Reflection on
My 2018 Summer Experience at the
Students and Teachers as Research Scientists Program

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I spent the summer of 2018 in the Students and Teachers as Research Scientists (STARS) program in St. Louis, Missouri. STARS consists of two parts: research and lectures.

Program Components

For the first part of STARS, each student was assigned to a professor doing research at St. Louis University (SLU), the University of Missouri, St. Louis (UMSL), or Washington University (WashU). STARS participants spent each week working on their projects, and, at the end of the sixth week, they all presented their research to the group and turned in a scientific paper.

The second part of STARS was a series of weekly lectures. Every Monday and Wednesday morning, participants would gather in UMSL's student-learning hall to listen to experts talk on subjects ranging from racial disparities in health care, to the process of repairing nerve injuries, to starting businesses based on scientific discoveries. After the lecturers concluded, we moved to the student center for a buffet lunch before heading off to conduct experiments to further our research.

Another feature of the biweekly lectures was the STARS challenges. Each Monday morning, one of the STARS proctors would challenge us to solve a problem, with a written solution due the following Wednesday. The challenges included designing experiments to evaluate the humanities surrounding the cannon, locating a hidden treasure using linear algebra, and explaining how a liquid seemed to spontaneously change densities. The next Monday, before the new challenge was issued, the STARS faculty would announce the winner(s) of the prior challenge and offer one of a variety of prizes. I won two of the four challenges!

My Research Project

My research was based at WashU, where I worked under Dr. Srikanth Singamaneni to develop gold-nanoisland-decorated filter paper and evaluate the ability of this material to enhance signals given off by trace chemicals under Surface-Enhanced Raman Scattering (SERS) analysis. SERS is a spectroscopic method in which a photon hits a molecule and loses a specific amount of energy to that molecule. This change in energy is molecule-dependent, thereby creating a spectral signature that is unique to the molecule. Unfortunately, under typical Raman conditions, only 1 in 1 million photons is Raman scattered, meaning that only 1 photon in 1 million fired is useful for analysis. To overcome this limitation, a surface covered in nanostructures can increase the likelihood that a photon Raman scatters, increasing the number of useful photons by as much as 14 orders of magnitude. Potential applications include detection and identification of everything from DDT to TNT to Anthrax.

My research focused on the fabrication of gold-nanoisland-decorated filter paper, the characterization of this material, and the testing of this material as a substrate for SERS analysis

of model compounds. I grew gold nanoislands on the surface of paper by dipping the paper in gold chloride solutions of various concentrations for various lengths of time. I then exposed the papers to known concentrations of BDT and ran SERS spectroscopy on the samples to determine the level of enhancement. Unfortunately, the papers did not exhibit a very high enhancement factor, so future research will have to manipulate the variables in order to identify how to optimize this process.

Dorm Life

While I was attending lectures and doing research, I stayed at the UMSL dorms. Unlike other summer programs that I have attended, the STARS program does not provide meals, supervise the students residing in the dorms, or organize any kind of group activity. This forced the residential students to live almost independently. Each week, I made a list of groceries and took the metro to the Delmar Loop to purchase them at the United Provisions International Grocery Store. From what I bought, I made my own breakfasts, lunches, and dinners for the rest of the week, preparing them myself and cleaning all the dirtied dishes. I was somewhat prepared for this because I have helped prepare meals in the past through Boy Scouts, and I am used to having to wash my dishes. (However, I ended up having to lend food and give advice to my roommate, who had done neither in the past.) I also had to wash my clothes and keep my dorm room neat.

However, after I finished these chores, I had to confront the problem of boredom. Only five STARS students stayed in the dorms, so we stuck together as a group. During our six weeks in St. Louis, we visited the Arch, the St. Louis Zoo, the Art Museum, and even went to watch the Fourth of July Parade. When there was less free time, we would just eat dinner on the Delmar Loop, play a board game, or watch a movie. At STARS, we had to learn how to live on our own, keeping ourselves clean, fed, and entertained without outside help.

Take-Away Lessons

STARS has helped me learn a lot of things about what I want to do in the future and how to handle all the related issues. I chose to research under Dr. Singamaneni because I am interested in engineering and wanted to get some experience in hands-on engineering research. While it will definitely look good on a college resume, of greater importance is the fact that STARS allowed me to perform some of the work that I might be expected to do in college. I even got to learn about UMSL and WashU, as I spent nearly all my time at STARS on their campuses. Furthermore, the STARS program expanded my basic knowledge of engineering and chemistry principles. I learned about Raman scattering, SERS, plasmonics, and nanostructures—all knowledge that could be useful if I choose to major in materials engineering. Outside of its practicality, the STARS experience has helped me develop and improve upon my self-discipline, focus, and ability to accomplish tasks with little outside support. I also had to learn to live independently: buying food, doing laundry, and finding ways to keep myself entertained. By learning how to survive on my own, I have prepared myself for college life.

STARS was a fantastic program. I learned about engineering and research, and I was able to experience working in a lab—something that would not have been available to me elsewhere. Outside of research, I learned many things from a variety of different disciplines that have expanded my knowledge of other careers, and I developed life skills that will help me thrive in college. I also made friends who share my interests in science and engineering; it would have

been challenging to make the same connections and to learn the same skills anywhere else. This fantastic experience, made available to me by the Garwin Family Foundation, has allowed me to further explore my field of interest and prepare myself for the future, including heading off to college.