Solving biological problems at the molecular level with the help of novel biotechnology method development is the primary goal in the Spence group. To accomplish this goal, our group blends a variety of methods found not only in the chemical sciences, but also bioengineering, pharmacology, and physiology. Our publication record is exemplary of this broad approach to solving problems; specifically, in the past 3 years, our group has published papers in journals whose primary focus is analytical chemistry, diabetes, pharmacology, and microfluidic devices, to name a few. We employ any measurement scheme necessary to find answers and make new discoveries. Therefore, it is not uncommon for students in the Spence group to be experts in cell culture and cell preparation, but also understand the basics behind laser-induced flow cytometry, chemiluminescence techniques, or how to prepare microfluidic devices from 3D-printing technology. During the past year or so, we have also used NMR, circular dichroism spectroscopy, absorbance spectroscopy, atomic absorption spectroscopy, gel electrophoresis, HPLC, amperometry, cyclic voltammetry, and scintillation counting in our efforts.

All of the work performed in the Spence group is problem-based and hypothesis-driven. Moreover, most of our work is centered around the bloodstream and complications that arise in, or from, the bloodstream during disease onset. For example, since 2006, our group has been interested in studying C-peptide, a 31 amino acid peptide secreted from the pancreatic beta cells with insulin. Recently, our group has discovered that C-peptide demonstrates activity on red blood cells (something insulin does not do), but only when bound to zinc. We are also in the process of determining how this zinc binds to C-peptide, and if it induces structure in the peptide that subsequently leads to its binding to the red cell. Our ultimate objective with this project is to prepare a correct formulation of Zn-bound C-peptide that can be re-administered to people with Type 1 diabetes, who no longer produce C-peptide in their bodies due to beta cell destruction.

In addition to our work in diabetes, we also have recently reported findings concerning hydroxyurea, the only proven therapy for Sickle Cell Disease. We also dedicate resources and time to studies involving platelets for Cardiovascular Disease and Stroke. Finally, a new branch of our laboratory efforts focus on improving stored red blood cells for Transfusion Medicine. Here we are formulating new, yet simple, storage solutions for the blood cells. Preliminary evidence suggests that some of the properties of our stored red cells are as fresh on day 35 of storage as they are on day 1! We hope to continue these efforts in the next few years to improve human health.

A new technique in our group involves 3D-printing. Nearing 30 years since its introduction, 3D printing technology is set to revolutionize research and teaching laboratories. With regard to research settings, 3D printing has been limited to biomedical applications and engineering, although it shows tremendous potential in the chemical sciences. The Spence group aims to utilize 3D printing technology to help us solve the problems listed above, especially those related to cell-cell communication, blood flow, and tissue-on-chip applications.

Research currently underway in the Spence group is focused on (a) platelets, (b) sickle cell disease, and (c) stored blood, in addition to our long-standing investigations involving diabetes.