This summer, I expanded on Professor Louters’ work with a transporter protein called GluT1. This protein allows glucose, a sugar, to pass across the cell membrane. Glucose is the preferred fuel of the cell for maintaining function, thus proper glucose regulation is critical for overall health of an organism. Abnormal glucose regulation is linked to several potentially devastating diseases. Diabetes is one example, which is caused by an inefficient glucose transport system. Cancer is also related to atypical glucose regulation, although the problem is the opposite: cancer cells intake copious amounts of glucose to satisfy the high energy demands needed for rapid cell multiplication. GluT1 is more abundant than normal in many types of cancer cells. A deeper understanding of this protein is essential for developing therapeutic strategies to treat glucose imbalance-linked disorders.

The primary focus of my research this summer was to investigate the mechanism of GluT1 activation. Previous findings suggested that GluT1 more efficiently intakes glucose when it is integrated into segments of the cell membrane called lipid rafts. Lipid rafts are compact parts of the cell membrane that often have a high concentration of transport and signal proteins, similar to “activity centers” on the cell surface. I hoped to enhance glucose uptake, then use a lipid raft isolation technique to compare how much relative GluT1 was in the lipid rafts in the activated cells compared to my control cells.

Like the name suggests, lipid rafts are partially composed of phospholipids, which are fat derivatives. These phospholipids are less dense than the proteins that compose the membrane surrounding the lipid rafts. The surrounding membrane contains phospholipids as well, but they can be easily disrupted or removed without breaking the lipid rafts. Because of this I could isolate the rafts by creating a density gradient in a small tube. I loaded my cell fragments in the denser, lower portion of the tube and spun it at 200,000 times the force of gravity for 17 hours. Because lipid rafts are less dense than the proteins in the surrounding cell membrane, they float towards the top. The protein outside the lipid rafts stay in bottom, more dense liquid. Then I would use an analysis called a Western blot to determine how much GluT1 was in the lipid rafts versus other portions of the cell membrane.

I was quite excited about my results. Further replications are needed, but my cleanest data indicated that when mouse fibroblast (L929) cells were deprived of glucose, about 20-25% of the GluT1 shifted to lipid rafts. I also found out that two techniques of disrupting the cell membranes result in different types of low-density membrane isolation. GluT1 can be found in lipid rafts collected by mechanical force, but not in “detergent-resistant membranes,” which are impervious to a compound called Triton X-100 that disintegrates the cell membrane. In addition, GluT1 does not appear to be in certain types of lipid rafts called caveolae. Caveolae are like “little caves” on the cell surface, but GluT1 appears to be in a different raft structure. In the future, I would love to figure out what type of low-density membrane I am isolating with my mechanical disruption technique and why GluT1 can be found in low-density fragments more often than in the surrounding cell membrane. I would also like to gather more data after exposing cells to different activators.

Even if I do not get another chance to pursue these questions further, I am still extremely grateful for the time that I was given in the Louters Lab this summer. I am considering a path in biomedical research and so it was valuable to be extensively exposed to work in a laboratory setting. This experience will help me evaluate if such a career is right for me. I gained a vast amount of knowledge in an area I previously knew little about, but I am simultaneously leaving with more questions than I started with! Perhaps most importantly, I went from being completely dependent on Professor Louters to being able to analyze data and propose future steps myself. I am so thankful for the people who made this experience possible and I have no doubt that I gained valuable skills for the future.