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Great Neck Breast Cancer Coalition Student Research Internship
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Some activities are so meaningful that you just can't stop doing them. For me, research has been such an invaluable experience that I could not resist returning to Dr. Richard Gross's green chemistry lab at Rensselaer Polytech Institute for a second summer of research. In the matter of 6 weeks, my partner Sunny and I were able to create antimicrobial hydrogels that were reinforced with an organic polysaccharide—chitin nanocrystals.

When we first arrived at the lab, Sunny and I decided to work with new mentors, Tony and Fei, rather than continue our work with Amanda from last year. At first, we were shocked by the totally different teaching/mentoring techniques Tony had. Especially coming out of a high school research setting, we quickly discovered the science is not regimented. After reading over a dozen papers, Sunny and I took an idea and set out to create a meaningful experiment that would yield valuable information to help solve a real-world problem. We didn't know what to expect, or if our idea would work. But regardless, we focused on the idea of antimicrobial hydrogels and we made it our goal to create and study them. Our real-world application would be to replace the antimicrobial agent triclosan, which according to the US Environmental Protection Agency (EPA), is an endocrine disrupter, developmental and reproductive disrupter, toxic, and possible carcinogenic substance. Triclosan has also been linked to cause antimicrobial strains of bacteria to develop. It is found in numerous consumer products, including soaps, detergents, toys, and medical instruments. After many trials, we decided to use silver nanoparticles as our antimicrobial agent. Silver nanoparticles are used as antimicrobial agents in clothing, food containers, wound dressings, and surgical instruments because of the silver's ability to kill bacteria. Later when we had made a successful hydrogel, we began adding the chitin nanocrystal, which we obtained from shrimp shells.

After two days of creating these hydrogels, we quickly discovered that we needed to manipulate the methods found in the literature to suit our purpose. For example, when

we were making the silver nanoparticles, we had to add 10x the amount of sodium citrate to create the nanoparticles we wanted. Later, when we were incorporating the chitin nanocrystals into our hydrogel, we had to adjust our methodology to make the most optimal hydrogel. This taught me how to identify a problem and take reasonable steps towards a solution. In a high school lab, we kind of know what to expect. While I may not be able to predict exact results, I usually have a general idea of what should happen, what a reaction's color should be, how long is best to stir a mixture, etc. However, I realized that since no one has ever done what we were doing, I didn't quite know what to expect. Before we were successful, we experimented with 2 other antimicrobial agents. Our method to making the hydrogels was customized—tailored to our specific purpose, but broad enough that it could be replicated for scientific validity.

This is my favorite part of science. Nothing in the lab is guaranteed to happen. Changing even a small characteristic could drastically change our final product. I also think that the fact that nobody really knows what will happen after a reaction makes science research so appealing to me. By the end of the summer, my partner and I had created antimicrobial hydrogels capable of potentially being used to treat burns and wounds. In addition, silver nanoparticles are a viable alternative to triclosan. At low concentrations, the nanoparticles are not toxic to humans; our concentration of silver nanoparticles was on the ug/mL scale. The US Food and Drug Administration (FDA) has, however, approved of silver nanoparticles to be used in antimicrobial wound dressings—indicating that they are nontoxic enough to be exposed directly to human flesh.

Since we did not limit ourselves to a specific application, we may also be able to apply our hydrogels to HVAC (heating, ventilation, and air conditioning) systems. Recently there was a Legionnaires' disease outbreak in the Bronx that left 12 people dead and more than a 100 sickened. If we were able to use our antimicrobial hydrogel to better filter and sanitize the system, such a disaster could have potentially been mitigated.

Overall, I am so thankful for such another great experience working in Prof. Gross's lab. In addition to my project goals, I learned real-world problem solving skills. Oftentimes, when our reactions did not go according to plan, we would troubleshoot and come up with new solutions. To me, that was the best lesson I could possibly take away

from the lab. Learning the solution to one problem is nice; but, learning how to solve any problem is much more useful. And that's what I learned this summer.

I would like to thank Laura, Lisa, and the entire GNBCC for providing me, again, with such a phenomenal, mind-blowing experience that I could not have possibly received anywhere else. I also want to thank Prof. Richard Gross, Tony, Fei, Amanda, Robert, and Mohammad for all their help. I really appreciate the fact that they were always willing to pause their own work to help us. I want to thank my family for all their support these past 2 summers, especially for driving me to and from RPI every weekend. Finally, I want to thank my partner Sunny for working with me to create a great project, and all the summer interns for making this summer such a memorable one!