

## Richter Research Ranges: Ecology and Ants to Proteins and Parkinson's Disease

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Lake Forest College is a hub of opportunities for undergraduates. One such unique and valuable opportunity offered by the College is the Richter Scholar Program. The Richter Scholar Program provides a group of first-year students with the opportunity to work one-on-one with a professor and experience research firsthand. This research experience refines the intellectual and critical thinking ability of the student. Two months of extensive research as a freshman is an opportunity not to be missed.

During the summer of 2011, a group of freshman was selected to be a part of this program. Two of those Richter Scholars, who worked in the Biology Department, were Kaya Cuper '14 and Rida Khan '14. Kaya Cuper is a biology and english major from Chicago, Illinois. Rida is a biology and chemistry major from Gilberts, Illinois. Through the Richter Scholar Program, students like Rida Khan and Kaya Cuper can learn to extensively set up experiments that answer sophisticated questions and test current problems.



Kaya Cuper around the base of the Lake County Permit Center Green Rooftop

### **Kaya's Richter Experience - Towering Over Ants on Green Rooftops**

One major problem my Richter Scholar Program project addressed is that in cities today there is a lack of green spaces resulting from over construction in urban areas. As an effort to revolutionize the concrete jungle of our cities, urban planners are beginning to turn our rooftops into green islands of the sky. These islands of the sky are green rooftops, which are environmentally friendly buildings constructed with waterproof, drainage, and growth media soil layers. These eco-roofs or green roofs serve many functions. They become a living space that provides soothing scenery for people in industrialized towns and cities across the world. They also decrease storm runoff, air pollutants, and high temperatures in urban areas. The most important function, however, in relationship to this project, is that green rooftops provided habitat for organisms in urban areas such as ants.

As a Richter Scholar, I was able to answer many questions on these topics. My project studied ant populations around four two-story tall green rooftops such as the Lake County Permit Center, the Chicago Botanic Garden, the Peggy Notebaert Nature Museum, and the Chicago Center for Green Technology. By observing ant populations on top of and around these buildings with my advisor Dr. Sean Menke at Lake Forest College, I addressed questions like what ant species colonize green rooftops and how does the age of the green rooftop influence ant diversity.

As a researcher in the Biology Department, I was able to really develop my skills in research and in the laboratory. I received the opportunity to be in both worlds as I was able to be "out in the field" while also being able to look through a microscope. First starting off with my field experience, I never knew what to expect. Each day was different as the weather was always a factor. Learning that the organism I was studying in my project, an ant, preferred certain weather conditions was also very tricky. It could never be too windy or too rainy because as Professor Sean Menke told me, "ants can drown in a drop of rain." Also, differentiating what insects were ants and which ones weren't was difficult. This is because when you look hard enough, there are millions of organisms that normally do not catch your eye as you tower over them.

Setting up experiments outdoors was very different to me because so many variables are uncontrolled in comparison to those of a laboratory experiment. When setting up my experiments on the green rooftops and around their bases, I dealt with questions like how many trials were enough and how many rows of tuna were enough to attract ants? As a result, I learned how to set up these experiments and what designs answered what questions. But in the laboratory, I learned how to identify ant species by learning about an ant's external anatomy. There are thousands of ant species, and their biomass is higher than any other organism in the world. Thus, looking at a small insect such as this could be difficult when trying to learn how to identify it. Deciding what features an ant has and then learning to distinguish them between species is quite the challenge. For example, knowing whether the ant you are observing under the microscope has 10 or 12 antennal segments is hard to do without practice. But the real excitement comes in when you have identified so many ants under the microscope that eventually you no longer feel like a giant and can identify them with the naked eye around Lake Forest College. This experience has led me to love research despite all its challenges.

Though this is only the preliminary research of a long journey ahead, I have observed certain trends in this project. For example, there does seem to be a relationship between green rooftop age and ant diversity. But much more work is needed and more trials need to be done to accurately come to a conclusion. This research is also only the beginning of me as a researcher. There is much more to learn and many more experiments to design. In addition to a long and productive summer, I have been truly lucky to be a Richter Scholar who has experienced so many different aspects of research.

### **Rida's Richter Experience - Days Spent in the Synuclein Lab**

My research with Dr. Shubhik DebBurman in his molecular

neuroscience lab was similarly interesting and also answered a crucial question in another field of biology at Lake Forest College. Dr. DebBurman's lab is interested in the pathology of the Parkinson's disease protein, alpha-synuclein, in yeast models. Most neurodegenerative diseases, including Parkinson's disease, are characterized by the buildup of a particular protein. A hallmark of Parkinson's disease is the accumulation of the protein, alpha-synuclein. Therefore, the ability to breakdown the buildup of alpha-synuclein can be of therapeutic interest. Previous research, including research from our lab, has shown that both major protein degradation organelles found in the cells (the lysosome and proteasome) are breakdown sites for alpha-synuclein. Whether these two organelles act independently to degrade alpha-synuclein or cross-regulate each other is not known. I supported the latter notion, and therefore, predicted that compromising both pathways would accelerate alpha-synuclein pathology. To test this hypothesis, I needed to develop effective ways to inhibit both pathways. For my Richter project, my first goal was to develop an assay to chemically inhibit the proteasome in a yeast model and then evaluate how such inhibition would alter the overall pathological properties of alpha-synuclein.

Along with getting a chance to work on my individual project and trying to answer the questions that came my way, I got the opportunity to assist Madhavi Senagolage, a senior thesis student in our lab. I learned so much from her experience, intellect, and advice. From basic handling of lab equipment and following lab protocols to interpretation of data and answering sophisticated questions, it was a great learning experience. Keith, our lab manager, and Madhavi were great resources for all first-year researchers in our lab.

Theoretically, my research project was very logical, but experimentally, it was a difficult one to accomplish. In order to test my hypothesis, I had to chemically inhibit the proteasome pathway. I could have used any normal inhibitor that could damage the proteasome, but yeast cells have a cell wall, which would not allow the inhibitor to enter the cell. Therefore, before I could start my experiment, making the cell wall permeable was very important. I knocked out a gene called *ise1* and made holes in the cell wall, which allowed the inhibitor to carry on its work. Working in Dr. DebBurman's lab, I was introduced to these new techniques and technology. I also learned and performed Western blot analysis to determine the amount of protein accumulated in proteasome inhibited yeast cells

compared to normal yeast cells. Also, to test localization of alpha-synuclein in yeast cells, I used green fluorescence protein (GFP) microscopy, whereby I could detect areas where there was a higher buildup of alpha-synuclein. Because my research experience was so challenging, I did not get a chance to complete my research over the summer and, like Kaya, I have preliminary data for further research that will hopefully answer more questions.

My Richter Scholar research journey was like a roller coaster ride. And that is what I cherish the most because I experienced the essence of challenges, which are an integral part of research. Although it was not as successful as I would have wanted it to be, I would attribute this experience as one of the greatest ones I have ever had. Getting a chance to work with such intellectual individuals and colleagues is an extraordinary opportunity, and I have the Richter Scholar Program and Dr. DebBurman to thank for that.



Rida Khan working with her mentor, Madhavi, in the lab

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