

Thesis Project Portfolio

Gas and Liquid Gradient Bioreactor to Mimic Tumor Microenvironment

(Technical Report)

Sex in Biomedical Research: A Case Study of Organ-on-a-Chip As Undone Science

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

One major barrier in cancer research is the inaccuracy of in vitro tumor models. In vitro research is vital to learn more about cancer biology and is a low-risk tool to test anti-cancer therapeutics before progressing to animal models and clinical trials. The technical portion of this thesis focuses on the design and validation of a novel bioreactor to more accurately mimic the tumor microenvironment in vitro. Working in collaboration with the UVA Department of Radiation Oncology, our team proposed to combine two distinct, gradient-generating technologies into a single device to enable the delivery of simultaneous gas and liquid gradients to cultured cancer cells. Our team validated our design through application of a nutrient liquid gradient and an oxygen gas gradient. However, we hope this device can be used for a variety of applications in the future. The tunability of the delivered gradients and cell culture within this novel device and in similar microfluidic devices presents a unique opportunity to advance research on women's health. Female cells can be used, and the gradients can be adjusted to mimic female physiology and to introduce female sex hormones.

Historically, women and minorities have been excluded from biomedical research. Not only were participants in clinical trials predominantly white men, but male-only cells, tissue cultures, and animal models were seen as the convention in studies. This exclusion has led to a gap in knowledge on sex differences and on predominately or exclusively female diseases/conditions. It has also contributed to worse outcomes for women, as therapeutics tested on men may be less effective or have increased adverse effects for women. The STS portion of this thesis utilizes the undone science framework to examine how counterpublics influence women's health research. Undone science describes areas of research that have been recognized by civil society as needing more research but are underfunded, incomplete, or ignored. I explore

research funding, agency policy/regulations, and science curriculum in regards to inclusion of women. With collaboration at the individual and organizational level, I conclude that it is possible to reduce the gap in knowledge and advance women's health.

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