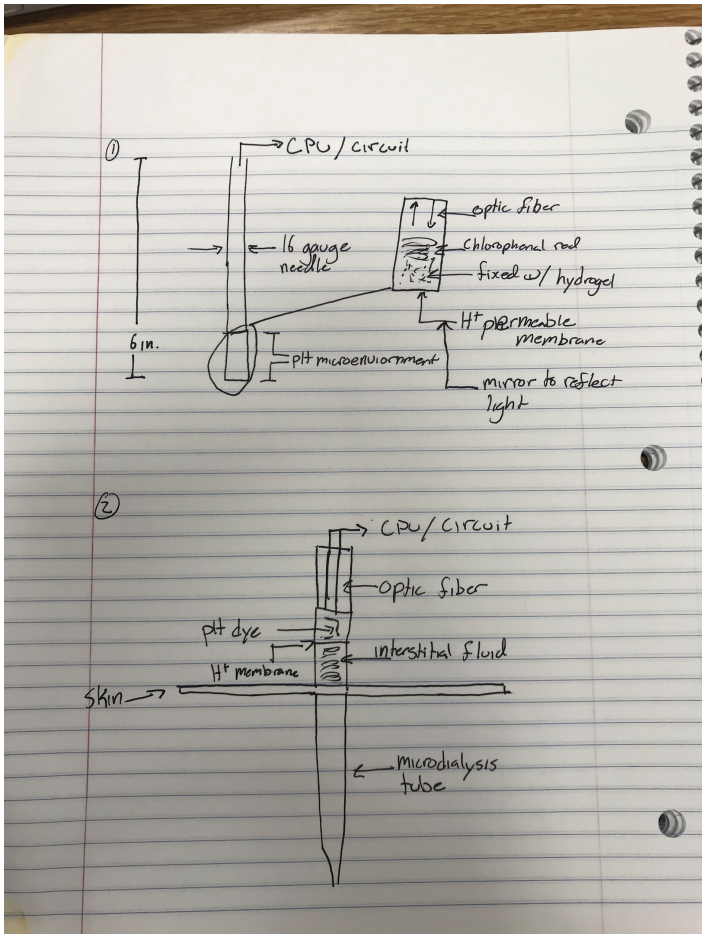
Progress Report

Week of 9/17/18

Alex Goodman
Work/Research Accomplished:

- Met with Client on Wednesday, talked further about expectations for project along with a thorough background explanation about ACS and current diagnosis methods
- Last year's glucose monitor was problematic because:
    - Too hastily made
    - Must be able to calibrate by comparing acute compartment measurement to healthy compartment
- Client pointed to promise of last spring group's effort and pointed us towards creating a probe that measures concentration of pH using pH-sensitive dye and optical fibers
    - Invasive
    - Cheap
    - Previous group did a lot of very solid background research
- Also met with team, discussed possible designs for implementing optical fibers to measure pH



Problems:

- Unsure about the physics involved with designing an optical fiber-based circuit.
    - Will we be able to measure a change in absorption and use beer's law to discern pH concentration?
    - Assuming we do measure a change in absorption, how do we filter out the noise from *everything* else except the change in pH Dye color?
- What is a viable way to test the design of the circuit independent of the design of the pH microenvironment?

Will Bacon
Work/Research Accomplished:

- Met with client, see Alex's section for breakdown of information gained from client meeting.
    - Additionally, client talked about how measuring ppO_2 was also very effective at detecting ACS, but the technique utilizes fluorescent spectrometry and is too costly. We could research if there are cheaper ways to measure ppO_2.
- Had a team meeting on Sunday to discuss preliminary ideas, brainstorm questions for client, and look over the work done by last semester's team.
    - Moving forward, Kelsey and I will divert our focus to the biomaterials aspect of the project while Mark and Alex focus on the bioinstrumentation aspect.
- The use of optic fibers and a pH indicator dye, as proposed by last year's team, seem to hold a lot of promise but most of their work was theoretical.
- One variation that could potentially be explored is using microdialysis to draw ions across a semipermeable membrane and outside the body into a dialysate solution containing the pH indicator dye. This would allow us to perform pH measurements *ex vivo*, potentially simplifying the process

Problems:

- I brought up the use of microdialysis to our client Dr. Doro and he raised some credible concerns
    - Will measuring the pH *ex vivo* alter the pH reading. For instance, does the microenvironment in the muscle affect the pH reading and thus cause a different *in vivo* reading.
    - Also pointed me in the direction of a paper that used microdialysis to remove fluid from a muscle compartment for biomarker analysis.

Mark Austin
Work/Research Accomplished:

- Met with Dr. Doro, was able to lay down some quantitative marks to shoot for:
    - Aim to be working in the 6-7 pH range (note dogs may be slightly more acidic)
    - <u>Needs</u> to be 100% sensitive (no missed diagnoses) and anything better than the current ~35% false-positive rate will be considered successful for the time being
    - Setup should take no more than 3-5 min
    - Should be getting sample feedback every 15 min
    - Price range within 50% of the current Stryker model

    - Once critical ranges are hit, decisive diagnosis should take no more than 5-10 min
    - Attempt to use no larger than a 16-gauge needle
- Things to consider from meeting with Dr. Doro:
    - Although up to this point, pH has been the frontrunning choice, oxygen conc. measurement seems pretty promising
    - NIRS doesn't tend to work due to the fact that immediately after trauma, NIRS measurements naturally rise, but for compartment syndrome cases they decrease. So would that mean that no change in measurements indicate compartment syndrome? Or just that nothing is seriously wrong?
- Were able to obtain a couple of boxes of equipment belonging to the previous team. Plan to look through these items ASAP.

Problems/Concerns:

- I'm not certain as to what our best measurement to take will be. Personally, I believe the circuitry would be simplified if we were able to simply measure the intensity of light passed through solution-samples, however, I'm not sure that intensity of light passing is a good enough indicator, in which case we will have to work more in depth with the reflectiveness and transmittance of the fluid samples.

Kelsey Murphy

Work/Research Accomplished

- Met with Dr. Doro to discuss the work from the past two semesters and our ideas going forward (see Alex and Mark's sections for more detail on the discussion). He feels strongly that fiber optics is the way to go because many medical devices already incorporate them in their design.
- Verified parameters for the product design specifications; the most important change from last semester is his desired pH range has narrowed from 5 - 7 to 6 - 7. We will have to verify that the chosen pH indicator (chlorophenyl red) will function well in this range, and also check if there are indicators that fit the range better and are proven to be biocompatible.
    - Would need to redo verification test if we change indicator
- Also spent time catching up on the background of the project:
    - Biology/prognosis/diagnosis of acute compartment syndrome
    - Current methods of diagnosing and where they fail
    - Basics of fiber optics

Problems/Concerns

- Verifying the correct pH indicator will probably take time, and according to the past group, there isn't much data in the literature showing which indicators are toxic and which aren't.
- Due to unknown toxicity, the indicator will likely have to be encased in a biocompatible material that allows only Hydrogen ions through. Finding and processing this material will also likely be difficult.