ABET-Addendum

Desired Needs

- Fabricate a hydrogel that mimics immature articular cartilage.
- Design a bioreactor to facilitate the generation of an osteochondral graft that fuses the hydrogel to a trabecular bone core/sample.
- Extract type II collagen and aggrecan for inclusion in the hydrogel.

Constraints

- Safety: Hazardous biological and chemical materials needed to be used, and waste needed to be managed.
- Risks: Leaks within the bioreactor, contamination, failure to gel, non-localized mineralization.
- Global Impact: Progress towards the development of an affordable and accessible long term and restorative/regenerative treatment for focal osteochondral defects.
- Manufacturability: Reproducible extractions, hydrogel formation, and cheap/easy fabrication of the bioreactor.
- Quality Control: Quantitative assessment of extraction efficiency/purity and hydroxyapatite character/identity, qualitative assessment of hydroxyapatite localization and hydrogel formation.

Engineering Standards

- ASTM F2150, ASTM F2451, ASTM F2900, ISO 13485
- ASTM F2077, ISO 10993, ISO 13485
- ASTM standards for imaging-based evaluations, FDA standards for pre-clinical testing of tissue-engineered devices

Ethical, Environmental, and Societal Concerns

- Ethical sourcing of human and/or animal tissues for extractions and cells for hydrogel formation.
- Safe disposal of hazardous waste.
- Availability and affordability of the graft.

Teamwork

- Splitting of the project into subprojects led by each member.
- Weekly meetings with our mentor to discuss progress of each subproject (and the project as a whole), set goals/deadlines, share ideas, and receive feedback.

Motivating Factors

- Personal, professional, and academic interest in tissue engineering and regenerative medicine.
- Being the lead for my own little subprojects helped create a sense of responsibility and urgency.
- Challenges and setbacks present opportunities to learn and grow.

Innovative Ideas

- Using type I telocollagen as the primary ingredient for the hydrogel.
- Planning to incorporate chondrocytes and ECM components for articular cartilage (aggrecan, hyaluronan, and link proteins) into the hydrogel.
- Formulating the hydrogel to mimic immature articular cartilage that can be cultured over time to mimic adult cartilage.
- Utilize the calcium assay to verify that specifically hydroxyapatite forms in the reactor.