"The invisible socioeconomic barriers to pursuing a research career."

Perhaps truer in STEM than any other industry is that breakthroughs require researchers to approach problems from unique perspectives. Innovation is powered by creativity and creativity thrives when the voices of diverse perspectives are elevated [1]. To foster this in academia, it's crucial to recognize the unique barriers some students face that may generate a research training pipeline that unintentionally selects students not for their academic talent or passion, but instead for their lack of said barriers. Importantly, many of these obstacles are invisible or unknown to faculty and thus, I recognize the importance to actively learn about them if I am to foster diverse perspectives in my research and curricula.

Personally, my challenge was financial; growing up low-income, it wasn't until I was in high school that my father completed his GED, and my mother earned her bachelor's degree. As the youngest of three, my parents were determined to see me be their first to finish college. The lack of financial resources and social capital, however, caused me to initially struggle due to not understanding the college credit system, being academically unprepared, feeling immense imposter syndrome, and balancing part-time jobs to pay rent. These challenges followed me into my postdoc where I realized that my parent's lack of financial stability and the need for me to help support them would make participation in the average 6-year length of a postdoc in the biomedical sciences unsustainable. Due to the invisible nature of financial instability, our current academic system can easily misinterpret lack of availability as a lack of dedication.

This concept has been foundational to my interests in making research training more accessible to first-generation and/or low-income (FGLI) students. Many of these underlying struggles are further exacerbated by implicit/explicit biases and cultural norms that are not always inclusive of students of color, people with disabilities, women, and those in the LGBTQ+ community [2]. Key to overcoming this is growing STEM social capital, fostering science identity, exposing students to the hidden curriculum, and introducing flexibility into the curriculum without sacrificing rigor. FGLI and other underrepresented students often lack "STEM social capital" so they don't have access to family or peer support systems with exposure in STEM [3]. Without an experienced support network, students are less likely to overcome the common challenges faced in the STEM classroom or lab [4]. Similarly, science identity which measures whether a student *feels* like a scientist positively correlates with retention and success and studies have demonstrated underrepresented students often have not had opportunities to cultivate it [5].

With this in mind, I have developed several programs, activities, and studies aimed at increasing these measures. My summer research experience includes peer-peer mentorship pairs and team-based science to cultivate community and grow their STEM social capital. I launched PennPORT Pals that matches underrepresented postdocs at the University of Pennsylvania with RUC undergrads to grow their mentorship network. By designing my research projects to be "bite-sized" with discrete end-goals that are feasible for an undergrad, I've increased my lab's accessibility while fostering ownership even in young students. In fact, we found that sending first-year students a Drosophila-based "lab-in-a-box" to complete a virtual research project on addiction in my "Neuroscience of the Opioid Epidemic" class increased their science identity [6]. Within the classroom, I write my syllabi without the assumption that students are familiar with standard college norms. This includes detailing how to navigate office hours, tutoring services, and study strategies for the particular course. Using backwards design when creating assessments of specific learning goals, I'm able to ensure students can clearly see the path to success which allows them to strategically navigate the challenges of the course while balancing other responsibilities. This can also introduce flexibility with deadlines and room to fail, improve, and ultimately succeed in mastering the material while not sacrificing the rigor necessary to have true comprehension of the content.

My interests in this space blossomed as an NIH K12 IRACDA Fellow where I trained as a researcher and educator to use best practices for improving DEIJ in biology. Working alongside Dr. Kwangwon Lee, we have developed the RUC MARC U-STAR Research Training Program specially designed to enable underrepresented students to thrive in their academics and research. We are currently seeking to expand the number of students who can participate in this program by transitioning to an NIH RISE grant that has more financial support. As finalists in the $2.5 million HHMI Driving Change competition, our efforts were awarded a $50K grant to facilitate an institutional self-study that will examine how we can make the RUC STEM culture more inclusive. We're currently meeting weekly to submit our final proposal this semester.

Given that RUC is now a federally designated Minority Serving Institution and that we have a large number of low-income students, its essential we design our curricula to consider the barriers, obstacles, and cultures that prevent academically talented students from fully participating or thriving in our research training environment. Given my sincere dedication to these efforts and years-long training in this area, I envision growing my research with an eye toward DEIJ so that RUC can become a leading institution for non-traditional students launching into research careers.

References

1. Hong, L. & Page, S. E. Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proc. Natl. Acad. Sci. U. S. A.* **101**, 16385–16389 (2004).
2. Asplund, M. & Welle, C. G. Advancing Science: How Bias Holds Us Back. *Neuron* **99**, 635–639 (2018).
3. Martin, J. P., Stefl, S. K., Cain, L. W. & Pfirman, A. L. Understanding first-generation undergraduate engineering students' entry and persistence through social capital theory. *Int. J. STEM Educ.* **7**, 37 (2020).
4. Cooper, G. & Berry, A. Demographic predictors of senior secondary participation in biology, physics, chemistry and earth/space sciences: students' access to cultural, social and science capital. *Int. J. Sci. Educ.* **42**, 151–166 (2020).
5. Stets, J. E., Brenner, P. S., Burke, P. J. & Serpe, R. T. The science identity and entering a science occupation. *Soc. Sci. Res.* **64**, 1–14 (2017).
6. Waddell, E. A., Ruiz-Whalen, D., O'Reilly, A. M. & Fried, N. T. Flying in the Face of Adversity: a Drosophila-Based Virtual CURE (Course-Based Undergraduate Research Experience) Provides a Semester-Long Authentic Research Opportunity to the Flipped Classroom. *J. Microbiol. Biol. Educ.* **0**, e00173-21.