



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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<b>Project Title</b>  <b>Effects of E-Cigarette Flavor and Nicotine Concentration on Human Alveolar Epithelial Cell Viability</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives</b> FDA Commissioner Scott Gottlieb declared the rampant youth nicotine addiction achieved through JUULs, the widely popular e-cigarettes, to be an epidemic, while UCSF researchers have noted with alarm the lack of knowledge about the acute and chronic effects of e-cigarettes on pulmonary function. This experiment explored the true health effects of nicotine concentration and the popular flavorant compounds in JUULs on the viability of human epithelial alveolar (inner lung) cells.</p> <p><b>Methods</b> Human epithelial alveolar lung cells (A549) were exposed for 24 hours to plain cell media, plain vape liquid (50% propylene glycol/50% vegetable glycerin), plain vape liquid with 5%, 3%, and 1% nicotine concentrations, and JUUL e-liquids of Mint and Virginia Tobacco flavors with 5% and 3% nicotine concentrations. The cells were then incubated for 48 hours. A lactate dehydrogenase (LDH) assay (using enzymatic detection to test for cell death) was then conducted on this media to reveal the effects of these different e-cigarette liquids on the cellular viability. Dr. Jeffrey Gotts of UCSF and his lab team provided the cell cultures; the LDH assay was conducted with his lab's equipment.</p> <p><b>Results</b> The experiment's results revealed that e-cigarette liquids with higher concentrations of nicotine cause greater cell death levels in human lung tissue, despite the presence or absence of flavoring. Concerningly, PG/VG, or plain, unflavored vape liquid without nicotine, also caused significant cell death when compared to the 100% media group. (<math>p = 0.018</math>) This means that vaping, even with a nicotine-free pod, still has a harmful effect on one's lung tissue. The difference in cell death levels caused by the difference in flavors suggests that tobacco caused 1.48% more cell death than mint did; yet this difference is so slight that it is not statistically significant (<math>p &gt; .1</math>). Therefore, nicotine level has a greater impact on cell health than these flavor compounds do. Nevertheless, more research into the correlation of e-cigarette liquid flavorants and cell death is necessary, but in order to be statistically reliable, larger samples would be imperative.</p> <p><b>Conclusions</b> This experiment revealed concerning trends in the ramifications of e-cigarette use on the cellular level; the evidence indicated that higher nicotine concentrations and certain flavor compounds corrode the lung tissue dramatically. As the popularity of e-cigarettes rapidly increases, especially among youth, it is critical to expand our knowledge of the short and long term health effects of these popular devices, as well as to raise awareness for the dangers of nicotine itself which spread far beyond its addictive potential.</p>	
<b>Summary Statement</b>  This study determined that e-cigarette liquids with high concentrations of nicotine and tobacco flavorants prompt greater levels of lung cell damage; however, flavorless, nicotine-free vape liquid is also significantly toxic to lung tissue.	
<b>Help Received</b>  Carl Ma, a biology teacher at my high school, taught me proper cell culture and sterilization techniques; Dr. Jeffrey Gotts, my mentor from UCSF, provided cell cultures and media. Also, he allowed me use the lactate dehydrogenase assay plate reading machine in his lab, under his supervision.	