Activation and Presence of GLUT1 from Protein-Protein Interactions

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The Glucose Transporter (GLUT) family of proteins are in the membranes of our cells and transport glucose, which is a major source of cellular energy. Many of the nutrients obtained from consuming a meal—especially carbohydrates—will eventually be broken down into glucose and will get into our cells using these proteins. Abnormalities in the GLUT proteins can lead to or worsen serious diseases such as diabetes or cancer, so understanding the functionality and mobility of these proteins throughout the cell is crucial. Among the GLUT family of transporters there are 14 known isoforms, all of which have distinct functions depending on what kind of tissue they are expressed in. We have been studying GLUT1, which functions as the major transporter for initial uptake of glucose in most tissues of the body. While there has been significant work done to understand how GLUT1 works in red blood cells, very little is understood about it in the context of other tissue types, which is where our area of research lies.

This past summer we have been using biochemical and molecular biology research methods to understand how GLUT1 activity and presence changes through its interaction with surrounding proteins in human kidney cells. We use microscopy and fluorescence technology to observe where GLUT1 resides in cells before and after we add cellular signals and CRISPR gene editing to add and remove genes within the genome of our cells. These methods together help us understand how the protein GLUT1 moves throughout the cell, and how other proteins affect its ability to transport glucose. To begin these studies, we had to have a firm grasp on how we could optimize the tools of molecular biology to best serve our purposes, which was the main focus of my work. Combining these tools, our goal was to delete genes that encode for proteins that have been shown to physically interact with GLUT1, and to observe the resulting change in the abundance or cellular location of GLUT1.

The several months of work led to both understanding and confusion, but ultimately brought us closer to our goal of better understanding GLUT1. Through an initial set of experiments, we could optimize the way we isolate our protein by testing different types of chemical detergents used to break apart cells at various concentrations. Following these experiments, we jumped into our main method of research, which was the deletion of specific genes from the human kidney (HK2) cells. While this initially proved to be more difficult than anticipated, we succeeded within last few weeks of research. This will now set us up for future set of experiments looking at the resulting effect the knockdown will have on GLUT1. Future studies will hopefully lead us to some exciting insights into how GLUT1 functionality changes in various tissues of the human body.

Scientific research takes experiential learning to the next level, serving as a fantastic opportunity to put into practice much of what is taught in science courses at Calvin. Beyond the academic side though, I believe research has taught lessons and shown me qualities that are crucial to my future career and what kind of person I want to be. Among these things I have learned the essential lesson of patience. Unlike any other work I have done in college, research demands patience and perseverance to keep going even when results or data do not turn out how you anticipate. Discovery is does not just involve success but also failure, and recognizing the failure in research is what can sometimes lead to the best results. In addition to this I have been able to greatly improve important skills such as organization, communication, critical thinking, and multitasking. All of which I believe will be extremely useful as I continue in my career.