Kirmser Application
Team OneDrop
BAE Department, Senior Design Project

The Kansas State University library aided team One Drop, a three-member senior design team in the Biological and Agricultural Engineering department with both online resources, textbook references, and database searches. Our team tackled a project involving microfluidics that involved a more in-depth understanding of fluid mechanics. Half of the fall semester was spent gaining background knowledge and conducting a literature review related to 'lab on a chip' cancer diagnostic devices and device concepts before prototyping unique designs and performing simulations on COMSOL Multiphysics, a simulation software for different physics studies. The Spring 2017 semester has been focused on performing COMSOL simulations on redesigned microfluidic 'lab on a chip' devices to achieve high mixing efficiencies between blood and reagent streams. The helpful research materials and other resources obtained from Hale library have aided in efficient literature searches, sparked innovative ideas, and helped with the continuation of a productive and successful senior design project in microfluidic technologies.

After first being introduced to our team's project goals of developing a microfluidic 'lab on a chip' device, we needed to focus our topic of study by conducting background research on both microfluidics concepts and lab on a chip prototyping considerations. While initially searching for appropriate online resources, our team noticed that there was a professor at K-State that specialized in microfluidics. After reaching out to Dr. Betz, a mechanical engineering professor, our team met with her a couple of times to gain some valuable information from a credible first-hand source on microfluidics concepts. Dr. Betz recommended our team read a microfluidic textbook along with a few other well-known research papers. After searching the book title in the search bar provided on the homepage of Hale Library's website, one of our members went to Hale library to check out the textbook held on reserve at the front desk. The microfluidics textbook was helpful to our team, as were the articles provided by Dr. Betz because we our team was able to focus our research even further and learn the basic equations needed to solve microfluidics problems necessary in making microfluidic devices.

After gaining fundamental information on the fluid mechanics involved in lab on a chip devices, our team spent a few weeks researching the basics on successful microfluidic lab on a chip designs. Our team goal was to become familiar with the concepts of lab on a chip devices so we would feel comfortable making our own device that complies with the requirements needed for these devices to function in limited-resource environments. Hale library has an excellent tab to find databases that are useful in all areas of credited research. Our team relied on PubMed, Scopus, the U.S. Patent and TradeMark Office, and K-State faculty webpages to find relevant and referenced articles dealing with microfluidics and lab on a chip devices. Our client for the project, Dr. Mei He, as Associate Professor of Biological and Agricultural Engineering also directed us to a few of her papers involving prototyping of microfluidic devices for disease diagnosis. Many innovative ideas were generated from conducting a literature search on these topics, and our team used creativity in creating four unique devices for lab on a chip studies using SOLIDWORKS modeling software provided by K-State.

A large portion of team OneDrop's project during the Spring 2017 semester has been heavily focused on running COMSOL simulations. Since no one in our team had any prior experience with COMSOL, we relied heavily on the library search engine to read various papers and articles that included a COMSOL testing component, along with introductory videos provided by the COMSOL website on how to use the software. Learning the functionality of COMSOL has enabled our team to understand what kind of physics analyses were appropriate for quantifying mixing efficiencies in the team's prototypes. This was an integral part in moving forward with different redesigns that were made and tested in COMSOL throughout this semester.

The most helpful resource we found involved an overview of COMSOL simulation software and introductory step-by-step instructions for beginners provided on the COMSOL webpage. We realized that in order for our project to be successful we needed to learn COMSOL from the ground up. It was an informative and easy to understand design of the article that allowed us to develop a pathway to complete our project. Once the team had become familiar with the basics of COMSOL, OneDrop searched for a mentor professor who had previous experience with COMSOL, however, since the program license is fairly expensive, we did not find anyone on K-State's campus familiar with the program. When finding a professor failed, we expanded our search beyond the university and contacted Matt Campbell, a K-State alumni working for AMI Manufacturing who specializes in modeling programs. He assisted us in setting up basic simulations and taught us the various simulations and physics that can be applied to study a microfluidic chamber beyond the information provided in the introductory information we found. Looking back over the year, almost 5 months of this 9 month project were spent working with this challenging software. Several months were dedicated to reading manuals, watching YouTube videos, and emailing back and forth with Matt until the team felt comfortable running simulations. The use of library resources to master COMSOL has enabled our team to eliminate designs, go through multiple redesigns, and make a final recommendation on a design with a high mixing efficiency.

The OneDrop team is incredibly thankful to the K-State Library for providing easy access to a variety of credible resources. This project could not have been completed without the assistance of K-State resources as well as the staff working at K-State who generously donated their time to aiding our team in our research. When Professor Alice J. Trussell, Director of Fiedler Engineering Library, came to the BAE 536 class (senior design), she set everyone up for success and instructed the best way to find resources. The project received an A in the course and won the Innovation Award for Engineering Open House.