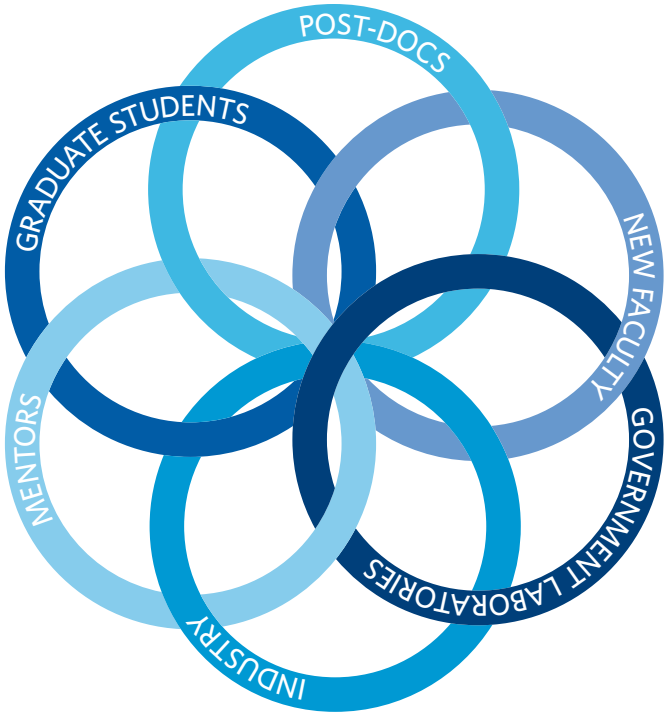
The Early Career Section offers information and suggestions for graduate students, job seekers, early career academics of all types, and those who mentor them. Katie Storey edited this section this month. Next month's theme will be communication.



BIG Math

A Career at a DOE National Laboratory: A Personal Journey

Pablo Seleson

Imagine working at a place hosting the world's fastest supercomputer and leading in neutron sciences, additive manufacturing, advanced materials, and clean energy technologies. I am talking about Oak Ridge National Laboratory (ORNL), the largest multidisciplinary laboratory of the U.S. Department of Energy (DOE), located in Oak Ridge, Tennessee. I have spent the last eight years of my career doing research at ORNL.

My first encounter with the DOE National Laboratories (DOE National Labs) was during an internship at Sandia National Laboratories (SNL) in Albuquerque, New Mexico, in summer 2008. Being a PhD student at that time, I still remember the excitement of spending the summer in another institution with the opportunity to learn new research topics and meet new researchers. I can't overstate the short- and long-term impacts of that internship, which ended in shaping my career and establishing my main research topic: *peridynamics*. Peridynamics is a relatively recent nonlocal reformulation of classical continuum mechanics suitable for material failure and damage modeling. The internship at SNL allowed me to dive into this emergent research topic, which by that time had less than a decade of history and only a few publications. Based on that internship, I wrote my most cited article "Peridynamics as an upscaling of molecular dynamics," which was published in SIAM's journal *Multiscale Modeling and Simulation* in 2009, for which I was awarded a student paper prize at the 33rd SIAM Southeastern Atlantic Section Annual Meeting. That internship provided me with the opportunity to impact a new research field and be among the earliest contributors to a field which today has hundreds of researchers and publications worldwide.

Following the completion of a PhD in computational science at Florida State University and a follow-up appointment as an ICES postdoctoral fellow at the Oden Institute for Computational Engineering and Sciences at The University of Texas at Austin, I joined ORNL in 2014 as an Alston S. Householder Fellow in the Computer Science and Mathematics Division and was then converted to a permanent research staff a couple of years later. This article intends to share some experiences and insights based on my personal journey at the DOE National Labs.

The DOE National Labs are considered the crown jewels of the nation's research and development ecosystem. There are a total of 17 labs in the DOE laboratory system, which is the most thorough research network of its type worldwide. It is often thought that the DOE National Labs are somehow in between academia and industry. While foundational research is being done at the DOE National Labs, it is driven by DOE's missions, and while applied research is certainly a focus, the end goal is not necessarily commercialization. The DOE National Labs offer different career options. I normally like to think about three main paths:

Pablo Seleson is a research scientist in the Computer Science and Mathematics Division at Oak Ridge National Laboratory. His email address is selesonpd@ornl.gov.

DOI: https://dx.doi.org/10.1090/noti2682

leading research, supporting research, and management. The first one, leading research, is probably the closest to faculty at a university, where researchers lead proposals and research projects and they set their own research agenda. The second one, supporting research, often comes in the form of proposal and research project contributions. The third one, as the name suggests, is not focused on research but on management. However, sometimes these roles may be neither sharply differentiable nor static: researchers may often lead proposals while other times supporting others' projects, and some positions may involve both research and management. Nevertheless, these three main paths represent general directions that researchers can choose as their career path goal. Of course, none of these would function properly without the support of administrative and technical staff.

Being a researcher at the DOE National Labs can be both exciting and challenging. The breadth of scientific problems studied in these environments is rich, and the opportunities for collaboration are enormous. At the same time, navigating the funding system may not be a simple task, particularly for early-career researchers. It often requires creative and out-of-the-box thinking, networking, and visibility to identify the right opportunities or to create them when they seem lacking; for example, seeking support from non-traditional agencies or funding sources.

It is important to realize that not all the DOE National Labs operate equally. They can be classified as Office of Science laboratories (such as ORNL), National Nuclear Security Administration (NNSA) laboratories (such as SNL), and others. A potentially useful tip for job seekers is that while U.S. citizenship is often required in NNSA laboratories, that is generally not the case in Office of Science laboratories.

Overall, looking back at the last eight years of my career, I see my journey at ORNL as an enriching learning experience. I got the opportunity to pursue research I am passionate about; mentor many bright students through different internship programs and postdocs; travel to many scientific meetings all over the world and grow a strong scientific network; heavily engage with the scientific community via minisyposium and workshop organization as well as participation in editorial boards, professional societies, panels, and committees; learn new topics while being involved in new collaborative research projects with multidisciplinary teams; and run my own peridynamics fracture simulations using the U.S.'s most powerful supercomputers.


Pablo Seleson

Credits

Author photo is courtesy of Oak Ridge National Laboratory, U.S. Department of Energy. Photographed by Carlos Jones.

Modeling Jobs in the Biopharma Industry

Helen Moore

I held academic/research positions for the first 11 years after my PhD in differential geometry. Early during that time, I had switched from studying surfaces that minimize area to studying drug regimens that maximize efficacy and minimize toxicity. At a party, I was talking with someone about my disease modeling and regimen optimization work, and they said their company really needed someone like me. I quickly got an interview and an offer from Genentech. It was a difficult decision, but I took a leap and started a 15-year career as a math modeler in the biotechnology/pharmaceutical (biopharma) industry. I returned to academia in 2021, to join a group of mathematicians embedded in a department of medicine. I will focus here on advice to help early career mathematicians who are considering working in the biopharma industry.

I will describe skills employers are looking for in job candidates. I will then touch on topics including how to get started if your PhD is not in modeling, returning to academia from industry, alternatives to industry, and differences between careers in academia and industry. A previous article by Allen and Moore (2019) covers some different aspects and details about math modeling jobs in biopharma.

Skills Needed for Biopharma Modeling

Mathematical, mechanistic, in-host disease models are commonly known in biopharma as quantitative systems pharmacology (QSP) models. If you are interested in a job as a QSP modeler in biopharma, here are some of the capabilities and experience that will make you a good candidate.

1. Building and working with ODE models in relevant settings
2. Familiarity with MATLAB or similar software
3. Use of appropriate sensitivity analysis methods to assess model dependencies
4. Ability to collaborate with scientists who are not modelers
5. Presentation and writing skills
6. Professionalism, including meeting timelines

When you are interviewing for a job, it is good to have examples you can discuss to demonstrate your capabilities. It's fine to use the same example to demonstrate multiple skills, but it is also good to have more than just one example overall.

Helen Moore is an associate professor in the College of Medicine at the University of Florida. Her email address is helen.moore@medicine.ufl.edu.

DOI: https://dx.doi.org/10.1090/noti2679