1) John Szajko  
2) Prof. Steve Ruggiero and Prof. Carol Tanner  
3) Development of laser transmission spectroscopy as a bio-molecular detection system

4) During the summer research, I learned how to use the LTS system. I was familiar with a similar system, but there were a few slight differences in the machine setup and software that I had to learn and get used to. I also learned how to use KaleidaGraph software, as well as becoming more familiar with Excel.

5) The portable LTS system, once it is verified to be as accurate as the larger model, will greatly reduce the time needed to determine the size, shape, and number of nanoparticles in fluid suspension. Its portability means that it can be taken directly to the test site. Once there, the system will be able to test field samples in real time with results in a matter of minutes compared to the hours or days it would take to send the samples to a lab for testing otherwise.

My work this summer involved using the portable Laser-Transmission Spectroscopy (LTS) machine. With this machine, we can take measurements of laser transmission to determine the diameter of particles in the solution as well as how many particles there are of that size. The project goal was to show that the portable machine is as accurate at analyzing nanoparticles as the full-size LTS apparatus.

To make the comparison, we took a paper written based off of research done using the full-size LTS and replicated the experiments on the smaller machine. These experiments were conducted using polystyrene nanoparticles (PSNP) of known size and concentration. This would allow us to compare our results to both the previous research and the manufacturer’s data. Tests were run to measure both a single PSNP size and a mixture of two PSNP sizes in solution. During these tests we were able to replicate the experiments done earlier with the larger machine. We were also able to give a more accurate measurement of particle size distributions, improving on the manufacturer’s information for the standard of deviation. We also looked at images of the PSNPs taken by a scanning-electron microscope (SEM). Measurements of the PSNPs in these SEM images reinforced our findings, showing that the portable LTS was taking accurate readings for most sizes.

For the portable device, we did experience several inconsistent measurements of particles that were around 220nm in diameter as compared to the table-top LTS apparatus. The portable device was still able to detect the presence of the PSNPs, but it was inconsistent with what size the particles were. It is possible that this is caused by the lower power light source in the portable system, and we are working on correcting the problem.
Figure 1. This is a simplified schematic of the Laser-Transmission Spectroscopy system. The laser is shot out of the light source and split, ensuring that both the reference and sample are measured at the same power and intensity. The reference is simply a cuvette filled with whatever solvent the sample is using so any differences that are measured are caused by the sample material itself. The computer diagnoses the readings, compares them, and puts the results on the screen.
Figure 2. This is a graph made using the KaleidaGraph software comparing our measurements of the 990nm polystyrene nanoparticles to the manufacturer’s data. Our measured results show a peak particle size density at 975nm while the manufacturer’s data says the size density should have peaked at 990nm. Since the manufacturer states that the standard of deviation is +/-30nm, our results are completely acceptable. The narrowness of the base range of our measurements suggests that the particles are actually more uniform in size than the manufacturer believed.
Figure 3. This is a scanning-electron microscope image taken of 220nm diameter polystyrene nanoparticles. The marks on the bottom right are the scale bar, with each of the spaces between marks being equal to 500nm. Using images like this one, we were able to conclude that, while there are some nanoparticles smaller than 220nm, the machine was giving us inconsistent density readings for this particular size.