Life AD-rift at Rosalind Franklin University

Yuliia Kulchytska
Lake Forest College
Lake Forest, Illinois 60045

During this past summer, I had the opportunity to join Dr. Robert Marr's lab at Rosalind Franklin University, and I would like to share more about him as a mentor. I will also discuss him as an associate professor, based on my interviews with him and his lab members. Dr. Marr started his educational journey at the University of Guelph in Ontario, Canada, earning his bachelor's degree in applied Biochemistry. He then completed a PhD in Molecular Biology, Genetics, and Cancer at McMaster University in Hamilton, Ontario. He had also joined the lab at McMaster, which is focused on gene therapy for cancer. After completing his education, Dr. Marr moved to California to the Salk Institute, where he began his postdoctoral research focused on gene transfer as a therapy for Alzheimer's Disease (AD). Today, he works as an associate professor at Rosalind Franklin University (RFU) in North Chicago, teaching medical/graduate school courses and leading a research lab that focuses on gene therapy approaches to Alzheimer's Disease.

This summer's primary focus of Dr. Marr's lab was to explore how, through viral delivery of a genetic construct, we could inhibit the NLRP3 inflammasome, which is a protein complex involved in inflammatory reactions in Alzheimer's disease. The NLRP3 inflammasome is an important protein complex in the innate immune system that, when activated, releases pro-inflammatory cytokines such as IL-1β and IL-18, which contribute to neuroinflammation in AD and worsen the condition. As a freshman with no prior laboratory experience, I found Dr.

Marr is to be incredibly mindful and supportive. He shared his perspective on mentoring by saying, "I think in one respect, it's a service that every mentor and laboratory should do. And two, it's a benefit because it attracts highly motivated people to work for us. And quite frankly, it causes things to be done that sometimes, when we take our time, we're dragging our feet on getting it done. So, it catalyzes things getting completed, and it's always a good learning exercise for the mentor, too." This philosophy was evident throughout my internship. Under Dr. Marr's mentorship, I became proficient in several laboratory techniques, including cell culture, lentivirus production, ELISA, and Western Blotting. He ensured that I understood the purpose behind each procedure, often giving mini-lectures to clarify complex topics or anything I was confused about.

His dedication to teaching was shared by members of his lab team. Mike, the lab manager, reflected on his experience: "I was a protein chemist in a previous lab. I did protein purification, cell surface expression, addiction models, and the like. This lab is mostly focused on molecular biology and gene therapy. After working with Bob for two and a half years, I can say he is a great teacher, and I quickly adapted and learned everything I needed to do my job here. It was a little challenging, but that's what made it interesting. I brought my knowledge about immunohistochemistry and various techniques that involve it, which other workers adopted. It's a great lab and place where you can easily fit in in a friendly environment. His depths of knowledge are very impressive; he is on a whole other level entirely. He designs the genetic makeup of the proteins. It is very impressive." Similarly, Sonia, a lab technician with a neuroscience bachelor's background from Loyola University, described the difference between Dr. Marr's lab and her previous experience: "In my past lab, we purchased every solution and virus. We didn't make anything ourselves. My previous lab was also more inclined towards behavioral techniques, whereas here it's less behavioral and much more cell culture, PCR, and genotyping. We didn't even do genotyping ourselves in my lab at Loyola; we just mailed them, and they were genotyped for us. This lab provides a unique experience in making everything yourself; everything is homemade."

The research project I was involved in aims to design a plasmid capable of inhibiting the NLRP3 inflammasome. The final goal was to make it enter the bloodstream via intravenous injection, cross the blood-brain barrier, and target cells in the CNS. We used the lentivirus gene delivery system to deliver those plasmids to the monocyte cells (THP-1 cell line), and later, by comparing the experimental and control groups, we assessed inhibition. We measured IL-1β levels (by ELISA) and Caspase-1 levels (by Western Blot) in the treated and control groups.

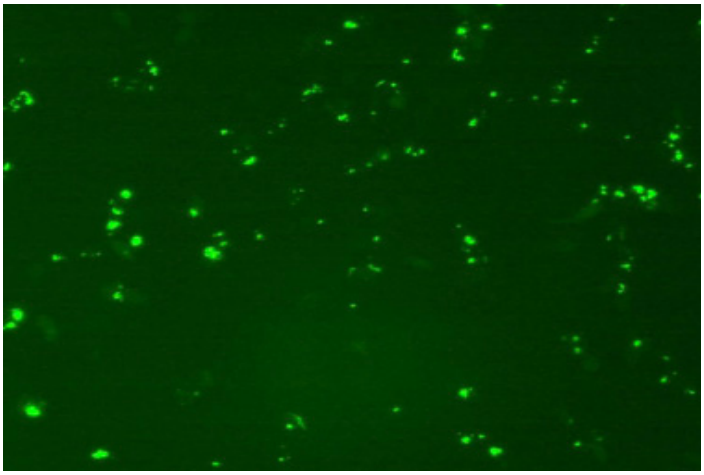

Figure 1. Visualization of virus transfection. GFP-Card (contains the self-made plasmid) medium magnification of lentivirus transfection in 293T cells (human kidney cells).

In the lab, students are welcome to work independently on procedures if they feel confident, with support from Dr. Marr or other lab members as needed. It was great to hear how many students got an opportunity to learn in such an environment. Since joining RFU, Dr. Marr has mentored a wide range of students, including three high schoolers, four INSPIRE students, ten summer interns from various colleges (including Lake Forest College and DePaul University), eight Summer Research Fellows, three student volunteers, five rotation students, twelve medical students, and numerous thesis students.

Dr. Marr's teaching extends beyond the lab. At RFU's medical school, he teaches courses on the limbic system, memory and emotional disorders, cerebellum, autonomic nervous system, and cranial nerves (7, 9, 10, 11, 12). At the graduate school, he leads courses on neurodegeneration and molecular biology and runs a journal club. Several students who took his courses were inspired to join his lab, including an MD/PhD student who eventually became a neurosurgeon. I asked Mike for his thoughts on whether this lab is suitable for students without prior research experience. He responded, "At least 10 students have been in his program. Everyone who was involved in his research and helped to make progress will get their name on the paper. He is very generous and happy to recognize people who contribute to the lab. Last summer, he also accepted a high schooler into his lab. Now that the student is applying to the University of Wisconsin-Madison. General interest in science is all that matters, so this is the place that would accept those students. It's a great opportunity for students to know if this is the area of research they would like to continue in the future, and just in general to find out what the actual research is like."

Beyond his professional role, Dr. Marr is known for being approachable and supportive, further enriching the lab community. Whenever there was free time, he would share stories about his students, give us (me and Sonia) advice if we ever planned to go to medical or graduate school, and answer any questions we might have had. When it came to explaining, his ability to break down complex concepts into understandable terms made a lasting impression on me. Even though I wasn't in his class as a formal graduate student, I still got a glimpse of his teaching style, though it was mainly focused on laboratory topics. Going through the experience of working with Dr. Marr might change one's perspective on the lab and, most likely, lead

to a realization of the lab community's importance. Dr. Marr's lab provides an environment where learning is constant, questions are welcomed, and every contribution is valued. One will learn early on that it's normal to make mistakes, and as Mike once told me, "Re in research stands for repeat, as it's the biggest part of the lab". Due to a lack of prior lab experience, I was nervous about making a mistake or doing anything without double-checking every step, making sure I didn't miss a word in the protocol. However, all the anxiety had faded away after the end of the first week.

Dr. Marr's lab community underscores the importance of being part of a lab that prioritizes both learning and strong mentorship. No matter if the participant is a high school student exploring research for the first time or a medical student preparing for their thesis, Dr. Marr's lab is a place where everyone will get an opportunity for growth and will be treated fairly. I am incredibly grateful for this opportunity and excited to continue building on these experiences in my academic and professional journey.