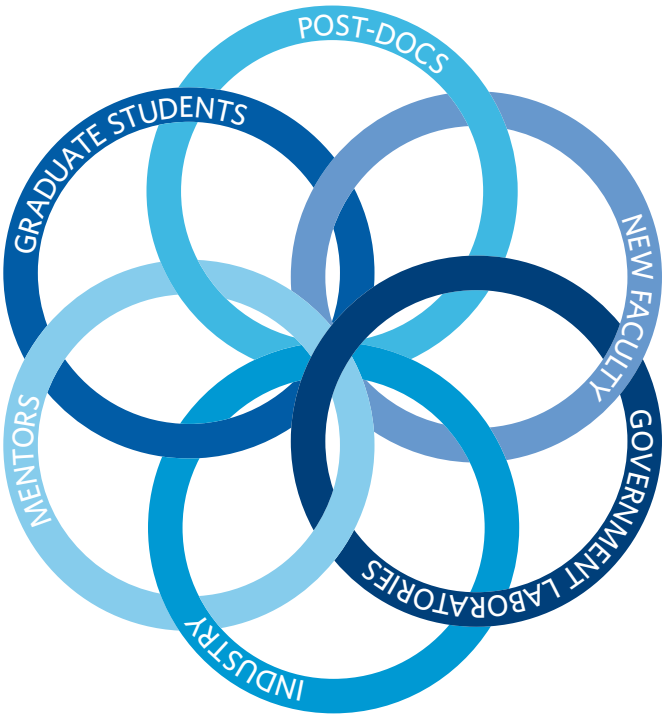
The Early Career Section offers information and suggestions for graduate students, job seekers, early career academics of all types, and those who mentor them. Angela Gibney serves as the editor of this section. This month we reprint five articles from the book *Living Proof*. Next month's theme will be about going online.



On the Path to Becoming a Mathematician: Perspectives from *Living Proof*

Hitting the Wall

Laura Taalman

Math was easy for me, until suddenly it wasn't. I suspect this is a transition that many people go through, some having a difficult time in high school and others hitting the wall in graduate school when they have to start doing serious work to succeed. I think sometimes people who hit that wall too late in their journey have trouble dealing with it because they never had to develop the necessary study habits and capacity for successfully handling "being stuck" without giving up. I was fortunate in that I hit this wall the minute I went to college and was somehow able to handle transitioning from the high school kid who was best at math to the dumbest, least-prepared kid in her calculus class.

I grew up in a small town of fewer than a thousand people, and at my high school, there were no calculus courses. I knew that I wanted to do math in college and that I wanted to test into the honors calculus sequence at the University of Chicago, where I was to be an undergraduate. So, I took a quick-and-dirty computational calculus course over the summer at a local college. Somehow, this was enough to allow me to pass the placement exam that put me in the honors sequence, so that's where I started in college. Of course, many of the other math majors passed out of calculus entirely and were starting out with honors real analysis, so for the major at Chicago, I was actually starting out on one of the bottom rungs.

In this honors calculus sequence, we used the book by Spivak—an insanely theoretical and difficult treatment of the subject. At the time it was a real shock to me. It was my first introduction to real mathematical thinking and proof. I had to work easily ten times as hard as everyone else in the class, literally. I remember spending every day working for hours to try to figure out the material and setting aside my entire Sunday—from when I got up to when I went to bed—every week to work just on this one calculus class. And even so, I was always the student with the dumbest questions and the most confused-looking face. I was barely hanging on for each homework assignment.

All excerpts are reprinted from Living Proof: Stories of Resilience Along the Mathematical Journey, *co-published by AMS and MAA, 2019. Available for free download from* https://bookstore.ams.org/lvngproof *and from* https://www.maa.org/LivingProof.

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Having to work so hard that semester and develop a thick skin for feeling stupid all the time in a math course really helped me in my career. I don't think mathematics was ever "easy" for me again after I got to college; it was always a struggle. College math courses were all hard, graduate school was hard, and researching and writing my thesis was hard, too. But at each step, it was a struggle that I loved working through. I didn't mind being stuck and feeling dumb. I knew I could get through it if I kept plugging away. In today's language, I would say that I was lucky to have formed a "growth mindset" about learning math—I was willing to work on hard problems to find success—rather than a "fixed mindset," where I judged myself harshly when I didn't know something. To this day, I still benefit from this mindset, and I've basically made a career out of trying new things that I don't know anything about. It's in the process of making mistakes and figuring out how to make progress where the real fun begins.

Laura Taalman

Credits

Author photo is courtesy of Laura Taalman.

The Unnecessary Struggle of Self-Mandated Isolation

Alicia Prieto-Langarica

Graduate school is hard. Most people will agree with that statement. However, what makes graduate school hard can vary from student to student. I was very fortunate to be immersed in mathematics from a very young age. I was a participant in the Mathematical Olympiad since the age of thirteen. Throughout my time at the Olympiads, I was exposed to formal mathematics, the kind that one learns in most undergraduate programs. The Math Olympiad training sessions were demanding and many times very hard. After high school, I was admitted to one of the most intensive programs in mathematics in my home country of Mexico. The kinds of classes I was taking there look a lot more like graduate-level classes in many other institutions. So when making the transition to a mid-level PhD program, everything seemed to indicate that the struggle had passed.

I was lucky to be able to pass the first two preliminary exams before starting my PhD program, which allowed me to start doing research during my first semester for the first time in my career. Research is so different from classes. During my first research meeting, my advisor and his collaborator started describing a program that would act as a simulation for a biological system. They talked among themselves and discussed what they expected the program to do and how the simulations should look. Then my advisor turned to me and asked: Do you have any questions? I realized then that *I was supposed to come up with this program*!

Since I had never done research, I had a million questions, but I asked nothing. I nodded and went to my office. It was a Wednesday. In my mind, I convinced myself that research was like class, so when given an assignment, one has a week to complete it. That's how it works, right? The only problem was that I had never programmed. I wasn't even sure what "Matlab" looked like or where to find it. So, as a lot of people my age were starting to do at that time, I asked Google. I did not sleep too much that week. I spent 12–14 hours every day in front of the computer trying to teach myself how to program so I could turn in my "assignment" on time. I questioned all my life choices and wondered whether I was cut out for this.

I tried and tried and by the end of the weekend, I had nothing good. Since I had taken this as an assignment, I assumed I could not ask anyone for help and that my advisor had assigned this work because I was expected to be able to do it. You would think that since I was doing well in my classes I would not question my capacity, but you would be wrong. Impostor syndrome has wonderful ways of sneaking up on you when you least need it. It was a very long and short week. I cried a lot and worked a lot. I made a lot of mistakes that week, but none greater than isolating myself. Neither my friends, professor, family, nor my then-boyfriend knew I was going through this. I was too ashamed to admit that this was hard, and I was struggling.

By the next Wednesday meeting, I had a very terrible version of what my advisor and collaborator had been describing—pretty much a cartoon of what they wanted. I was so ashamed and nervous to show the program to my advisor. I was sure he was going to drop me as a student. Much to my surprise, when I presented my progress, they were both impressed and told me what I could change to make it better.

I have learned since then that research is not like a class and that research progress is just that: progress. It's not an assignment that you are supposed to finish from week to week. But more importantly than that, I have learned to ask for help, to admit when I am struggling, and to lean on my

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