Bridge between biology and engineering explored in cancer research

PLATTEVILLE, Wis – Jessica Symons, senior engineering physics major at the University of Wisconsin-Platteville, has always been interested in the connections between engineering and biology. She recently had the opportunity to work as a research assistant at Virginia Tech in Blacksburg, Virginia, where she helped conduct various research efforts, including analyzing E. coli cells. Her biggest aspiration is to enter the biomedical field to study cancer therapeutics, and when she heard that cancer research was being conducted on the UW-Platteville campus, she took the initiative to get involved.

“Last year, I found out that Dr. Miranda Bader-Goodman and Dr. Marilyn Tufte were conducting cancer research on campus, and I immediately reached out to them to see if I could help,” said Symons. The research stems from work done in the 1980s by Tufte, a biology professor at UW-Platteville, and the late Dr. A. Keith Brewer.

Bader-Goodman, a Platteville native, who recently completed a post-doctoral program at the Mayo Clinic in Rochester, Minnesota, joined Tufte on campus to continue the research. “The goal is to determine how cesium compound works in treating and fighting cancers,” said Bader-Goodman.

Symons, determined to make a contribution, sought out and generated her own portion of the research project, including developing a microfluidic device that can electrochemically separate a single cell and measure the pH of the entrapped cell. “The previous research hypothesized that cesium induces a pH change in the individual cell, which could be proven or disproven by this device,” explained Symons. “Microfluidic devices have emerged as distinct new structures
that can precisely control the transport of fluids through channels at the micro and nano scale, and therefore have the ability to control and study small particles over time."

That drive to contribute earned the admiration of Bader-Goodman. “When Jessica first came to me and asked if she could help, I didn’t have any work for her, but I told her that she could contact me if she came up with any ideas. A couple months later, she came back with this idea to use microfluidics.”

“I only have my limited biology and chemistry ideas,” said Bader-Goodman. “But Jessica had already done some background research. We met with Dr. Jorge Camacho, assistant professor of mechanical engineering, and discussed how microfluidics could be used in cancer research.”

However, while the microfluidics device is useful for separating the cells, Symons and Bader-Goodman needed a way to analyze the chemical composition of the cells. After further investigation, Symons proposed integrating Raman spectroscopy into the project. Not only did Symons have prior experience with the technology, Camacho was also familiar with Raman spectroscopy. But, with a new Raman spectroscope costing around $10,000 - $15,000, Camacho had to get creative. So, he reached out to a senior mechanical engineering design team, and the group of five students was able to build a spectroscope from scratch for less than $2,000.

“Raman is an excellent way to analyze our biological samples,” said Bader-Goodman. “The technology is being used a lot more in clinics, it is used in tissue for diagnostics. So it’s definitely relevant to the human translational portion of this research.”

This summer, Symons will complete her design of the microfluidics chips and will begin testing them to understand how the pH of the cells changes with the introduction of cesium. Then, the Raman spectroscope will be tested, and Symons will conduct Raman analysis on the cells to better understand the
chemical changes that are occurring within the cell while affecting the level of pH. The goal is to begin collecting data for publication in the fall.

“It’s been a fantastic learning process for everyone,” said Bader-Goodman. “For me, it’s exciting that I got to integrate so many undergraduate students into the process. That was the end goal, but I never thought it would happen so soon. My hope is that this can open the eyes of other researchers that you shouldn’t be limited by money. If you don’t have something, you can build it. It takes a little more time, but if you build it yourself, you really understand the machine and how to use it, and then you can teach others. This is an education opportunity.”

According to Symons, one of the most rewarding parts of this research has been the opportunity to collaborate with other students, professors and departments within the university. “The microfluidic chip could be used in labs across campus to help students further understand the possibilities of bridging microfluidic technology with different types of STEM research,” said Symons. “This device has applications in the testing of soil, ground water and drinking water. The wide range of applications could result in collaborations between different departments or, in this case, between the College of EMS and the College of BILSA.”

Likewise, Bader-Goodman enjoyed the collaboration between departments. “We can get more done and do it faster when we work together,” she said. “When we ran into a problem, Jessica would come up with something new, or I’d come up with something new, or Dr. Camacho would have an idea. Each of us knows a piece of the puzzle, but there has to be some sort of glue — and that was Jessica. She’s that bridge between engineering and biology. That’s something that I always wanted to do. My background includes both molecular biology and chemistry, and I’ve always wanted to bring these two disciplines together. I think it opens more doors to what you can do.”

Overall, Symons hopes she can get one step closer to finding a cure for cancer. “I am very passionate about cancer therapeutic research because of my father, who passed away from head and neck cancer in October 2014. He struggled for
many years from the effects of radiation,” she said. “There are many ways to treat cancer, but many of these methods can be very harmful to the healthy parts of the body. In previous studies, using cesium as a therapeutic has been shown to target cancer while causing little to no side effects. Although we will not be performing clinical trials with humans or animals, this research may help us understand how cesium destroys cancer at the cellular level.”

Originally from Benton, Wisconsin, Symons plans to pursue a doctorate degree in biological sciences after graduating from UW-Platteville.

A Cancer Research Development Fund has been created through the UW-Platteville Foundation for those who would like to make a contribution to support the research. For more information, contact the UW-Platteville Foundation office at 608.342.1182 or foundation@uwplatt.edu.

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