Prasanth Kurup
William A. Shine Great Neck South High School
Great Neck Breast Cancer Coalition
Polytechnic Institute of New York University

This summer I had an amazing opportunity to become an intern at Polytechnic Institute of New York University, NYU-poly for short, under Dr. Richard Gross. At NYU-poly, my partner Lawrence Lin and I researched for new ways to strengthen bioplastics to replace petroleum-based plastics, which contain Bisphenol-A, a known influence for the onset of Breast Cancer.

On my first day at the lab, I was nervous as to how the other interns and the professor were going to act. However, it turned out that all the interns, who were from Plainview-Old Bethpage John F. Kennedy High School were easy-going, yet also determined, making them easy to relate to. This was especially helpful since at some points we worked together for the first few weeks. My mentors were amiable and knew their individual topic thoroughly. They also were ready to help us no matter what the time was. Dr. Gross himself was very helpful in giving us suggestions when we were out of ideas or plans.

On the very first day, Dr. Gross went straight to business and told us that we would be working with Cellulose Nanowhiskers in an effort to strengthen bioplastics. Cellulose Nanowhiskers, CNWs for short, are the micro-fibers that help build up cellulose molecules. Our main idea was to use CNWs to strengthen current bioplastics making them more favorable than current Petroleum-based plastics which contain Bisphenol-A, or BPA for short. This way we could prevent the spread of plastic which uses BPA.

BPA is a commonly used polymer often used to make petroleum-based plastics.
In fact, every year, 8 billion pounds of BPA itself are produced. It is most commonly used in the plastics that are in plastic bags, water bottles, and receipts. It is also used in epoxy resins as well. From recent studies, it has been seen that BPA is an endocrine disruptor which affects the body's hormones. In recent years, it has been seen that certain animals which even have low quantities of BPA were more likely to contract breast cancer and those with high doses were almost certain to develop breast cancer.

To counteract the use of BPA, my partner and I decided to try and strengthen bioplastics, plastics which are developed without BPA. Bioplastics are created with starches, cellulose and biopolymers and so as a bonus decompose faster than petroleum-based plastics. To strengthen said bioplastics, my partner and I used a blend of Polycarbonate 14 (PC 14), Polylactic Acid (PLA), and Cellulose Nanowhiskers (CNWs). Polycarbonates are molecules of carbonate, carbon double-bonded to oxygen, attached to each other. PLA is groups of lactic acid attached to each other, all formed by bacterial fermentation of corn starch. It has been seen one can put PC 14 into bioplastics to strengthen it; however, if one were to blend PLA with PC 14, the blend is more heat resistant and more impact resistant, allowing an overall better substance to put into bioplastics. The goal of my partner and me was to add CNWs to the mix to create a blend that would be the stronger of the two blends. If we could create stronger bioplastics, hypothetically, we could start to replace petroleum-based plastics in things, such as plastic water bottles, with the new strengthened bioplastics.

To start off our experiment we tried to find better methods to create CNWs because the current method uses acid hydrolysis, which has been shown to be more harmful to the environment due to the leftover acid waste. Two methods that my partner and I looked at with the rest of the interns were enzyme catalysis and bacterial synthesis. I looked at enzyme catalysis with some of the other students, which consisted of taking Ramie fibers, which are fibers from plants such as Ramie and potato, and Microcrystalline cellulose (MCC), which comes from sources like wood and flax. My group would then decompose the Ramie and the MCC using enzymes such as Viscozyme.

My partner, Lawrence Lin, worked with the rest of the other interns on bacterial synthesis, in which bacteria, Gluconacetobacter Xylinus, produce Cellulose Nanowhiskers in a pure mat form. This is beneficial because the bacteria-created cellulose does not have the proteins and other polymers found in plant-created cellulose. Afterwards, he would then break up the cellulose mats using methods such as sonication, which consisted of sending ultrasonic waves through the sample to break it up, or enzyme catalysis with the purified cellulose. When my partner and I teamed together, we used bacterial cellulose because it was quick to produce and more pure than the plant cellulose. We decided to look into ways to increase the yields based on the medium as a secondary project, achieving this by comparing the CNWs obtained from different mediums.

While we were in the lab, my partner and I had unforgettable experiences. Most of the time when we were waiting for our reactions to finish, which sometimes took 3 to 6 hours, or when we finished work for the day, we would go with the rest of the interns and play ping-pong downstairs. Often when it was time for lunch we would look around the rest of the city to see what there was to see and then usually find a nice restaurant to go to. Even while we were working in the lab, I would get into some very interesting discussions with the rest of the interns about random things such as the Olympics or even the Metro system.

I really loved going to NYU-Poly over the summer and completing this internship. I would really like to thank the Great Neck Breast Cancer Coalition and all the people in it for allowing me to have such an amazing opportunity. Though we accomplished much this year, there is still more to be done to aid in the prevention of breast cancer. I still feel very gratified in helping to prevent such a dangerous cancer.