**Thesis Project Portfolio**

# Manufacture and Validation of Advanced Cell Culture Inserts

(Technical Report)

# Tissue-Engineered Organs and Its Relevance to Society

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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Bachelor of Science, School of Engineering

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## Sociotechnical Synthesis

The technical portion of this thesis covers the design and research of my capstone project, the manufacture and validation of advanced cell culture inserts with electrospun biodegradable nanofiber membranes. Under the advisement of Dr. George Christ at the University of Virginia and Lauren Costella at Luna Labs USA, my team built off previous work conducted by Luna Labs on the RESORB cell culture inserts designed under a Phase I NIH grant. To address the limitations of current cell culture techniques, such as petri dishes and plastic well plates, the overarching goal of this project was to create a substrate that allows for better cell viability in conditions, i.e., benefits of the natural extracellular matrix, that more accurately replicate that of *in vivo* cells. We conducted our project under the direction of two aims, 1) the design and manufacture of optimized electrospun nanofiber membranes and 2) the validation of membrane performance through *in vitro* cell culture of mouse myoblasts. Using optimized electrospinning protocols, we spun batches of membranes composed of varying chemical chemistries that were selected through research of prior literature and guidance of our advisors. With these membranes, we conducted a series of trials to determine reliable and replicable seeding and staining protocols. Data was collected and analyzed for two experiments, one in which we compared the cell viability of plasma-treated membranes against nonplasma-treated membranes and another in which the cell viabilities of four membranes of different chemistries were compared.

My technical project, along with other cell culture techniques, is just one miniscule tool within the wide scope of tissue engineering. However, by utilizing *in vitro* models that more accurately replicate *in vivo* cell behavior, researchers can better understand how the work they conduct relates to the human body, thus opening doors for better treatment and bringing science

one step closer to the principal intention of tissue engineering, the development of artificial organs. Once fully achieved, artificial organs will be the saving grace of all those lost in the great imbalance between the supply and demand of the organ transplant list. However, before this advancement can come to fruition, its bidirectional relationship with societal values has to be acknowledged and understood.

The second portion of this thesis, my STS research paper, uses Sheila Jasanoff's Theory of Co-Production to analyze this relationship in which ethical debate facilitates an oscillation of support and opposition for the development of artificial organs. To explore the interdependency between society and artificial organ technologies, I reference failures of current organ transplant protocol and the technical aspects of research and development within the field that cause moral conflict for varying communities of society. Using records of national policies dating back to the Reagan presidency, I illustrate the fluctuation in coherency between public opinion, government regulation, and scientific opinion that results in delayed progression of engineered organs and public confusion or mistrust of the technology. With this understanding, I propose potential accommodations that may be conducted to promote moral and financial support of this technoscience. Through transparent research and regulation, artificial organs will be closer to the horizon of development and implementation, thus saving the lives of countless individuals.