



2025 Summer Scholar Profile: Abigail Marciniak



My name is Abigail Marciniak. I am a third-year student at the University of California, Irvine (UCI), where I am majoring in Biomedical Engineering. At UCI, I specialize in immunology research, working under Dr. Abraham Lee and Dr. Anshu Agrawal. As a researcher with Dr. Lee, I generate artificial antigen-presenting cells (aAPCs) capable of immune cell (T cell) activation, utilizing microfluidic technology. These aAPCs have the potential to serve as a powerful form of immunotherapy in the future. The immune system declines with age, so in Dr. Agrawal's lab, we are working to understand dendritic cell (an antigen-presenting immune cell) activity in aging adaptive and innate immunity. At the Buck Institute, I am mentored by postdoctoral researcher Dr. Meiyang Wu in the lab of Dr. Chuankai Zhou. The Zhou lab uses the budding yeast *Saccharomyces cerevisiae* to study protein homeostasis and its role in cellular aging. Although it is a simple single-celled fungi, yeast is a eukaryote with many conserved human biological pathways, making it an ideal model organism. The lab incorporates novel technologies, including microfluidic platforms, to examine aging in yeast.

At the Buck, I quantify changes in yeast replicative lifespan (RLS) in response to varied environmental conditions. RLS, defined as the total number of divisions that yeast undergo during their lifespan, is one of two aging paradigms. Budding occurs every 90 minutes and results in a mother cell and new daughter cell. While studying total lifespan in *S. cerevisiae* is an excellent model of aging in post-mitotic cells, RLS measurement gives insight into the aging of actively dividing cells and the factors that control longevity. The traditional technique utilized to count yeast RLS is manual microdissection, where a microneedle is used to isolate newly formed daughter cells from the mother cells as budding occurs. However, this process is time consuming and labor intensive. Alternatively, the Zhou lab utilizes microfluidic technology to analyze yeast RLS. This is a high-throughput approach free from the pitfalls of microdissection. Microfluidics (fluid study at the microscale) is a multidisciplinary field integrating physics, chemistry, biology, and engineering. Microfluidic platforms have revolutionized drug discovery, cell biology, medical diagnostics, and yeast studies. In our lab, a complex microfluidic chip with small channels featuring hollow column structures allows us to trap yeast mother cells as media flows continuously through the device. Budding is then captured through time-lapse microscopy imaging.

However, there are limitations to this mechanical trapping approach. While the columns are uniform in size, yeast are not, so not all mother cells are captured. In addition, mother cells are often washed away during analysis, preventing further study. Alongside Dr. Meiyang Wu, I am working to develop a novel 3D polymer mesh method of yeast capture that is size independent and compatible with a simpler microfluidic device. The mesh structure is a firm yet malleable surface for *S. cerevisiae* to grow on. The flexible gel ensures that when daughter cells bud off, the mother cell is pushed into the matrix and is not washed away. This specialized mesh would be applied to the bottom surface of a one-channel microfluidic device (to maintain a constant flow of nutrient-rich media). This method is compatible with imaging and is not limited by yeast size. We will use this approach to study the impact of heavy metal supplementation on yeast RLS, which is highly relevant given the ubiquity of metal supplement use among individuals of all ages.