

SPOTLIGHT: THE UNDERGRADUATE RESEARCH EXPERIENCE

What is your current position and how did you get to where you are?

I am **Julie L. Fenton**, an Arnold O. Beckman Postdoctoral Fellow in the Chemistry Department at Northwestern University, conducting research on crystalline porous polymers and their applications. I earned a PhD in 2018 from The Pennsylvania State University, where my dissertation research focused on synthetic methodology for inorganic nanomaterials, and I began my chemistry journey at Messiah College (PA), where I earned a B.S. in chemistry in 2014.

What made you decide to do research as an undergraduate student?

While I was vaguely aware of the importance of undergraduate research, I didn't immediately seek out research opportunities at the beginning of college. That changed after my first semester of general chemistry, when Prof. Rick Schaeffer (my academic advisor and the course instructor) offered me an opportunity to join his research group. I jumped at the opportunity. I started working in his solid-state inorganic chemistry lab shortly thereafter and didn't stop until I graduated, continuing for seven semesters and one summer term.

As an undergraduate researcher, were there particular incidents that stand out?

Between my junior and senior year of college, I had an opportunity to participate in a summer REU program, sponsored by the U.S. National Science Foundation and conducted in a solid-state chemistry lab at the Universite de Strasbourg (Strasbourg, France). Aside from the (substantial) adventure of living in a different country for a few months, this was a formative professional experience for me. Coming from a small undergraduate college, this was the first time that I worked alongside graduate students and research-focused faculty members, and had access to top-tier characterization facilities at a large university. In short – I loved it. I was excited to go to work every day and think about chemistry, talk about chemistry, and do chemistry research. I had planned to go to graduate school previously, but this experience gave me a clear understanding of what graduate school would entail and cemented my decision to apply and go after it.

How did undergraduate research play a role in your career choice?

Undergraduate research truly laid the foundation for my career thus far. While undergraduate coursework is obviously necessary and useful to build a base of technical knowledge, science in practice is not nearly as controlled as it is in an undergraduate lecture or teaching lab setting. It can be messy, experiments can fail, results can be inconclusive, and progress towards a goal can be a windy road. I learned how to participate in the real scientific endeavor by conducting (semi) independent research as an undergraduate. It was simultaneously the most challenging and the most fulfilling endeavor that I had ever embarked on – there was no guidebook, there were no recipes, I just had myself, my own hypotheses, and the guidance of my advisor to explore problems that didn't yet have answers. I made mistakes and things often didn't work the way I planned them, but all along the way, I learned, I grew, I developed stronger chemical instincts, and I got better. Pushing the boundary of knowledge (even in very small ways!) was incredibly exciting to me, and it still is, which is why I have continued in laboratory research settings through a PhD program and postdoctoral studies. The lessons I learned as an undergraduate researcher were invaluable as I progressed into graduate school and beyond.

Did you publish your research as an undergraduate, and if so how did that experience serve to encourage you?

Yes - during my REU experience, I discovered and characterized a new metal-organic macrocyclic compound. My REU advisor and I wrote up a manuscript with the results in my last week in the lab. The process of putting together the paper was educational, giving me new insight into how to transform interesting raw data into a narrative, complete with introductory text, comprehensible figures, and supporting information to bolster the conclusions. It was definitely a thrill to see our work and writing available in the journal several months later! While this was a very exciting development, I will point out that the vast majority of my undergraduate research was not published, but those other projects represented invaluable education to me as a developing scientist.

Any final thoughts?

To prospective undergraduate researchers: don't be afraid to fail. Research can be intimidating, and the only way to make it less intimidating is to get in there and give it a try (and sometimes, fail). You can learn a lot from experiments that don't go exactly as planned! If there is something that is interesting to you, explore it. Be curious, ask lots of questions, and if you can't find the answer, build the tools to answer it yourself.

To undergraduate research mentors: Don't be afraid to let an undergraduate researcher have some freedom to research (semi)independently. The very best thing my undergraduate research mentors did was give the latitude to figure things out on my own, to explore problems that I was interested in and passionate about, and to let me make attempts on my own (safely). Though reaching a conclusion may take longer, developing the skills to interrogate a problem, design an experiment, and troubleshoot the results is invaluable experience for a developing scientist, particularly for those who will go on to graduate school and continue doing research.

