempt to recreate the physiological conditions that prevent differentiation. For this reason, there is a need for a culture system that allows researchers to sustain multipotency in their cells by mimicking the bone marrow microenvironment through substrate stiffness and oxygen concentration.

Last Week's Goals:

- Meet with Dr. Nimunkar/Bioinstrumentation TA to discuss bioreactor ideas/difficulties
- Order new biomaterial materials, hopefully they arrive this week
- Finalize biomaterial protocol
- Michelle – start MSC cell training in Li lab
- Finish planning Outreach project
- Finish PDS
- Begin preparing midsemester paper

Summary of Individual/Team Role Accomplishments:

- **Taylor Marohl:** Wrote progress report.
- **Veronica Porubsky:** Reached out to client to schedule a regular meeting. Requested materials to be ordered by the client's lab manager; documented this in the budget.
- **Michelle Tong:** N/A
- **Maddie Meier:** Updated website.

Summary of Design Accomplishments/Literature Search:

- After meeting with Dr. Puccinelli last Friday, we have realized is it possible to run gas lines into/out of a cell culture incubator, allowing us to modulate gas flow to a cell-containing device
    - We plan to meet with Dr. Nimunkar on Thursday to discuss this idea and others
    - After getting Dr. Nimunkar's feedback, we will proceed with a design matrix
- New materials for the biomaterial were ordered on Monday

    - Materials ordered include N-Acryloxysuccinimide, PEGDA 4000, and N,N-Dimethylformamide
    - Dr. Li has told us that one of his grad students will perform the MSC cell culture with us to ensure high quality results. Thus, none of us needs to be trained to cultures the MSCs
- We completed our Outreach activity on Tuesday! The kids had a lot of fun with the water beads, Jello, and hydrogels. Everything went really well.

Activities:

Person	Task	Time	Weekly Total	Sem. Total
Taylor	-Progress report -Outreach prep -Journal paper initialization	-1hr -3hr -0.5hr	4.5 hr	8 hr
Veronica	-Outreach practice -Biomaterial protocol writing	-1hr -1hr	2 hr	9 hr
Michelle	-Outreach practice -Edit PDS	-1hr -0.5hr	1.5 hr	7.5 hr
Maddie	-Bioreactor: Mechanical components research, Meeting w Amit -PDS and Design Matrix Updates -Outreach Prep/Practice	-2hr -1hr -1hr	4 hr	6 hr
Team	-Team Meeting -Outreach practice -Advisor meeting -Outreach activity	-1.5 hr -2 hr -0.5 hr -2 hr	6hr	7.5hr

Goals for This Week:

- Hopefully biomaterials will be delivered and we can start experimentation
- Bioreactor design matrix, finalize design, discuss materials
- Continue working on midsemester paper, start working on presentation

Schedule for Upcoming Week :

- **Friday 2:30pm** Advisor Meeting
- **Thursday 6:00pm** Team Meeting

Difficulties:

- We have not yet been able to achieve our goal biomaterial stiffness. Veronica submitted a new materials request to Dr. Li's lab manager so that we may work with a higher molecular weight chemical. These materials will likely be ordered on Monday and will hopefully arrive next week.

Project Schedule/Timeline:

Color Key: Deliverables Bioreactor Biomaterial Outreach Questions

Mon 1/16 - Sun 1/22

- Discuss O2 bioreactor ideas (Maddie)
  - Take the week to research/plan any updates
- Update on biomaterial
  - Need to formulate a rationale for choosing our stiffness goal (100-200 Pa) so it can be included in our paper.
- Ask Dr. Puccinelli about format of midsemester report (scientific publication?)
- Plan Outreach project

Mon 1/23 - Sun 1/29

- Plan a client meeting
- Meet with Dr. Nimunkar/Bioinstrumentation TA to discuss bioreactor ideas/difficulties
- Design matrix for bioreactor
  - Decide on design, start discussing/researching materials
- Order new biomaterial materials, hopefully they arrive this week
- Finish planning Outreach project

Fri 1/27 - Thurs 2/2

- Conduct outreach at Bayview Community Center on Tues (1/31) from 3:45-4:45pm
- Michelle - start MSC cell training in Li lab
- Finalize biomaterial protocol
- Meet with Dr. Nimunkar/Bioinstrumentation TA to discuss bioreactor ideas/difficulties
- PDS due Friday 2/3
- Begin preparing midsemester paper

Fri 2/3 - Thurs 2/9 (VERONICA GONE 2/8-2/10)

- Biomaterials delivered, start experimentation
- Bioreactor design matrix, finalize bioreactor design, discuss materials
- Continue working on midsemester paper, start working on presentation

Fri 2/10 - Thurs 2/16 (MADDIE OUT 2/15-2/16)

- Biomaterial experimentation
- Order bioreactor materials
- **MIDSEMESTER PRESENTATION Friday 2/17**
- Finish midsemester paper

Fri 2/17 - Thurs 2/23 (VERONICA GONE 2/21-2/25)

- Fabricate multiple biomaterial stiffnesses, freeze
- Begin bioreactor fabrication
- **MIDSEMESTER PAPER DUE Wednesday 2/22**

Fri 2/24 - Thurs 3/2 (VERONICA GONE 3/1-3/5)

- Start cell evaluation on biomaterial
- Continue bioreactor fabrication

Fri 3/3 - Thurs 3/9

- Continue cell evaluation on biomaterial

- Finish bioreactor fabrication

Fri 3/10 - Thurs 3/16
- Finish cell evaluation on biomaterial, analyze data

Fri 3/17 - Thurs 3/23
- **SPRING BREAK**

Fri 3/24 - Thurs 3/30
- Begin cell evaluation on bioreactor
- Begin final cell evaluation on bioreactor + substrate

Fri 3/31 - Thurs 4/6 (MADDIE GONE THIS WEEK)
- Continue cell evaluation on bioreactor
- Continue final cell evaluation on bioreactor + substrate

Fri 4/7 - Thurs 4/13
- Finish cell evaluation on bioreactor, analyze data
- Finish final cell evaluation, analyze data
- Begin working on poster, final report

Fri 4/14 - Thurs 4/20
- Finish poster, continue working on final report

Fri 4/21 - Thurs 4/27
- **Fri 4/28 FINAL POSTER PRESENTATION Friday 4/28**
- Finish final report

Fri 4/28 - Thurs 5/4

- **Wed 5/3 FINAL REPORT DUE Wednesday 5/3**