Teaching Statement & Philosophy of Nathan T. Fried, PhD

"Student-Focused Experiential Learning Equitably Fosters Science Identity."

I almost dropped out during my first semester in college. I was the youngest of three from a low-income family and although my parents were determined to see me be the first in college, I felt ill-equipped and overwhelmed as I sat amongst my well-prepared peers. Unbeknownst to me at the time, much of my hesitation was due to my unfamiliarity with academia's hidden curriculum for success since my parents had minimal exposure to college norms. A string of mentors and early research experiences, however, fostered the confidence and "science identity" I needed to continue in academia and become a successful researcher and educator at a range of institutions. Looking back, I now understand how experiential learning and mentorship contributed to my persistence in science and the immense impact it can have on both traditional students and those from underrepresented backgrounds. **Fundamental to my teaching philosophy is that science identity drives success in biology, and experiential learning along with a sincere dedication to mentorship effectively fosters it.**

The first year of college is rather precarious for STEM students, especially for nontraditional students [1]. Even the best may experience self-doubt that can drive them out of biology or college altogether. Science identity, defined as whether a student "feels like a scientist", strongly correlates with retention and success by fostering a sense of belonging in STEM [2]. Cultivating science identity requires students to participate in science, either through problem-based learning or research experiences. However, many biology curricula rely on lecture-based classes devoid of active-learning. This is especially true for the first two years of college when retention is most unstable. Thus, experiential learning early-on is essential for developing science identity and arguably is the most effective intervention to improve biology retention and student success.

The development of science identity is even more vital to underrepresented minority (URM) students, first-generation and/or low-income (FGLI) students, and students with disabilities. In these groups, a lack of representation, financial stress, and the awareness/opportunity/achievement gaps decrease science identity and retention rates [3]. FGLI students, for example, often struggle with imposter syndrome on campus and alienation at home as they straddle dual identities in a transition through social classes [4]. On a very practical level, these students may find it hard to navigate academia's "hidden curriculum" which includes unspoken college norms such as effective study strategies, the definition of office hours, or how to convince a professor to accept you into their lab. These can decrease a sense of belonging and thus, decrease science identity. To equitably foster science identity, it's essential to approach mentorship and the development of experiential learning with a focus on the individual student, their challenges, and their needs.

The evolution of my focus on science identity.

Although I didn't know of the term "science identity" early in my career, I found myself trying to empower ownership of identities such as "scientist" or "biologist" in my students. Soon after graduating with my BS in biology, I began tutoring math and recognized that many of the students were not necessarily bad at math. Instead, they were struggling to overcome a fear of math. I would openly discuss this fear and frame it with a growth mindset by changing their "math identity" from someone who is "bad at math" to someone who would "eventually be good at math." Instead of math being something to quickly pass by, the students began to see it as a challenge to overcome. During my PhD, I started focusing on mentorship with the same goals of empowering student identities and co-authored a publication describing how graduate school could be enhanced by putting a stronger focus a one's ultimate career goals with student-focused mentorship [5].

It was during my NIH K12 IRACDA Penn-PORT postdoctoral fellowship where I first learned that what I was doing was known in discipline-based education research as "science identity". Given that the goal of this unique three-year, independently-funded K award is to develop faculty with equal interests in research, teaching, and mentorship, I found myself immersed in opportunities to cultivate how I nurture science identity [7]. As part of this program, I had two mentored teaching experiences at minority-serving partner institutions, Rutgers Camden (RUC) where I am now and Delaware Country Community College (DCCC). At RUC, I developed and taught a new neuroscience course focused on the basic science behind how chronic pain contributed to the opioid epidemic. At DCCC, I taught Anatomy & Physiology I.

In both classes, there was a wide range of student expertise; while some had extensive science training, others were still new to basic concepts. I approached this by focusing on my own identity in science. I openly contrasted how I was incredibly unprepared for college but regardless became an expert in my field. I urged students to recognize that they are all on the path to becoming biologists, but that some are further along simply because they've had more experience. On a practical level, I created teams for in-class activities that had a mix of students with different levels of experience and specifically told them to discuss their weaknesses and strengths. This helped them identify who had the most experience and created a culture where those students were resources for the others. This student-centered approach balanced my teaching by providing a means for the best students to refine their knowledge while helping the weakest. **With recognizing that experience was what separated mastery, I could encourage science identity independently of grades.**

Fostering science identity put into practice.

As an IRACDA fellow, I developed an interest in experiential learning and crafted a vision for a future faculty role where I could develop a successful research career entirely driven by undergraduates to generate an environment primed for cultivating science identity. Currently, I integrate experiential learning in three ways: 1) a personalized "course-based undergraduate research experience" (CURE), 2) a traditional research experience I've coined as "bite-sized authentic research experiences" (B-SARE), and 3) Problem-Based/Project-Based Learning that focuses on skill development.

In the CURE class, second-year students identify, develop, and carry out an independent research project of their choosing. We don't limit them to a specific organism or area of research, and we provide them with a budget for supplies. Unlike competitive research experiences where not all students are accepted, this course is open to any dedicated biology major. This unique experience not only fosters science identity, but also provides a research experience baked directly into the curriculum. This is especially important because many of our students have part-time jobs and can't volunteer in labs, as is traditionally done, to attain necessary experience for their post-graduation plans. To publish their projects, we created a peer-reviewed (Faculty & students) Rutgers undergraduate research journal, the Journal of Biological Sciences (JBS).

The origin of B-SARE evolved from my goal of integrating undergraduates into my research. To do this, I complement my rodent research with drosophila, a model organism very accessible to undergraduates, and craft studies that can be conducted on a semester-by-semester basis, forming the "bite-sized" component of the acronym. Importantly, these studies address a critical problem devastating our local community (the opioid epidemic) and so I find that students more readily take ownership of the work because they can actively engage their community with it. **When a professor promotes ownership of a project for a student, that research inevitably enhances science identity.**

In more traditional courses where research can't be integrated, I use problem-based and project-based learning to cultivate science identity. With lectures, I lean heavily on the Socratic method coupled with a well-organized framework of material. By engaging students with conversation, they move away from passive learning and take ownership of the material. I also integrate recent science news into all my lectures to give tangible examples of class material and turn them into team-based and problem-based exercises. In my neuroscience course, I complement this with teaching students how to use the Allan Brain Atlas and online MetaNeuron simulators. In my Communicating Biomedical Science course, students produce a range of products including live tweets of conferences, a script for a research study video, a news story for a Rutgers Biology Blog I created, and a document that can be submitted for a grant, paper, or REU experience. When a student knows the world will see their work, there's stronger buy-in that drives a product they are proud of. Importantly, experiential learning is not just conducting research. When a student develops a practical skill in their field, science identity can flourish.

In large classrooms, these activities are more challenging, so I've been studying ways to still foster science identity. This Fall, I've been collaboratively implementing a scalable "STEM-based nostalgia exercise" into a 100+ person course to study whether it increases science identity, especially for FGLI students [6]. Diversity in science heavily guides my teaching since experiential learning is especially beneficial for students who are URM, FGLI, LGBTQ, women, or have disabilities. Given this, I co-wrote a successful $1.2 million NIH T34 MARC-U-STAR grant, under the leadership of Dr. Kwangwon Lee as PI/director, and now serve as it's Assistant Director/Program Coordinator. This training grant provides tuition, research experiences, and a two-year stipend for underrepresented students so they can forgo jobs unrelated to their careers and instead focus on research training in preparation for PhD programs.

As a passionate educator with a successful research training background, I am uniquely positioned to expand the experiential learning opportunities for undergraduates with the goal of increasing science identity in an equitable way. Importantly, although I'm an educator and a scientist by trade, my foremost role as a professor is to be a mentor and it's this philosophy that drives my teaching.

References

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