A growing problem in medicine today is the development of antibiotic-resistant bacteria; a promising new class of potential antibiotics are the $\gamma$-lactams. Our primary goal is to develop and optimize a new method for the synthesis of $\gamma$-lactams from $\beta$-lactams, which form an integral part of many current antibiotics; these include all of the penicillin and cephalosporin derivatives. We also plan to optimize the synthesis of the requisite $\beta$-lactam derivatives from alkenes, which are simply carbon-carbon double bonds. Using carefully selected compounds, we hope to find the correlation between the structure of an alkene starting material and the structure (and yield) of the resulting $\gamma$-lactam. By aggressively developing new forms of antibiotics, medicinal chemistry will hopefully be able to keep pace with the bacteria that it fights.

Approximately eight to 10 $\gamma$-lactams will be synthesized via a two step sequence starting from alkenes (compounds bearing C=C bonds) via the intermediacy of the corresponding $\beta$-lactams. First, the alkenes will be prepared by subjecting a series of carbonyl (C=O) compounds to a special reagent that will transform them into corresponding alkenes. These alkenes will then be treated with chlorosulfonylisocyanate (CSI) to form the desired $\gamma$-lactams in one step. Assuming that the alkene forming reaction proceeds in high yield, this project can be completed by the end of the spring semester. Product identification and purification will only take several weeks, depending on the yield of the target $\gamma$-lactams.

This is my senior year as a Chemistry major with a Biochemistry concentration. I have been a part of the Honors Program for four years and have completed almost all of the required courses in the major as well as for the Honors Program. My background consists of two semesters of General Chemistry, Organic Chemistry, and Biochemistry along with the corresponding labwork. I have also completed Quantitative Analysis, Descriptive Inorganic, and Medicinal Chemistry, which are all tools for knowledge in the completion of this project. I am currently enrolled in Instrumental Analysis, a course that teaches one to analyze compounds with specific instruments. All of this together should allow me to successfully complete this project. How long have you been in our group, perfecting your own skills and working on this very type of chemistry?

New types of antibiotics are constantly in demand to defend against bacteria which have mutated to strains that are resistant to standard drug therapies; they release an enzyme which destroys the $\beta$-lactam portion of the antibiotics. Further research involving the formation of $\beta$- to $\gamma$-lactams will provide insight into new compounds used in penicillin and cephalosporins. Currently, no methods exist for the conversion of $\beta$- to $\gamma$-lactams, although our group has perfected the $\beta$-to $\gamma$-lactone conversion; this leaves the future open for new $\gamma$-lactam syntheses. The initial experiments have yielded successful results and the members of the research group are excited and focused.

Various types of spectroscopy will be employed for the analysis and structure proof of our synthesized chemical intermediates and products; typically, infrared spectrophotometry (IR) and nuclear magnetic resonance (NMR) are daily tools. Thin-layer chromatography (TLC), a qualitative technique indicating the number of compounds present, is used first, since it indicates product purity, and whether purification is necessary. This technique is simple and at our fingertips for everyday use.

Hopefully, we will be able to publish two scientific papers which describe the results of our research in international, peer-reviewed journals. The first would describe the conversion of aldehydes and ketones (C=O compounds) into alkenes in a short methylenation reaction, while the second would be the actual syntheses of $\gamma$-lactams from $\beta$-lactams via the spontaneous rearrangement process. Also, podium and/or poster presentations can be made at various events, ranging from student research conferences all the way to American Chemical Society national meetings.