Since joining Dr. Silvia Muro's laboratory two years ago, I have studied fundamental and translational aspects of endocytosis, the natural ability of cells to internalize surrounding material. Endocytosis plays an important role in drug design, as it represents a key means for therapeutic compounds reach intracellular sites. However, the effects of disease on endocytosis are often poorly understood, creating an obstacle to drug development. This project explored how individual endocytic pathways were affected by Type A-B Niemann-Pick disease, a hereditary condition characterized by aberrant intracellular storage of metabolic substrates. Understanding and incorporating these effects into the design of drugs requiring endocytic uptake could open new therapeutic avenues for these types of diseases.

Dr. Muro approached me last fall and proposed that I analyze and compile the results of this project into a manuscript. She had objectives in mind for the paper, but the data were several years old, raising concerns that other groups may have published comparable findings. Before we began to prepare an outline, I used UMD library tools to complete a preliminary literature search. I was interested in journal articles published within the past decade, which I found in electronic databases recommended by ResearchPort, especially PubMed and ScienceDirect. This search proved frustrating, as several papers indeed described aberrant endocytic behavior in Niemann-Pick disease. For example, Dhami et al. observed diminished uptake of the mannose-6-phosphate receptor, a cell surface protein involved in drug uptake via clathrin-mediated endocytosis, the same pathway in which we observed aberrant behavior. I was initially concerned that their publication diminished the novelty of our data.

Dr. Muro quickly allayed my concerns by explaining that Dhami et al. described the behavior of one specific protein associated with clathrin endocytosis, whereas our data indicated overall dysfunction of the pathway. Based on my literature search, we agreed that the project remained valuable to the scientific community; however, we needed to modify the message of the paper to incorporate and expand upon existing literature. We developed an outline emphasizing the message that intracellular storage was associated with broad clathrin-mediated endocytic deficits, and drugs designed to bypass this pathway enhanced therapeutic efficiency.

Preparing the manuscript required extensive use of library resources, both to educate myself about the drug delivery field and to collect sources worth discussing in the context of our findings. Dr. Muro was a great resource and suggested optimum keywords for electronic search engines. I grew increasingly efficient as I recognized keyword patterns that offered the most relevant hits. General terms, such as "uptake," rather than specific ones, such as "clathrin-mediated endocytosis," produced better results due to the differences in terminology used by various research groups, even when referring to the same concepts. When selecting sources, I typically read the title and abstract to identify the relevance of the article, and then read the discussion to evaluate the author's approach. Applicable sources often discussed findings tangentially related to ours, such as those of Marks et al. and Puri et al. These authors found unusual intracellular lipid trafficking in storage diseases, indirectly implying aberrant endocytic behavior, and creating an opportunity for our work to elaborate on specifically affected pathways. Articles that

appeared to contradict our findings proved valuable as well. For example, Klein et al. observed increased endocytosis in another cell type, despite the storage disease, raising questions about tissue-specific regulation of endocytosis, an interesting parameter for the scientific community to consider. I also found that secondary sources (review articles and book chapters) cited in the primary literature provided a framework of knowledge that helped me write the introduction of the manuscript. The ability to find large volumes such as *The Metabolic and Molecular Bases of Inherited Disease* in the chemistry stacks was invaluable, and helped clarify the disease processes associated with Niemann-Pick.

My experiences with the Muro group, both through this manuscript and other ongoing projects in the laboratory, have demonstrated the challenges and rewards that accompany the research process. It can be easy to grow close-minded about a research project rather than remaining open to new objectives. Working with Dr. Muro to reframe the direction of the manuscript and expand upon the findings of Dhami et al. offers a prime example. I learned the importance of remaining informed of current literature and recognizing alternative roles of the project in the context of the broader scientific community. Finding existing knowledge gaps, identifying the means to explore open questions, and contributing novel results is incredibly fulfilling to me, both for the benefit of my scientific colleagues and of patients with currently incurable diseases. These are lessons I will carry with me as I enter an MD/PhD program this fall and eventually begin my own research program as a physician scientist.

Reflecting back on my project and the library resources, I believe two key features contribute to the effectiveness of a library system: accessibility of resources and efficiency of identifying sources. I was thrilled with library accessibility; I could log into my student account and access journal articles anywhere with an Internet connection, and when a source was unavailable, I could readily request it from the interlibrary system. Efficiency is perhaps a more challenging feature to develop, requiring a continuous evolution of existing tools. For example, ResearchPort and WorldCat provide a powerful means for researchers to connect with one another in the form of “lists” of gathered sources. Much like music playlists or citation libraries, these lists create the potential for researchers to benefit from others’ previously completed searches. However, I was disappointed by the limited relevance and public availability of these source collections. Providing, improving, and publicizing such features could transform literature searches into a more collaborative and time-efficient process. Indeed, if I could change anything about my research experience, I would try to improve my own efficiency by exploring and becoming more proficient with the tools available through the library. Ultimately, the library effectively provided the resources for my manuscript and has prepared me well for future research.