# FACES OF / MASS SPECTROMETRY / Callie Cole



Anne Brenner is a science writer at Technica Editorial Services

May 2023



## Learning from the Best

From a very young age, Callie Cole has had the opportunity to learn the ropes as a scientist—and, specifically, as a female making her mark in the science field—from some of the top names and faces in the business. As a young child, she learned from her grandmother, a successful science teacher, who provided mentorship to many generations of students. Later on, as she pursued her Ph.D., she was immediately drawn to the natural teaching abilities of Dr. Veronica Bierbaum, who heavily influenced her eventual area of expertise within the mass spec field.

Yet Callie still realizes that not everyone has the luck, or the privilege, to gain access to such influential mentors—and that is why she strives to serve a strong mentorship role for those who need it. She has especially made efforts to promote diversity, equity, and inclusion in her work, paying close attention to the curiosity-based questions from students with all different types of backgrounds.

Working at Fort Lewis College—an institution with a diverse student population—has made Callie acutely aware of just how exclusive the science community can be—and she has made it her mission to change that. "I'm proud to be part of an institution that is bringing an end to the exclusive, ivory tower approach to higher education," she says. "Everyone is welcome here."

#### How did you get your start in mass spec?

The very first time I saw a mass spectrometer was during my first work study job at the Montana State Crime Lab in Missoula, MT when I was 19. I was mostly filing evidence and cleaning glassware for that job, but I was really interested in the instruments surrounding me in the forensics lab and how they worked. It wasn't until Dr. Chris Palmer at the University of Montana offered to mentor me in his analytical lab at the University of Montana that I got the opportunity to use a mass spectrometer for the first time, and I thought it was absolutely fascinating. I recall I had a chance to use a GC-MS with a single guadrupole and an LC-MS with an ion trap when I worked with Chris. We were looking for urinary biomarkers of woodsmoke exposure. As a kid who grew up in a home that used exclusively wood heat, I was really interested in the health outcomes of increased wood smoke exposure. It was a perfect project to get me hooked on mass spectrometry, because it involved quantitative analysis that was directly tied to an issue important to the health of those I love.

#### What was the focus of your Ph.D. work at the University of Colorado Boulder? Does it align with your current focus in mass spec?

When I arrived at the University of Colorado Boulder, I wasn't sure how I wanted to focus my work. I only knew that I wanted to use mass spectrometry in some capacity. Dr. Veronica Bierbaum was teaching general chemistry at that time, and I had the opportunity to TA for her and sit in on her class. The first thing that drew me to Veronica was her absolute mastery of teaching. I knew I wanted to learn more from her as I watched her perform thoughtful and educational demonstrations in class. She made general chemistry fun! When I toured her research lab and got a peek at her homebuilt flowing afterglow selected ion flow tube mass spectrometer (FA-SIFT-MS), I knew I'd found my home. I ended up working with the FA-SIFT-MS as well as an ion trap mass spectrometer that I modified in Veronica's lab to study ion-neutral reaction kinetics and mechanisms that are relevant to the interstellar medium. Switching from urinary biomarkers to astrochemistry and employing very similar instrumental techniques served to drive home the importance of mass spectrometry to me.

During my Ph.D., I really came to understand that mass spectrometry is a technique with enough versatility to address any scientific topic that I became curious about throughout my chemistry career. So far, I'm not wrong about that! Currently, I'm applying mass spectrometry with my undergraduate research group at Fort Lewis College to study the biotransformation of hops natural products during the brewing process. My students and I are working in collaboration with Ska Brewing Co., whose world headquarters is located here in Durango,

## FACES OF MASS SPECTROMETRY



I am doing my small part to change the field of mass spectrometry by training undergraduate students who express interest and curiosity in research and helping them to feel welcome in the mass spectrometry community.

> On the right: Callie Cole in her teaching laboratory at Fort Lewis College. She teaches general chemistry, analytical chemistry, instrumental analysis, and senior research courses. On the left: Callie's grandmother, Lois Schaaf, who is one of her biggest mentors. (Photo courtesy of Callie Cole.)

CO. Our current project is funded by the American Society for Brewing Chemists, and we are employing headspace solid phase microextraction gas chromatography mass spectrometry to profile the aromas of various hopped beers to better understand hops biotransformation. Through this project, my undergraduate students gain experience in sample preparation and instrumental analysis, and a local brewery gets meaningful information to guide their brewing process—it's a win-win!

#### Was the high enrollment of multicultural and Native American students a contributing factor to your decision to begin work at Fort Lewis Collage?

In August 2014, I drove from Boulder to Silverton, CO and backpacked into the San Juan Mountains. It was love at first sight. The mountains and alpine lakes reminded me of where I grew up (Sandpoint, ID). When I got back from that trip, I started doing Google searches for small colleges on the western slope of Colorado to see if any positions were open. I couldn't believe my eyes when I found an open analytical chemistry position at Fort Lewis College. At that point, I hadn't begun writing my Ph.D. thesis yet; I didn't feel ready yet. My thought process was: What do you have to lose? Just throw your hat in the ring and see what happens. I'm sure glad I did—that's when I started learning all about Fort Lewis College's mission and how it aligns with my own.

Above all, Fort Lewis College focus on inclusivity was a big draw for me. Since the moment I arrived on a college campus as an undergraduate, the exclusivity of higher education was palpable to me, despite the many privileges that I already had going in. For one thing, everything cost so much money, and all these fees came as a surprise to my 18-year-old self. I was a waitress when I started college, and those tips only went so far. Textbook prices were exorbitant, and they still are (which is why I've removed them entirely from every course I teach). It was because of the Pell Grant and scholarships that I was able to attend college. I always wanted to work at a school that cared about the students for whom college was not guaranteed or easy. A core value of Fort Lewis is being student-centered. Our tuition is lower than most colleges in Colorado, and we provide a Native American student tuition waiver. Our student population is diverse, with 185 tribes and Alaska Native villages represented on campus, 58% students of color, and 46% first generation students. I'm proud to be part of an institution that is bringing an end to the exclusive, ivory tower approach to higher education—everyone is welcome here.

#### We understand you served as the Chemistry Instructor for the CU Upward Bound Program to mentor high school students; how did this help you as a scientist and a mentor?

A pivotal moment in my early career was having the opportunity to work for Tanaya Winder and the CU Upward Bound program that she directed. During the summer, I taught chemistry as a part of a six-week program geared toward giving high school students living on reservations a glimpse into college life and connecting them with the resources necessary to access higher education. It was a very fun and meaningful experience for me, and I loved the students. We ran together in the mornings as part of a little running club. Then, we would meet in college classrooms and learn chemistry together. I had only been a TA before this experience, so it was my first time ever designing chemistry curriculum myself. I incorporated demonstrations, games, videos,



and simulations. It was the connections with my students and the joy of teaching CU Upward Bound that really solidified what I wanted in my future career.

#### Who was your own biggest mentor?

I certainly can't talk about my work in sciences without talking about my grandmother, Lois Schaaf, who had a long and illustrious career as a science teacher from the 1950s until the 1980s, teaching biology, chemistry, and physics. Her career spanned multiple schools across rural Nebraska: Beemer, West Point, and Stuart. She currently lives in Nebraska on a farm and will be 97 years old this year! She pursued, and was awarded, National Science Foundation (NSF) funding as a high school teacher, and she got a master's degree back in the 1960s, long before it was typical for women to do so. She ended up getting one of her students' experiments launched on NASA's Skylab in 1973 at Kennedy Space Center. She and her student attended that launch, and that was a huge moment for her career. She's still regularly visited by her former students, and they still write to her, which illustrates the huge impact she had on them. Her stories of these NASA experiments invariably influenced my decision to study astrochemistry for my Ph.D., which was also funded by both NASA and the NSF.

Callie enjoys exploring the desert around Durango, CO during her free time. She loves to camp with friends, trail run, and hike in the Four Corners region. (Photo courtesy of Callie Cole.)

During my childhood, whenever I visited her farmhouse in Nebraska, she had tons of NASA posters up on the wall, and she'd tell me hilarious stories about her classroom—things like a snake escaping in her classroom or her whiskey barrel that she used to collect frogs for dissections. She would offer a nickel to any student who caught a frog and added it to the barrel! The best part about her approach was that it was completely based in curiosity-whatever got the students excited. That's kind of what I keep trying to do in my career: keep my research focused on curiosity-driven questions. I have my grandma to thank for that-I just realize how privileged I was to have her to look up to from a very young age, as a female making her mark in the sciences. My grandma demonstrated to me that women are excellent scientists before I had the chance to hear any contradictory story from the outside world; she taught me that science is for everyone! But not everyone has that kind of privilege, so my goal is to try to fill that mentorship gap and promote inclusivity within the field of mass spectrometry—I really want to provide the same mentorship to others that I have been so lucky to have in my own life.

#### How has the mass spec field benefited from your work with disadvantaged minorities and those with learning disabilities and special needs?

In order to be effective and sustainable, diversity, equity, and inclusion efforts require the consistent work of many people throughout an organization and community, at every level. I am doing my small part to change the field of mass spectrometry by training undergraduate students who express interest and curiosity in research and helping them to feel welcomed in the mass spectrometry community. I am one small cog in the wheel, and I contribute everything that I can to the effort. I have heard too many stories about folks feeling excluded, left out, or isolated when attempting to enter the field of mass spectrometry. I have also felt these feelings, but to a much lesser degree than those in my mentors' generation. All we can do is take small steps every day to change things. I am hopeful that although change is sometimes excruciatingly slow, we are making progress by opening doors for future scientists of all backgrounds.

#### We understand you were the recipient of the 2019 ASMS Research Award from Agilent Technologies, along with the 2019 Undergraduate Analytical Research Program Award from the Society of Analytical Chemists of Pittsburg (SACP). What achievements were recognized by these awards?

I am so grateful to both ASMS and SACP for funding undergraduate research. Both of these awards contributed greatly to launching my students' careers in medical school, graduate school, and positions in industry after graduation. They were for mass spectrometry research in different areas. The ASMS award recognized my research in astrochemistry using a modified ion trap mass spectrometer to measure ion-neutral reaction kinetics. The SACP award recognized my new undergraduate research program in fermentation science using headspace solid-phase microextraction gas chromatography mass spec. Currently, my research group is funded by the American Society for Brewing Chemists (ASBC) 2023 Project grant to monitor volatiles during brewing. My students and I have really enjoyed applying mass spectrometry to explore these diverse research questions.

## What are some of your interests outside of the lab? Do they include any service activities?

I love science that engages the whole community. Outside of the lab, I've had the opportunity to serve on the Board of Directors of the Powerhouse Science Center for the past year. We are working to cultivate and support a community of curious young scientists in the Four Corners region. As a part of this work, I recently volunteered to judge the student projects at the San Juan Regional Science Fair, and I loved seeing the creative experiments and measurements that the middle schoolers and high schoolers in our rural community are working on. Before the COVID-19 pandemic hit, my Fort Lewis College students and I designed a Homeschool Chemistry curriculum that we implemented at Powerhouse Science Center so that kids in the community could get a chance to try some of our favorite hands-on experiments as well. In general, my favorite service activities involve getting kids excited about science.

My favorite things to do outside of community engagement and mass spectrometry are centered around being outside. I was lucky enough to win the permit lottery for a private Grand Canyon rafting trip that is launching in a couple of weeks, and I am really looking forward to some time away from screens to unplug and just soak in the beauty of the desert. The San Juan mountains still have my heart—skiing in the winter and trail running in the summer are my favorite mountain activities that keep me centered, happy, and calm. During COVID-19, a very cute and persistent orange cat kept showing up at my door begging for food, and I eventually caved and adopted him. His name is O'Malley—it's nice to have a cuddly cat to relax with between adventures and experiments!

