Tendon Bioreactor

Overview
Penn State’s Musculoskeletal Regenerative Lab required a method of culturing tendon cells on scaffolds through mechanical stimulation. To do so, they required a machine that could place a desired strain on six tendon scaffolds and would allow the user to vary the magnitude of strain, the strain rate, the frequency of the strain, and include any rest periods. This device had to be built with materials that were cytocompatible, non-toxic, and autoclavable.

Objectives
Provide a suitable, easily sterilized environment for tendon cell growth. Create a device that will provide experimentally significant and repeatable strain with appropriate user inputs.

Approach
- Researched and studied designs of similar devices from other labs based on Learning Factory project description.
- Held meetings and kept in continuous contact with sponsors to ensure we met their standards.
- Divided the design into three components (platform, motor complex, and tissue culture chamber) and outlined how they would interact.
- Used concept generation techniques to provide multiple options for each component.
- Created SolidWorks models of chosen bioreactor components.
- Used COMSOL Multiphysics to analyze gas exchange and stress on bioreactor parts.
- Manufactured components from stainless steel and polycarbonate and assembled them.
- Tested bioreactor against all needs set forth by the sponsor.
- Bioreactor was tested for autoclavability, motor function, and experimental accuracy.

Outcomes
- Tissue cultures can be strained and provide the research team with significant experimental results.
- Sponsors will save $9000 compared to other groups who have designed similar products.
- All materials are easily cleaned through autoclave sterilization.