

## Bioengineering Day Poster Addendum (ABET questions)

### **1. Desired Needs**

- a. Increased CO<sub>2</sub> released in the atmosphere since the Industrial Revolution contributes to climate change, disrupting the biosphere.
- b. Current hosts for biomanufacturing are not very predictable.
- c. Some industries that require a constant, reliable supply of energy. Fossil fuels are more reliable than renewable, and they will produce carbon emissions as a byproduct.

### **2. Constraints**

- a. Learning curve for troubleshooting gas chromatography-mass spectrometry (GC-MS)
- b. Waiting for cells to grow
- c. Long protocols due to long incubation periods

### **3. Engineering Standards**

- a. NIH guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules
  - i. Section III-D-1-a and Section III-D-2-a - transforming our cells must be performed in biosafety level 2 (BSL2) environment
- b. ISO 14080 - in an effort to reduce carbon emissions, our technology needs to produce less emissions than it consumes
- c. ISO 14091 - adapting to climate change instead of acting on its source

### **4. Ethical, Environment, or Societal Concerns**

- a. We are unsure how this project could be scaled up. Using a living system requires a stable inflow of nutrients and outflow of waste. This technology most likely cannot be set up and left alone, it would need to be monitored often.
- b. The process of researching this technology produces waste (single-use pipette tips, plastic and glass vials, etc.). We hope this technology can reduce more emissions than we have generated.

### **5. Active Teamwork and Leadership**

- a. There has been constant communication within the team and with the PI, allowing everyone to stay informed on the work being done.
  - i. In particular, we make an effort to uphold detailed documentation in the lab notebook.
- b. Simpler subprojects are shared. More complicated projects are divided to allow individuals to specialize in different areas.
  - i. The division of responsibilities was communicated early on, and continued to be talked about as subprojects change and develop.
- c. We have been applying criticism from our PI and the TAs to improve each step of our work.

### **6. Motivating Factors**

- a. Primarily, we are motivated by the environmental needs for our product.
- b. We were motivated to explore new concepts and understand the underlying mechanisms that contributed to our results. This knowledge allowed us to troubleshoot any unexpected results in the process.
  - i. In particular, understanding the chemistry behind derivatizing our metabolites and GC-MS as a machine for detecting concentrations of metabolites.

### **7. Innovative and Entrepreneurial Ideas**

- a. We introduced many controls to have more confidence in our results.
  - i. For example, testing samples with wild-type cells, pure media, and pure solvent in parallel with cell samples, to determine which signals are considered background noise.
- b. We've made many changes to the original GC-MS setting based on literature review and our understanding of how the GC-MS operates.
  - i. For example, changes in oven temperature to separate the compounds, optimizing the detection settings to save time and energy and target the range where our compounds are detected