**Team: P21677 – 3D Bioprinter Engineer: Diana Kulawiec**

**What were the outcomes of the prior phase?**

1. What did I plan to do?

In the System Level Design phase, we planned to work on breaking down components of the printer that we hope to design and/or improve, and will brainstorm creative, reasonable, and testable designs. Specific aspects that we hope to focus on include print head mounting, printing nozzle design, printing parameter control, syringe pump automation, biomaterial selection, and the introduction of cells into the system

1. What did I actually do?

During this phase, we created a list of functions and subfunctions of the bioprinter that we hope develop and optimize, and determined how various inputs such as biomaterials, print settings, and energy will flow through the device to produce a successful print. We conducted benchmarking research on current bioprinters on the market, hydrogels, cells, pressure systems, extrusion methods, and crosslinking techniques, which led to the development of a variety of concepts that could perform our specified functions. These concepts were refined in a morphological chart and combined to generate systems-level concepts. Each systems-level concept was evaluated in iterative Pugh matrices based on criteria that we deemed important for a functional bioprinter. Once the optimal design was selected, we brainstormed benchmarking, analysis, and prototyping based feasibility studies to perform that will ensure our design is reasonable and finalize undetermined aspects of our design. A high level view of our design was developed to help us start thinking about how to build the bioprinter. Lastly, we reassessed the risks specific to our selected design. Apart from the assigned work, a few of us were able to go into the lab to play around with the current prototype with guidance from Nick Lee, who worked on this MSD project last year. We also met with Dr. Dan Reynolds, an engineer at Harvard who works with 3D bioprinters to learn more about how they are used in research. Finally, we met with Dr. Iris Rivero, a professor at RIT who also conducts research using 3D bioprinters, and gained some useful insight on what designs might work well for our project and application.

1. What did I learn? How were plan and reality different?

I learned that there is a lot more detail and things to consider than I originally thought! I wished that I had done a bit more background research and that I went in to see the printer.

**Team level goal for next phase**

In the Preliminary Detailed Design phase, we will divide work and develop specific schedules for the bioprinting and mechanical/electrical/software teams. Each team will work on design and conduct feasibility tests for their appropriate subsystems in order to determine viability of the selected concept and discover necessary adjustments to the system. Specifically, some feasibility tests that will be conducted include cell and material combination, crosslinking implementation, compatibility of existing electrical equipment, print head design details, and extrusion pressure limits.

**What do I plan on doing to ensure that my team has a successful review at the end of the next phase?**

1. Background research on UV crosslinking methods, ~5 hours, early on in the next phase
2. Background research on 3T3 Fibroblasts in 3D bioprinting, ~ 5 hours, early on in the next phase
3. Design tests for (a) mixing biomaterials and cells, (b) testing print speeds and measuring viability, (c) prototyping and analyzing different UV crosslinking methods, ~20 hours, by the end of the phase
4. Figure out how to analyze mechanical properties of prints, ~10 hours, sometime middle of next phase
5. Organizing weekly (at minimum) subteam meetings with the bioprinting group and mechanical group, ~1 hour to plan, Monday October 12

**What is standing in my way of meeting my next phase goals?**

I am really busy this semester with grad school applications and I am already really drained. I think dividing up our meetings into bioprinting and mechanical meetings will help us be way more productive. It would be nice to run some tests with cells and materials but it is time consuming and expensive to keep cultures alive, so we will likely hold off on that until next semester.