The kidney, while most known for its role in filtering waste products from the blood, also plays an important role in regulating blood pressure and water balance. Made up of tiny networks of tubes, called nephrons, the kidney will produce and activate water channels, ion pumps, and other carrier proteins in response to signals coming from the body (i.e., hormones). The acute, or immediate response to thirst is known in detail, however, exactly how the body responds to long-term thirst is poorly understood. "Genes" are sequences of DNA that encode for the production of proteins. Initially translated from DNA, messenger RNA (mRNA) carries the code to the protein "factories" of the cell, the ribosomes. These proteins encoded in our genes are the building blocks and enzymes that make our bodies function. Proteins called "transcription factors" bind to specific sequences of DNA and regulate when and how much of a gene is made into mRNA and eventually protein. Understanding which transcription factors regulate which genes can give us a better understanding of how gene mutations or deficiencies cause disease and how to possibly artificially turn on or turn off genes using pharmaceutical methods.

In this study, we are trying to figure out which genes regulate important proteins in the kidney, responsible for regulating blood pressure, water balance, and blood ion balance. To do this, we tested several "candidate" genes and, through experimentation, quantified the levels at which they were being produced in various regions of the kidney. Our results showed that of the three candidate genes we tested, expression of all three genes correlated closely with the spatial distribution within the kidney of the ion and water transporters we are interested in, suggesting that the transcription factors may be tied to their regulation.

A second aspect of our study was to further quantify these genes in several important organs, in order to better understand where these transcription factors are found and possibly correlate their localization and function in other organs with hypothesized functions in the kidney. Lastly, we developed a new method for dissecting microscopic segments of the kidney nephrons using transgenic technology. By introducing a gene encoding a fluorescent protein into a developing mouse in the place of a common kidney water channel, we are able to see specifically in which cells the mouse's kidney is producing that channel. After mincing the kidney into small pieces, we can see the fluorescent cells and nephron fragments under a microscope and isolate them with a tiny suction pipette.

These transcription factor studies are the first of their kind in the kidney. They show the factors may be isolated to the collecting duct portion of the nephrons, suggesting an important role in water or ion regulation. Future research will be able to more accurately describe the function of these and other genes and help our overall understanding of how the kidney works.