Thesis Project Portfolio

Design and Verification of a Modified Ichip to Incorporate Coculturing of Soil Microbes

(Technical Report)

How the political economy hinders antibiotic discovery and how that can be changed

(STS Research Paper)

An Undergraduate Thesis

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

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Jack Stalfort

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Department of Biomedical Engineering

Table of Contents

Sociotechnical Synthesis

Design and Verification of a Modified Ichip to Incorporate Coculturing of Soil Microbes

How the political economy hinders antibiotic discovery and how that can be changed

Prospectus

Sociotechnical Synthesis

The overwhelming majority microbial species don't grow on normal laboratory media, which is necessary in order to study their biology. There are many different strategies that aim to grow these "unculturable" microbes, with one such strategy being the ichip. The ichip is a rectangular piece of plastic with many holes that are filled with agar and on average one microbial cell. Then membranes are attached to either side, which retain the microbes in the ichip yet allow small molecules to diffuse in and out. My technical topic was centered on trying to modify this device to include coculturing by changing the size of the holes. We underwent multiple rounds of iterative design and experimentally verified that this modified ichip was working properly.

One reason why there is a great interest in growing these so-called unculturable microbes is because they can produce novel antibiotics, which has only grown in importance due to the relatively recent rise in antibiotic resistant pathogens. However, despite this need, most pharmaceutical companies have stopped looking for novel antibiotics. My STS thesis was centered on figuring out why they are not attempting to bring novel antibiotics to market and ways we can bring them back, viewed through the lense of the political economy of the pharmaceutical industry. My main findings were that antibiotics are not profitable for pharmaceutical companies due to their low price, short duration of treatment, and their restricted prescription once approved in order to curb the development of resistance. There were two main categories of solutions: push and pull incentives. Push incentives lower the cost to develop a novel antibiotic, while pull incentives increase an antibiotic's profitability. I concluded that both are necessary in order to adequately incentivize antibiotic production.

I'm happy with the way both projects turned out, however I would've liked to have accomplished more with the technical research. The original plan included an attempt to grow unculturable soil microbes with our modified ichip, yet the design phase of the project took much longer than expected. One of the reasons for this delay was trouble with actually producing multiple copies of our design and having to troubleshoot the experiment verifying our device. We overcame this adversity through perseverance and by testing changes to our procedures.