11-16-2020

Challenges Facing Young Scientists in Academia and Industry in the United States from the Lens of a Millennial Academic

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Chemistry – A European Journal, Vol. 26, No. 68 (November 16, 2020): 15759-15762. DOI.

Challenges Facing Young Scientists in Academia and Industry in the United States from the Lens of a Millennial Academic

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Abstract

Rising to the challenge: Pictured from left to right: Salma L. Nuñez, Albert Reyes and Lisandra Santiago-Capeles, Ph.D. The challenges that young scientists face in academia and industry in the United States are discussed. Prof. Joseph Clark provides insight about how social media, funding, diversity, natural disasters, COVID-19 and student loan debt are impacting young scientists. A discussion of strategies to meet these challenges and support young scientists are presented.

Introduction

Growing up, my grandmother would sometimes call me a “worry wort”, because when I learned of a new problem facing society, I became fixated on finding a solution. My grandmother was a strong figure in my life who always provided sound advice at the right times. She survived childhood in Frankfurt, Germany, during WWII and eventually immigrated to the United States in 1945. Her war time accounts of living in constant fear with hunger so intense that she couldn't sleep, shaped her grounded outlook on life. Although she passed away several years ago, her advice to be patient and not worry too much still echoes in my head, especially now as I serve as an assistant professor of chemistry.

I was raised in suburban upstate New York as part of the millennial generation and believe my life parallels the lives of many millennials in the US.[1] I am single, do not have children or own a house. I own a smartphone and have Twitter, Instagram and Facebook accounts. I am also burdened with a significant amount of student loan debt.[1, 2] I consider my tenure-track faculty position at Marquette University a significant personal achievement and feel enormous gratitude to my family and former advisors. I recognize the incredible opportunity I have been given. From a humble voice of a “worry wort” and through the lens of my own journey and experiences, I offer a unique perspective of the challenges facing millennials in science. I will address challenges within our field in the hopes of facilitating the success of future generations of young scientists.

Career Options

Industry

When meeting prospective graduate students, I always ask about their career goals. Industry jobs are attractive to incoming graduate students likely because of the perception of many that industry offers a higher salary and a regimented work structure. There are also many more job opportunities available in industry relative to academia. Industry positions can range from pharmaceuticals to agrochemistry, food chemistry, cosmetic chemistry, commodity chemicals, oil and gas, and many others.

Applying for jobs can be an overwhelming and formidable challenge for graduate students. A lack of call backs or interviews that don't lead to job offers are common. If you are facing these challenges as you approach your PhD or master's defense, it is important to recognize there are several steps you can take to better position you for landing the right job.[3]

If the option is available, do not be afraid to stay in graduate school an additional six months or one year to publish a manuscript, network and practice your job talk. Keep an open mind about different types of positions and heed the advice of your mentor.[3b] If you are able to secure your dream job because you extended your PhD six months, this is a huge success. You will avoid the possible regret from settling for a position that is not a good fit. Alternatively, consider a postdoctoral position to learn a new research area and perfect your skills as a scientist. Postdoctoral training could help you reach your career goals by making you more competitive for the

right industry position.[4] However, anyone considering this path should be sure they have reflected on whether postdoctoral training is in their best interest.[5]

When I began graduate school, I was in a hurry to graduate and find an industry position. Looking back, graduate school was the best time of my life. My advisor, Professor Steven Diver at University at Buffalo taught me how to become an excellent experimentalist and project leader. He invested significant time in my training and encouraged me to consider postdoctoral research instead of rushing into industry. From there, I was fortunate to join Professor Christina White's research group (University of Illinois, Urbana-Champaign) as a postdoctoral researcher and was enamored by her enthusiasm for tackling frontier problems in chemistry. Professor White developed my ability to think deeply about solving impacting problems in chemistry and provided excellent mentorship to enhance my grant writing abilities.

Academics

It is no secret that public funding for science is being threatened[6] and grant support is very competitive, especially for young faculty.[7] Yet, as a society we rely on scientific research to positively impact our daily lives. Consider how this pandemic has taught us the importance of funding scientific research from a human health perspective. Professor Jen Heemstra from Emory University tweeted concerning the coronavirus, “A year ago, if you read about government funding being used to measure the velocity of a sneeze, it would have been tempting to call it wasteful spending. But, much of this seemingly wasteful research is now saving lives.”[8]

Like many research groups, my team performs fundamental research. We develop new methods to install deuterium into small molecules, not knowing if or how this will be used in applied research to positively impact human health. Aside from the measurable societal impacts, our work involves training future young scientists and healthcare professionals to perform research in preparation for impactful careers in chemistry and medicine. Shouldn't this alone be enough to justify more funding for science?

The challenges associated with securing tenure can oftentimes feel insurmountable. The three categories commonly evaluated for tenure are teaching, research and service. Among these categories, research and securing research funding is becoming the top priority at many PhD granting institutions.[9] This has led to young scientists spending an enormous amount of time preparing multiple major grants per year. Now, young faculty spend less time mentoring and performing experiments with their students. The intense pressure for faculty to secure federal grants compromises the risk-taking and creativity necessary for new discovery.[9] Bottom line, increasing the budget for science will have a direct benefit to society and allow more young faculty to tackle high risk projects with a focus on publishing their findings instead of writing multiple major grants.

I am beginning my third year as an assistant professor and learned quickly that senior colleagues will offer many pieces of advice about grant writing, publishing, teaching, mentoring and recruiting. It is important for you to listen and choose to do what you think is best. Sound advice I received was to seek out mentorship from an organic chemistry senior colleague on how to write a syllabus and exams. I was also told to ask if I can adopt their course notes for my section. The first course I taught was Organic Chemistry I for Majors. I quickly recognized that organic chemistry is a course that senior colleagues have perfected teaching over decades. If you are timid about asking for course notes, you should understand that most senior colleagues will likely be flattered at your willingness to adapt their notes for your class, while adding your own personal flair to them and developing them further over time.

Education and Technology

Student loan debt

With the increasing number of students attending college, a major challenge that not only faces young scientists, but many recent college graduates, is and will continue to be student loan debt.[2] I am among the generation of students who faced tuition increases that exceeded the relative to cost-of-living inflation during my undergraduate years (2004–2008).[10] Tuition increases continue into the present era and the rising cost of education does not seem to be subsiding anytime soon in the United States as most state governments continue annual cuts to the amount of money spent per college student.[11] Aside from the obvious point that states should invest in educating their population, I will not pretend to be an expert on how we can solve this crisis. However, I recognize that this is a major challenge we face in promoting education and training for our future scientists. One recommendation I have for students entering college is to consider the possibility of early graduation. Although this option is not available to everyone, early graduation is a trend that I see among students I mentor at Marquette University. A way to prepare for early graduation in the United States is to take advanced placement courses in high school and to enroll in summer courses at a local community college during your undergraduate years. Although there is a cost per credit hour associated with enrolling in a summer course at a community college, it is usually less expensive than credit hour prices at many four-year colleges and institutions.

Smartphones in the classroom

Smartphones are changing everything in education; they are now commonplace and allow people to connect at any time. Having the ability to post or see the posts of other friends at any time is a game changer in so many ways. As a young scientist, I immediately recognized the challenges that smartphones present for a professor. Students are constantly distracted by social media and texting. They no longer interact face-to-face in a manner similar to just a decade ago.[12] Banning cell phone use was a quick way to combat these distractions in the classroom. But how do you engage a classroom that is used to learning new information in a passive manner, simply swiping to the next story when they are bored or lose interest? To engage students, I have moved all of my lectures to chalk talks while incorporating active learning strategies into portions of each lecture.[13] This method allows me to frequently interact with my students in a non-threatening way. I also schedule office hours in a classroom and during times when more than 90 % of my class is available. About 40–50 % of my class typically attends and this provides me with the opportunity to watch students solve problems at the board and understand the challenges each student faces while working through questions. I find there is a lot of room to engage students by providing a safe environment for them to take learning risks in a dynamic classroom setting.

Social media

Social media provides a platform for scientists to disseminate new research, mentoring strategies and safety or experimental advice to the broader scientific community.[14] It also provides a space for everyone's voice to be heard. This is something that I believe is impactful and beneficial for scientists. In times when there is a pandemic and the voices of scientists must be heard, social media gives scientists a platform to engage the public and policy makers about the economic and societal importance of science. The positive features aside, I actually find my participation in social media to be challenging at times. As a faculty member, I submit grants to the same agencies with the same deadlines as many of my colleagues. When the notification arrives in your email that you did not receive funding for a recent proposal you can immediately go on Twitter and see several of your colleagues received the same funding that you were just denied. While I am happy to see my colleagues succeed, I can't help but wonder what I did wrong or why my proposal was not scored as high as my colleagues. In these moments, it is difficult to not feel like an imposter. For these reasons, I check my Twitter less often, try

not to post too frequently and avoid using social media during the workday. Our science will ultimately be judged by its impact, not the number of likes a post receives.

Outreach and Diversity in Science

The young generation of scientists are going to be tasked with continuing the battle against humanitarian crises including several outlined in the 17 goals of the United Nations.[15] Climate change, pandemics, neglected infectious diseases, antibiotic resistance, famine and drought are just a few of the monumental challenges that young scientists will be able to positively impact. It is crucial for us to inspire, educate and train the next generation of scientists. To do this, we need to understand the barriers to success for young scientists and clear the path for them to reach their career goals.

In the scientific community, our leaders and trainees should represent the diverse population that exists in the United States.[16] Something that has me concerned is the situation among the young generation of scientists in Puerto Rico. Prior to the start of my academic appointment, I lived in Puerto Rico for 7 months following hurricane Maria. The hurricane hit Puerto Rico on September 20th and when I arrived in December 2017, I was shocked by the extent of the devastation. This devastation manifested beyond physical damage. In the year following hurricane Maria, enrollment dropped 15 % in the College of Natural Sciences at the University of Puerto Rico Cayey (UPR Cayey).[17] When I visited the university to give seminars and interview students for paid summer research positions in my laboratory it was obvious that the buildings and classrooms had not been repaired since the hurricane. UPR is the main Hispanic Serving Institute in the United States and the student body in the Natural Sciences College at UPR Cayey is comprised of 63 % women. The campus is well-known for training students for careers in science and medicine.[17a, 18]

The devastation left by hurricane Maria is just one of many examples of how global climate change impacts different regions and groups disproportionately.[19] As a scientific community, it is our duty to ensure that underrepresented groups do not continue to be disproportionately affected by humanitarian crises. It is prudent that we (the United States) make every effort possible to re-invigorate the passion of our young generation to continue their pursuit of knowledge and learning, especially in regions that have faced the devastation of a natural disaster. Further expansion of internship programs, seminar series and workshops will allow students to see and experience the opportunities they have in the scientific field. Expansion of the National Science Foundation Research Experience for Undergraduates (NSF-REU) program[20] in the upcoming year would allow for more undergraduate summer internships in the United States. STEM programs at colleges and universities that serve a diverse student body, such as the University of Puerto Rico, should be given priority consideration for funding. This will help address the lack of diversity among leaders in science in the United States, because it will ensure that our diverse young scientist population have opportunities to succeed in the field.

COVID-19

The arrival of COVID-19 is a shock for all of us. The healthcare workers who are our heroes throughout this pandemic serve as role models for our young scientists looking to enter the healthcare field. The “new normal” is being defined daily as we struggle to find and maintain purpose in our lives. I am grateful for my health and the health of my family. I remain indebted to Marquette University for all of their support through this pandemic.

However, the hiring freezes and layoffs associated with the pandemic may present significant challenges for the scientific community in the years to come.[21] A recent article in Chemistry and Engineering News predicts an 80 % or greater drop in new faculty positions for the upcoming year.[22] I have tremendous empathy for all of the current PhD students and postdocs, especially those who will be finishing their appointments soon and beginning their job searches.[23] From an academic perspective, it takes a remarkable amount of dedication and

time to write proposals, teaching statements, a budget, cover letter and research summary. Candidates will have to make the difficult decision about whether to risk applying for academic jobs this year. Undergraduates studying and preparing for a career in science are also facing challenges. Most summer internships, including the ones I planned for students from UPR Cayey, have been cancelled due to lab closures. These experiences can be greatly advantageous for preparing undergraduate scientists for graduate school and careers beyond graduation.

I am also concerned about the challenges facing professors and their respective universities during this time. The pandemic forced most professors to be working from home for extended periods of time. Additionally, schools across the globe closed in order to slow the spread of COVID-19. While I do not have any children of my own, my close friends in academics who are parents find themselves working harder than ever to balance their job responsibilities with home-schooling. Achieving work–life integration, especially as a junior faculty member, must be incredibly difficult.[24] Hiring freezes, salary freezes, furloughs and drop in enrollment are all direct consequences of the pandemic that are affecting universities as well. From an enrollment perspective, there is much uncertainty about if and how we will be able to recruit talented international students for our undergraduate and graduate programs.[25]

I also recognize that COVID-19 will disproportionately affect underrepresented groups in science. The pandemic is poised to erase progress that has already been made to increase diversity in science.[26] While there is much room to improve diversity in academics and industry, we must be careful not to undo this important progress. University support for young scientists from traditionally underrepresented groups will serve to increase diversity in scientific leadership positions in the years following the pandemic.

Conclusions

The upcoming years will be filled with challenges and opportunity. While scientists work to eradicate COVID-19, I am optimistic that science funding will increase to make us better prepared for the next pandemic. Young scientists are currently facing much uncertainty, but with the right mentoring and opportunities we will continue to push forward. We are the generation that endured The Great Recession at the early stages of our career. We will be the generation that significantly impacts the recovery from COVID-19 while expanding opportunities for young scientists. If my grandmother was alive today, I believe she would tell me to not worry, have faith and stay the course. Every generation experiences challenges. These challenging times will pass and serve to increase our strength and resiliency.

Disclaimer

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Conflict of interest

The authors declare no conflict of interest.

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