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This summer I worked in an organic chemistry lab as a member of the Pongdee Research Group in Sewanee, Tennessee. I saw my internship as a small stepping-stone to attaining my goal of attending medical school and becoming a physician. Such a career choice seemed natural for someone interested in biology. After working in a lab this summer, I realize now that there are many other career options besides becoming a physician. With this in mind, I am open to going to graduate school and pursuing other scientific careers in research.

Our research focused on the small macromolecule Urdamycin, a molecule with known biological activity as a cancer-fighting and possible antibiotic agent. Such properties are attributed to the attached D-olivose sugar unit and the glycositic linkage. My research entailed cloning and over expressing the glycotransferase UrdGT2, which catalyzes the reaction enabling the sugar group to attach to the rest of the molecule. An understanding of the means by which the reaction takes place leads to the possibility of creating new analogues with diverse biological activity.

By working in a lab this summer, I learned more about the nature of doing research, which I came to realize demands precision and patience. Everyday I was given written instructions to follow, which seemed simple. When doing the procedure, however, I had what felt like millions of questions. The instructions were vague on what materials I should use or what my end product would look like. Instead of asking questions, I would go with my gut instinct. This led me to using the wrong test tubes to hold my product or pipetting the incorrect volume. By using my own interpretation of the directions, the experiment did not work. I learned that a clear understanding of the procedure, rather than blindly following the procedure, is key to research. When applying the procedure, attention to detail is crucial to conducting successful experiments. I had to be meticulous when reading pages upon pages of directions and pipetting volumes like

one micro liter. Such an amount appears almost invisible, but without the reactant the reaction will not occur. When doing the procedure, I realized that I must be as accurate as possible. For instance, when running gel electrophoresis the buffer must contain the precise ratio of water to TBE in order separate the DNA bands clearly. In running a column to purify a protein, only a few milliliters of solution must be collected. Or when creating plasmid DNA, the substances were exposed to high or low temperatures for the exact amount of time that was required so as not to denature the substances and alter their properties.

While following the directions and understanding what each step requires, research entails that the scientist reflect and question steps in the procedure. After conducting each experiment, I would analyze the results to determine where possible mistakes were made or how I should proceed. For instance, when I conducted a polymerase chain reaction (PCR), the imaging revealed that the DNA did not exponentially multiply as intended. I realized my mistake after reviewing the order of reactants added. The gene of interest was composed of mostly Cytosine and Guanine pairs, which contain an additional hydrogen bond that leads to the DNA becoming tangled. If the DNA is too twisted than the reaction will not take place. By changing the order of reactants, I was able to achieve a successful outcome. I was able to alter the materials or procedure and make experiments run more smoothly. For instance, in order to purify a protein I first grew a bacteria culture. The process was tedious because the culture grew for almost five hours before reaching the correct optic density reading. I later repeated the experiment, but this time I did so in a larger beaker so as to expose the cells to more oxygen and thereby enhance their environment. The culture reached the correct optic density reading in four hours less time than previously.

My research exposed me to new knowledge of machines as well as skills that I will be able to use in upper level science classes. I learned that when doing biochemistry research all materials used must be sterile so as not to contaminate any of the reactants. Materials, such as pipette tips, LB broth, and beakers were all autoclaved, a process that uses high-pressure and heat to sterilize materials. I learned how to run a column to purify a protein, and I learned how to plate LB agar, a source of rich nutrients, which enables the growth of bacteria colonies. Such knowledge, while elementary, is useful because such procedures are regularly done in the lab.

Going into the internship, I imagined that everyday I would make progress, which would inevitable lead me to complete the objective of synthesizing the enzyme by the end of the summer; however, in reality this was not the case. I would spend days working on one part of the procedure. More likely than not, my experiments would yield little to no results causing me to repeat the procedure several times. Even once I obtained data, the results were incorrect. For instance, after completing a three-day long process to obtain plasmid DNA, the results were sequenced. I compared my results with the actual sequencing results gene of interest and found that my sequencing was incorrect. I repeated the experiment three more times before I finally obtained data. One particularly frustrating moment occurred when I was purifying the protein. The procedure took a week to complete. When I was on the final step I was suppose to centrifuge the supernatant in a machine resembling a washing machine to create a pellet. While I questioned whether putting the supernatant in a plastic falcon tube would be acceptable, I decided not to ask. This turned out to be a mistake. When the process completed running, the tube containing the supernatant was crushed into tiny pieces because of too much pressure. The liquid that was supposed to solidify into a pellet was everywhere, destroying several days of work. Before doing research I envisioned myself moving around the lab as smoothly as Bill Nye the Science Guy, the

reality, however, was much different. I realize now that in research there are ups and downs. Reactions do not always take place as they appear as they should on paper, and the reason for this is that in the real world they rarely work as planned. There are days with small victories, days when nothing goes as planned, and days to simply reflect on the experiment. Only through the slow culmination of these days is progress truly made.