

Bioengineering Day Poster Addendum (ABET questions)

1. List two to four **Desired Needs** of your project that led to your final design objectives. Answer in two to four bullet points or concepts within a sentence or two.

- Researchers need a label-free, spatially resolved method to study how rapamycin affects lipid and protein synthesis across tissues.
- *Drosophila* provides a practical short-lifespan model for aging-related rapamycin studies.
- The project needed to compare rapamycin effects across organs and age groups, including gut, ovary, and fat body.
- A major design need was to create a quantitative, reproducible Raman/D₂O metabolic imaging workflow.

2. List the major **Constraints** on your design/project

- a) Safety/Regulatory Affairs: Raman imaging requires careful laser alignment, shielding, PPE, and avoidance of direct beam exposure. Rapamycin, D₂O, solvents, slides, dissection tools, and biological samples require standard lab safety protocols.
- b) Risks: Major risks include imaging artifacts, inconsistent tissue dissection, biological variability, limited repeats, and uncertainty in assigning Raman changes to specific biochemical sources.
- c) Global Impact: *Drosophila* is useful for early-stage aging research, but results must be framed as model-organism findings rather than direct human treatment conclusions.
- d) Manufacturability: Research-based (N/A)
- e) Quality Control/Marketability: Quality control requires consistent imaging settings, spectral preprocessing, artifact filtering, biological replication, and transparent reporting of limitations.

3. List the major **Engineering Standards** on your design/project

- ASTM E168: Guides quantitative spectral data collection, calibration, and interpretation for reproducible Raman/spectroscopic analysis.
- ISO 13485: Relevant if the workflow becomes a formal analytical or diagnostic platform requiring documented quality-management procedures.
- ISO 14971: Relevant for identifying and reducing risks in any future translational or medical-device version of the workflow.

4. Explain **Ethical, Environmental, or Societal concerns** for practical applications of your project.

This project raises ethical concerns around interpretation and communication of results. Because rapamycin is widely discussed in aging research, *Drosophila* findings should not be overstated as evidence for human anti-aging treatment outcomes. The use of flies reduces ethical burden compared with vertebrate animal models. Environmental concerns are limited because only small quantities of reagents are used, but rapamycin solutions, D₂O, solvents, slides, biological waste, and potentially fixatives still require proper disposal. Socially, the project may help researchers better understand longevity-related metabolic changes, but the workflow should be presented as a research tool rather than clinical guidance.

5. Describe **Active Teamwork and Leadership** in your design group

Our group maintained clear communication and openly shared ideas throughout the project. We sought guidance from Dr. Shi and experienced lab members when needed. Shuo led the group because of his prior experience with the project and lab techniques, and he helped me learn the methods needed to succeed in the Shi Lab. We also gave each other constructive feedback, set goals and deadlines, and created contingencies when challenges arose.

6. What were the most significant motivating factors that led you to

A major motivating factor was my strong interest in potential anti-aging therapies and how drugs like rapamycin may alter metabolism across different tissues. This interest pushed me to learn Raman spectroscopy, D₂O metabolic labeling, and tissue-specific data analysis. Imaging artifacts, biological variability, and complex data interpretation motivated me to persist, seek guidance, and continue refining the workflow.

7. What are your most **innovative and/or entrepreneurial ideas** for this project

The main innovation was studying how rapamycin affects metabolism differently across organs and aging conditions. Another innovative aspect was developing a Raman-based analysis pipeline that could help other researchers study drug-induced metabolic changes in biological tissues.