Modern medicine has given us the means to diagnose disease, fight it, and outlast it; however, a deeply unequal distribution of disease incidence has emerged in areas that lack the resources for preventative measures. For example, the 20th century's boom in global trade led to an explosion of vector-borne diseases like Malaria and Dengue in second- and third-world countries. I joined the Erickson Lab at Cornell University as a mechanical engineer to work on microfluidic technologies with the potential to to address these inequities.

As leaders in society, scientists have a dual role. One, of course, is to produce impactful, innovative research, and I will achieve that through my proposed work on an autonomous device that can detect Dengue virus in the field. The second, of equal importance, is to ensure the public knows about science, understands science, and supports the next generation of scientists. **I decided to pursue a PhD because I love to learn, experiment and build, and I wanted to better position myself as an advocate for science, in entrepreneurship or policy, post-graduation.** Through journalism, in-classroom teaching, curriculum design, I have devoted my budding career as a scientist to meaningful outreach.

Figure 1 NBC Nightly News featured Cycle for Science in May. I'm on the screen, furthest left.

Most recently, I co-founded Cycle for Science[1]. Earlier this year, I and another scientist bicycled across the country earlier with two goals: to show kids that science can be creative and accessible, and to better understand the factors affecting science pedagogy. As two women who did not enter college intending to be scientists, my co-founder and I interviewed teachers to find out how they were actively engaging groups traditionally underrepresented in STEM.

Through a crowdfunding campaign, we raised $7,900 from 134 supporters **to travel to 10 schools, libraries and summer camps and teach science lessons about physics and renewable energy.** For our lessons, we designed and manufactured a miniature, 3D-printable, solar-powered bicycle called the 'Sol Cycle'. Over three months, we reached more than 600 kids, aged 4-16, many of whom lived in rural, low-income areas like Cambridge, Idaho. These schools and camps lacked access to the resources of wealthy urban programs; for many, **we were the first scientists they had ever met**. NBC Nightly News profiled us[2], along with the Christian Science Monitor, NPR's Sacramento affiliate, local papers and scientific organizations. We kept active social media accounts, including a daily blog, and wrote for the Department of Energy, who invited us for a visit to their offices when we reached Washington, D.C. Based on enthusiastic feedback from teachers and supporters, we aim to turn Cycle for Science into a non-profit in 2016.

Figure 2 Kids cheer on the Sol Cycles at a summer program for Burmese refugees in Philadelphia, PA.

The root of this mission took shape in college, when I built and ran an exhibit about a stationary bike that powered light bulbs and radios for more than 4,000 kids from around Los Angeles County. I also wanted to better understand my early experiences with STEM in middle

[1] Cycle for Science website with more information: www.cycleforscience.org
[2] Jackson. "What two women on a cross country bike ride want girls to know." http://www.nbcnews.com/nightly-news/video/what-two-women-on-a-cross-country-bike-ride-want-girls-to-know-441747523795
[2] Jackson. "What two women on a cross country bike ride want girls to know." http://www.nbcnews.com/nightly-news/video/what-two-women-on-a-cross-country-bike-ride-want-girls-to-know-441747523795

and high school. Before entering college, I had never considered a future in science, stymied by the overwhelming male majority in classes that taught science as rote and uncreative. **As a scientist, I want to ensure fewer girls sell themselves short like I did.**

The media attention surrounding Cycle for Science put me on the other side of the microphone for the first time – previously, I trained extensively in science communication. In 2013, I spent the summer at The Oregonian, Oregon's largest newspaper, **as the only undergraduate chosen that year to be an AAAS Mass Media in Science and Engineering fellow.** A story I covered forced lawmakers to take a second look at pesticide regulations in state, and earlier this year, **the legislature banned certain neonicotinoids – an insecticide – to protect native pollinators.**

After graduation, I had begun planning for Cycle for Science and chose to spend a year as a science journalist before attending graduate school. I joined the staff at the Davis Enterprise in California's Central Valley; less than a year later, **the California Newspaper Publisher's Association recognized me as the best agricultural journalist at a paper with a circulation under 15,000**. In the newsroom, I organized a series of workshops on science reporting and data analysis for journalists self-identified as math illiterate. The skills I built as a reporter serve me well as a scientist: I am able to clearly teach and explain research to the broader public. I plan to keep an active blog of my work in graduate school, to discuss my research and as a platform to comment on issues within science, like gender parity and open access.

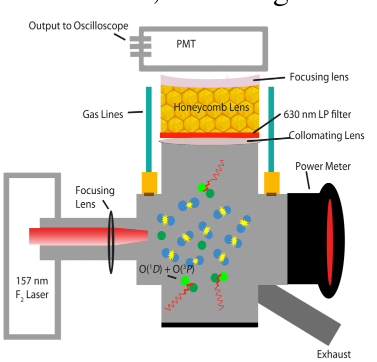
The similarities between my two passions, journalism and engineering, reflect C.P. Snow's argument in *Two Cultures* that the humanities and sciences are stronger united. Technical skills like data analysis made me a better reporter; the insatiable curiosity I developed as a journalist has contributed greatly to my success as a scientist. Besides, the big picture goals of each are the same: investigative journalists and groundbreaking researchers doggedly pursue the truth, reporting only the facts, but weaving a story – or a technology – out of their findings.

Moreover, I owe my career in science in part to the written word. Michio Kaku's *Hyperspace* had a seminal effect: his elegant intertwining of physical concepts and mathematical proofs led me straight to the lecture hall. I found a home in my first two quarters of introductory physics, in the hands-on experiments with real-world applications. Because I excelled in the class, Dr. Walter Gekelman invited me to do research on signal amplification.

Research Experience and Intellectual Merit

Under the mentorship of Dr. Gekelman, I built modular amplifying circuits as part of a study using Alfvén and Whistler waves to prevent damage to satellites from energetic electrons. These palm-sized electronics needed to be secure and interchangeable, to allow for easy variation of the waves, so I designed and machined a prototype inspired by a candy tin from Starbucks. Coming full circle, my knowledge of circuits has proven to be useful in the study of microfluidic devices, where fluid flow can be modeled by circuit analysis.

The following summer, I worked with Kostas Kalogerakis in the Molecular Physics department at SRI International as part of NSF's Research Experiences for Undergraduates (REU) program, **one of just six chosen by SRI out of more than 100 applicants.** The first half of my research focused on determining the temperature dependence of excited oxygen quenching. This process plays an active role in Martian and Venetian atmospheres, and affects measurements being taken by the



Experimental set-up for excited oxygen quenching at SRI International

Venus and Mars Express satellites. I measured reaction rate constants that matched closely with theoretical predictions and prior experiments, and spent the second half of the summer designing experiments to verify these results. I presented the findings at the end of the summer to the SRI physical chemistry department. Through this project, I learned how to use LabView for data collection and analysis, and isolate and test each individual piece of a complex experiment.

After the summer, Dr. Kalogerakis remained a mentor and was one of the first to encourage me to consider graduate school. For next few years, I was torn between pursuing science journalism and a PhD, especially as I hadn't worked in research with real-world, near-future impact. Ultimately, two experiences sealed my decision to become an engineer. First, in a materials science class, I discovered micro- and nanoscale engineering had both fascinating physics and direct applications to environmental and health. Second, I felt my job as a journalist to be one about finding problems, as opposed to building solutions. As a scientist, I could act – creatively, immediately – on what I learned.

After graduating from UCLA, I wanted to explore more research at the nanoscale, so I joined the UC Davis NanoFast Lab for eight months while working full time as a reporter. Under Dr. Ting Guo, I worked on a novel method to measure the quantum efficiency (QE) of x-ray nanophosphors using the voltage output of photovoltaics (PV). When excited by x-rays, Eu-doped Gd_2O_3 nanoparticles emit a solar-like spectrum (peaking around 611 nm), which induce a voltage in the photovoltaic that corresponded to the QE. Other methods to determine quantum efficiency depend on local machine calibration, making them difficult to scale.

Previously, my co-researchers were unable to measure the power produced by the PV cell because of a large resistance of unknown origin. Through careful testing of the nanophosphors, photovoltaics, and x-ray system, I determined it came from portions of the PV cell that had been covered to focus the x-ray beam. By redesigning the experiment to reduce cell size while maintaining focus, I decreased the amount of power dissipated through the covered PVs by orders of magnitude and increased the scope (down to nanoamperes) and accuracy (reduced variable resistance of the circuit) of the measurements. In the end, we successfully proved proof-of-concept by measuring the power outputs of low concentrations of nanophosphors.

My proposed graduate research, autonomous detection of Dengue virus, draws on both technical skills I learned as a researcher and the public health knowledge I gained through journalism. A network of these devices will allow for real-time, scalable monitoring of the virus, using microfluidic technology that can be modified for a wide variety of diseases.

Looking forward: Broader Impact and Outreach

In graduate school, I have already taken on leadership roles that will advance access to the sciences. As a member of the graduate student Diversity and International Students Committee, I am co-lead on the bi-annual "Let's Talk Diversity" dinner that aims to build relationships between the breadth of ethnic, socioeconomic, and academic divisions at Cornell. I'm also designing a variety of workshops for the Engineering Graduate Student Association on open access and science communication. Finally, I'm organizing a workshop about Cycle for Science for Expanding Your Horizons, a daylong conference that teaches middle school-aged girls what it's like to be a scientist through hands-on experiments and mentorship.

With my technical background in physics and experience as a journalist, I have a proven record of successful research and broad engagement. At Cornell, my work with Dr. Erickson will improve access to healthcare through novel applications of microfluidics and mobile diagnostics, and with support from the NSF Graduate Fellowship, I can focus on ensuring the public also has hands-on experience with the science behind the research.