Department of Chemistry
MCMICKEN COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APPLICATION DEADLINE: March 1, 2010

The Department of Chemistry is pleased to offer the following research project for the summer of 2010. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and, if possible, develop a timetable for the twelve-week research period.

PROJECT TITLE: Plastic Bottles from Switch Grass? A Chemical Route to Convert Biomass-Derived Carbohydrates to Ethylene Glycol.

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Project Description

Ethylene glycol is among the most important commodity chemicals in industry. It is often used as the main ingredient in deicing fluids for windshields and aircrafts. The majority of ethylene glycol consumed worldwide, however, goes into the production of polyethylene terephthalate (PET), which is ultimately processed into soft drink bottles, adhesive tapes, food packaging materials, and synthetic wool fabrics (or anything with a recycling code 1). The global demand for ethylene glycol was 6.0 billion pounds in 2006, and there has been a steady growth of 3% per year in the past decade. As the world's population grows and the living conditions in developing countries improve, the demand for ethylene glycol is expected to rise sharply in the coming years.

Existing technologies for manufacturing ethylene glycol rely heavily on ethylene gas, which is produced in the chemical industry by steam cracking of petroleum or direct separation from the natural gas. The supply of these fossil fuel-derived feedstocks cannot be sustainable as the US Energy Information Administration has estimated that the known reserves of petroleum and natural gas last no more than 25 years and 45 years, respectively, if consumed at the rate projected for a growing global economy. For this reason, many companies are taking strategic approaches to seek their long-term supply of ethylene glycol. Significant investments have been made in developing alternative methods to manufacture ethylene glycol. One of the attractive strategies is to change the feedstocks from fossil fuels to cellulosic biomass, such as grasses, wood, forest product residues, and specialty energy crops. Because cellulose cannot be digested by human beings, its use, unlike corn and starch, will not impose a negative impact on food supplies. Biofermentation processes are known to break down cellulose into smaller

carbohydrates; however, further degradation to ethylene glycol is not possible due to the poisoning of enzymes by ethylene glycol.

This research project is to develop a chemical route that catalytically and selectively transforms carbohydrates into ethylene glycol under mild reaction conditions. The research has the potential to revolutionize the methods of manufacturing ethylene glycol. The utilization of renewable resources for chemical synthesis will alleviate our dependence on fossil fuel consumption and will help us to develop a more sustainable society.