Pharmaceuticals and Personal Care Products in Sewanee’s Wastewater

My summer research with Dr. Emily White, in Sewanee’s Chemistry Department, focused on the analysis of pharmaceuticals and personal care products in Sewanee’s wastewater. These products, called PPCP’s, are contaminants of emerging concern because little is known about their fate in the environment. I focused on developing a method for analyzing these compounds to determine the effectiveness of Sewanee’s wastewater treatment process in removing these contaminants. During the method development process, I worked to achieve reproducible results over an expected range of concentrations. Beginning with the method of Ferrer et al. (2010), which is a modification of EPA Method 1694, and a published paper by Li et al. (2013), also conducting this analysis, I worked towards obtaining accurate and reproducible calibration data before beginning with the wastewater samples.

Beginning with a comparison of the two methods, I looked for the differences in the analyses. After comparing the steps of the two methods, I found that the method of Li et al. (2013) was a simplified version of the EPA method that was adapted to work efficiently in a laboratory similar to ours. Because of this, I chose to look further into this method to begin working on the analysis. Focusing on the comparison of analytical methods, I compared the two methods to determine which one produced more accurate and reproducible data while presenting fewer analytical difficulties. The Ferrer et al. (2010) method was found to present more problems, so the sample analyses were
conducted following the method of Li et al. (2013). The Ferrer et al. (2010) method tended to produce data that was variable and consistently higher than the calculated concentrations for standards. The Li et al. (2013) method had lower variability and reported a more reasonable percent recovery from the extraction method. Although some earlier tests of the method did not produce accurate results, practice and careful measurements led to the adapted method providing reproducible results.

The extraction method was conducted in accordance with the published method of Li et al. (2013). Standards and samples were run through a solid phase extraction process that removed unwanted contamination while concentrating the analytes of interest. By concentrating the samples and standards in this way, the method improves the range of concentrations that can be detected and reported. Both extraction methods were compared for accuracy and reproducibility, and the Ferrer et al. (2010) method was found to be inferior in comparison. As I worked through the comparison of these methods, I began to understand the chemistry behind the procedures and why the procedures worked.

Working with the calibration data and standards, I began to understand the analysis better while obtaining useful data about both the instrument and my laboratory techniques. The analysis used high performance liquid chromatography and mass spectrometry (HPLC-MS) to determine the concentrations of the contaminants. I worked to determine whether the instrument could accurately identify compounds and their concentrations. Another focus was to determine whether the compounds broke down over time, which would influence storage and how the samples were treated before analysis.
Most of the analysis was done by the HPLC-MS, which was one of the greatest tools of this project. This research helped me learn both the extraction process and the method for working with the instrumentation. Since the instrument generated the data, I learned about interpreting the data presented by the analysis program. After working with the data in the beginning of the summer, I began understanding how the data was generated and became more proficient in understanding and interpreting the numbers given. One of the greatest skills I learned the summer was the ability to interpret data and present it logically to others working on a related project.

Through this experience, I learned about the process of research, with all of its ups and downs. Although the research process can be slow and difficult, the results are rewarding. By working on this research project with Dr. Emily White and the rest of the research team this summer, I have gained valuable experience in chemical research. Although I have not yet decided whether I will continue working towards a career in chemistry or engineering, I know that I will always have an appreciation for research. This summer has assured me that I will continue doing research throughout the next school year to help me decide what career to pursue.