FACES OF MASS SPECTROMETRY / Theresa Evans-Nguyen

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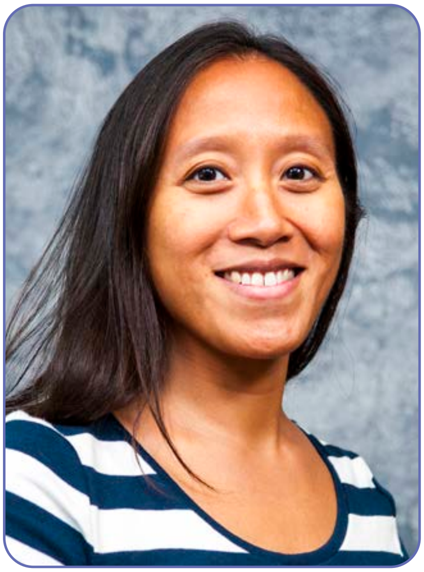


Mass Spec Gone Cosmic

Stepping up to a podium and gazing out into a room filled with 150 to 180 expectant student faces was not something that Theresa Evans-Nguyen predicted she would ever do. Delivering talks about analytical chemistry was not part of her career plan, but Theresa's lifelong love of learning and enthusiasm toward her subject channeled a new course. Theresa transitioned from industry work to teaching in 2015, when she became assistant professor in the chemistry department at University of South Florida.

Intent on making a connection with the many students in her classes and "stretching beyond the technical stuff," Theresa has adapted her communication skills, using relatable language, humor, and Harry Potter-themed lab sections as needed, to get undergraduates hooked on science and to be a motivating mentor to graduate students.

The homepage of the Theresa Evans-Nguyen Research Group displays a person surrounded by a gigantic night sky lit up by celestial bodies. The image is symbolic of the broad and exciting expanse of the group's mission—"to explore strange new worlds." And who better to lead the mission than Theresa, who has extensively investigated our solar system through her mass spec work and who, to this day, is intrigued by even simple technologies that might be applied to astrobiology studies.

While teaching has been one of Theresa's most significant challenges, it has helped her become a vibrant and engaging scientist who knows how to have fun and find new ways to educate, inspire, and lead others.

How did you get your start in the mass spec field?

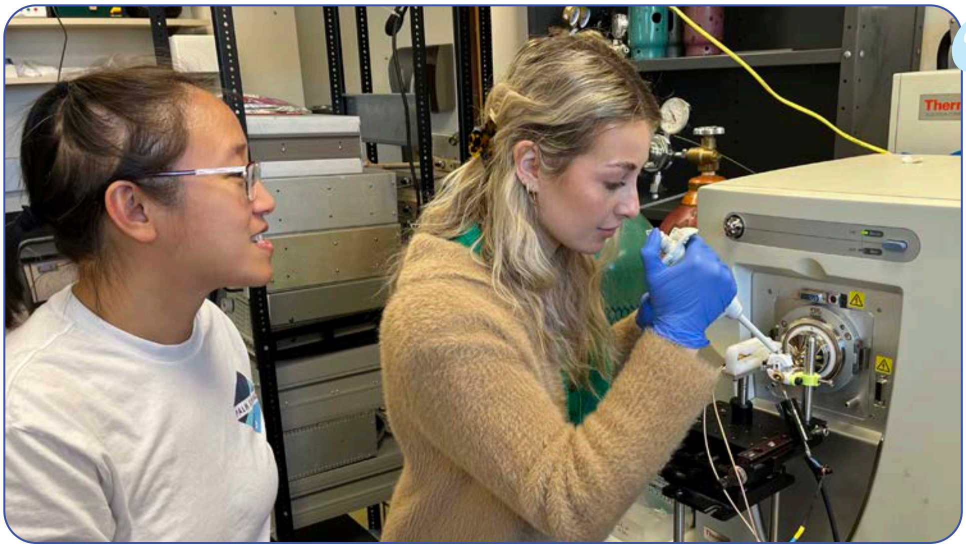
I got started in graduate school. I just knew that I liked analytical chemistry, and I thought that building things was neat. I was going to build electron paramagnetic resonance instruments, but mass spec seemed cooler. So, I ended up switching out of that group and joining the physical chemists. I started by building an aerosol mass spectrometer, and from there I went and worked for Bob Cotter. I was doing my postdoc, and it was supposed to be amending the same kind of instrument, so it just became a lot of building.

When and how did you decide that you wanted to focus on teaching?

That was a total twist. At first, I didn't even want to go into academia—I thought that was a crazy idea. My husband is in academia, and he was set on teaching primarily undergraduates. He had this vision, from very early on, and I thought at first that I'd want nothing to do with it. He had gotten a faculty position at the University of Tampa, and I started working for a biomedical engineering company called Draper Laboratory, which had a startup feel. There, I learned some engineering practices, but they also did the type of work that was very adjacent to academia —DOD contracts and such. Then, after about six years, very fortuitously, they had an opening at USF for an analytical chemist. My husband told me I should apply for that job, but I still had no desire to teach—I just thought I was a bad teacher! But I applied for the job, interviewed, and they made me an offer. But one of their hesitations was when they asked me, very specifically, how I felt about teaching. I just said, "I don't know. I'm scared. I don't know what I would do."

How have undergraduate students responded to hands-on learning?

It was funny, because everyone had told me, "Teaching is really rough your first time out of the gate. You don't know what the students know, because it has been so long since you've been in their shoes." Sure enough, some of the comments evaluating me from my students were harsh. But as time went on, I really began to enjoy the students—it was always fun to try to figure out what they didn't know. And they are always so bright-eyed and bushy-tailed, and excited about their stuff. I enjoyed teaching because it reinforced what I was learning—I really liked learning this stuff, and it was as if I was relearning it all. Teaching was definitely a progression, and I never felt super comfortable with it. But I found it was a challenge to overcome—putting science



Theresa with student Ashton Taylor working on their latest project using custom ambient ionization sampling source.

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in people's brains. Just trying to make the subject matter fun and interesting to the students is always a challenge.

How has mentoring students of different levels from high school all the way up to the graduate level helped you grow and develop as a scientist?

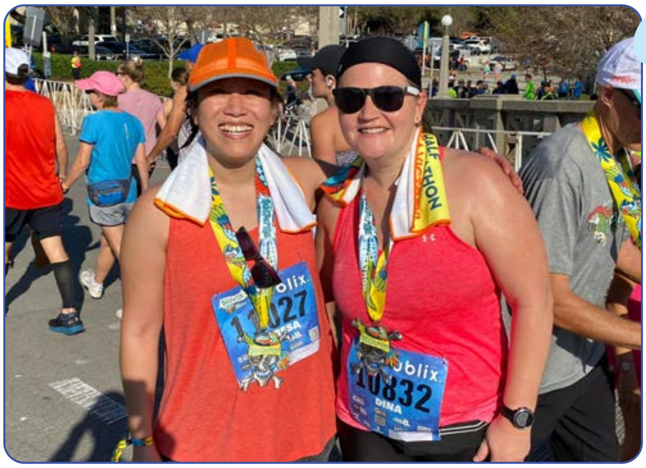
It helped me to be more cognizant of where students are. You have to know where they're coming from and what their level of understanding is. Drawing lots of analogies is always, I think, the most useful thing. Not everyone is like me, and that was a hard thing to recognize. It's weird, because it doesn't feel technical at all. It's about relating to people and using these soft skills that aren't explicitly taught. In a way, it's almost like parenting, because they're not necessarily going to listen to me. Maybe I'm telling them, "Well, in my experience, this and that," but I must realize that people haven't always had the same experiences as me. I get reminded of that constantly. It definitely stresses to me that you have to adapt your communication, which ends up being one of the more important skills you need to develop as a scientist. It's not fun to realize that you're not communicating concepts well—it's very humbling, but so important.

What was an impactful experiment to introduce students to real-life applications of quantitative analysis techniques?

We had this experiment affectionately known as the "drunk cow experiment." I had a collaboration with the medical examiner's office, and they regularly looked at blood alcohol content. That's always a fun thing to think about: forensic application. We spiked ethanol in some cow blood and had the students do the workup of the sample prep, where they were trying to calibrate it, and they did a headspace analysis of the alcohol that evolved from the blood. The joke was, "Was the cow drunk or not?" It's a very common assay, and we took it from the medical examiner's office and reworked it so that we could make it work with the students. Another experiment was measuring some essential oil content. That's also always fun because there's a memory component to things like smells. We thought that would be a neat thing for students to do in the analytical lab. So, we put together those two GC-based experiments, and we wrote a journal article for them.

When and why did you decide you wanted to focus on mass spec as it relates to astronomy?

That's something that I just fell into. I was doing applications and atmospheric chemistry in grad school because we were building this aerosol mass spectrometer. It had a lot of parallels with Earth and Space sciences. When I went to do my postdoc, I was doing a similar thing, but I didn't necessarily really care for the atmospheric or environmental chemistry - -mass spec as it related to space seemed to capture the imaginations of more people. While I was doing my postdoc, my boss (Bob Cotter) received funding for a NASA project. It used a different kind of ion trap instrument, and I just barely understood the principles of it. But the purpose of the instrument was to look at organic molecules on Mars. This was an early planetary instrument development program for NASA, and we put it together with the Applied Physics Lab. I learned so much from it, and the whole thing got me thinking about space - - it just never seemed like something that affected me. But I thought the instrumentation was for me, and I started to appreciate the bigger aspects of it. As a scientist, I'm used to staying in my lane, but this really did spark my interest—the origin of life is a huge scientific question for humanity. Exploring space and answering questions about the origins of life were just far more attractive than thinking about, say, bio warfare agents. Once I finished my postdoc and started working at Draper, they had designed the guidance and navigation control systems for the Apollo missions. But it was just when I started this job at USF that I really started trying to do more space stuff. It's inspiring to me to think about problems in space that we could solve as instrumentation analysts. Learning more and more about space, mass spec, and instrumentation—and even going beyond that and thinking about analytical chemistry, general analytical chemistry, and instrumentation—has been like a rabbit hole. I keep learning about more and more different technologies as they're developing to answer these bigger questions about life. It's just neat to see how we're throwing out an arsenal of our technologies to answer these big picture questions.



Theresa (left) with student Dina Swanson before running the local Gasparilla Half Marathon.

> *Being Vietnamese, I was very self-conscious about speaking out or doing anything until I got into a job where I saw students who I wanted to support, and I wanted them to feel like this was their potential career path. With not only Asian students, but any minority students, I sympathize and understand their situation.*

How has mass spec helped us to better understand our solar system?

We have sent mass specs to various places. For instance, the Cassini-Huygens mission to Titan in the early 2000s was a huge success. They were looking for organic nitrates, because that is in Titan's atmosphere. They sent a mass spec to Venus as far back as 43 years ago when they also sent this one type of mass spec based off what they call the "cosmic dust analyzer"—they're literally banging the spacecraft into this piece of dust. The spacecraft is going 7000 meters per second across a plume that's coming off Enceladus, which is a moon of Saturn. Just by impact ionization, they see all sorts of inorganic species. I feel like Mars has gotten unfair attention, largely because it's easier to get to Mars. But there's a new mission that just got approval last year that's going back to Venus. Sadly, it will only operate for the few hours it takes to descend from the top to the bottom, because Venus is very hostile. It is very different from what you see on Mars where these instruments can go for extended missions. You just can't get too attached to the single-use instruments.

How has your Vietnamese heritage influenced you in your life and work?

As far back as when I was growing up in Richmond, Virginia, we were the only Asians in our school up through probably middle school. It's sort of isolating when you don't have that community around you. There were other Asians at our Catholic church, and when I got to high school, my best friend was Chinese, but I was always, and still am, very aware of my minority status. You have, of course, all the stereotypes of Asians, so people always think you're going to be a doctor, and I had all that pressure as well. I think I very quickly disappointed my parents, because I was not going to be a "real" doctor. But I just thought to myself, "I'm good at chemistry, so I'll just keep doing this." It was nice to be challenged. I think I failed my first chemistry test in high school, so that was the first time I had to work on something. And I never had any real role models in that arena, so I never thought of it as a potential career. It makes me much more aware now of my influence on students as a minority representative. Sure, there are tons of Asians in science, but not necessarily second-generation immigrant Americans. So, in that sense, my status there just makes me super self-aware of my "otherness."

What has been a significant challenge of your career?

I was very self-conscious about speaking out or doing anything until I got into a job where I saw students who I wanted to support, and I wanted them to feel like this was their potential career path. With not only Asian students, but any minority students, I sympathize and understand their situation. While I can't necessarily know exactly what they're going through, I realize that they're experiencing many of the same things that I experienced in terms of being overtly aware that you're very different from everyone else around you. It makes me think about how I can support them and show them that they can do this. That really keeps me going—having that representation for those students. I feel like, to some degree, it's a responsibility for me.

How has your group applied mass spec to the defense sector?

We are continuing a project with nuclear forensics. When you're working with chemical warfare agents, they are a little tough to obtain, but methyl salicylate, for instance, is reasonably common. Still, with any contentious chemicals, there are a lot more things to worry about. If something is radioactive, you must inform EHS and have protocols for how you're operating things, and you must find proxies. The reason I know about the methyl salicylate is because when I was at Draper that was the proxy we used. With contentious chemicals, I don't want to accidentally expose students. I joke with my students by telling them, "To keep me out of jail, please make sure that you do things safely." You hear enough horror stories that freak you out. It is a weird concern, especially with students who are training.

What are some of your interests outside of the lab?

I recently started running and am actually training for a half marathon. I also enjoy cooking and eating; I have a friend who is an organic chemist, and she describes organic chemistry like cooking, with the way you make things. I especially love trying to cook the Vietnamese food from my childhood. I'll call my mom for her to tell me how to make something, and I've been successful with a few dishes. With my kids being young—my daughter is 6 and my son is 10—there's not a lot of time to do things that I used to think were fun, like just relaxing and watching TV. Maybe when things settle down and my kids are a little older, I can get back to that. Right now, though, I guess you could say one important hobby is parenting!