How to succeed in PhD program lab rotations

Dave's opinionated guide on how to start grad school successfully

In the US, biomedical research PhD students arrive on campus in late August and soon begin a daunting and stressful process of lab rotations. As I describe in my graduate student philosophy, this is akin to speed dating. In a few short weeks, students need to assess a lab and advisors need to assess students. I'm not sure students always receive guidance on how to maximize the likelihood of rotation success; I'm quite sure no one ever gave this sort of guidance to me. Here are some pointers, gleaned from nearly 15 years of interacting with PhD students in biology.

Figuring out where to rotate

Welcome to UW-Madison graduate school. Now sit down and listen to 80 five minute presentations on the work being done by faculty trainers in your progam. I remember being hopelessly confused, lost, and bored during these presentations. There is no standard template. As a professor, I'm asked whether I want to give a presentation to students and, if I say yes, I'm assigned a block of time. I could use it to talk about my most recent paper, all the work my lab has ever done, what my former students have done, or what I did during the summer. At best, you are going to get a very partial and incomplete picture of each lab. You'll need to sit through these presentations, but I do not think they are the best way to learn about a lab.

Instead, you should take advantage of the more senior students in your program and adjacent programs. There are heaps of "welcome events" – attend them. You don't need to become best friends with the second-year students and beyond, but you should absolutely ask them:

1. Whose labs did you rotate in? How was your experience in those labs? What lab did you join? How have you liked it? What's been the best and worst parts of being in the lab? Note that while some of the worst parts should be huge red flags, I suggest treating them with light skepticism, since complaining about PIs and labs is a universal grad student tradition. What are huge red flags? I'd worry about any lab where two or more students independently corroborate a toxic or abusive work culture. Avoid labs with no extramural grant funding. Be wary of labs where a high proportion of students do not successfully defend their PhDs and instead leave with MS desgrees (unless they are MS students, of course).
2. Did you have any especially good teachers in your classes? Effective teachers often make effective mentors.
3. What they think of any professors who are already on your "short list." Can they introduce you to students who are in these labs? Take second-hand information for what its worth. I was told not to rotate in the lab where I eventually did my PhD thesis because the PI was unreasonably demanding. When I met with the grad students in the lab, they told me that they did work hard but appreciated the opportunities that the lab provided. I'm quite glad I didn't listen to those who told me I would be nuts to work with him based entirely on second-hand knowledge.

At the end of your first week, or thereabouts, you should have a preliminary list of labs where you would consider doing a rotation. There isn't a hard and fast rule about how many labs should be on this list, but 5 is probably a reasonable goal (you might identify other labs as the rotation process progresses). You definitely should have more than 1 or 2. There are simply too many unforeseen variables that could make your "perfect lab" the one that you end up *not* joining. One other note, don't limit yourself just to those labs that advertise themselves during the 5-minute talk dog-and-pony show. Some professors travel before the start of the semester and aren't in town for those presentations. Others aren't planning on taking a student, but might reconsider if an excellent student contacts them. Rejection and failure abound in science, but you should learn sooner than later that nothing ventured, nothing gained.

Contacting potential rotation advisors

So you've put together a list of professors for possible rotations. Now what? You need to reach out to them. But first you need to do some homework. You **will** make a bad impression if you show up for a meeting with a professor and do not know about their research. A PhD is a degree in research, so it doesn't exactly inspire confidence when a student asks to do a rotation but hasn't done the research to understand the lab. How should you do this research? Here is my suggestion, which should take about 1-2 hours of prep time per lab:

1. Look up the professor's most recent publications on NCBI PubMed Central. The best part of PubMed Central is that all the manuscripts are freely available. Download the five most recent papers from the lab into reference manager software (see below).
2. Read the abstracts of all five papers. Try to understand most of the words. For at least one of the papers, read the entire results section. Don't worry if you don't understand all the jargon. Identify the types of experiments that the lab describes in the paper. Are they cellular assays? Animal experiments? Computational or statistical tests? Molecular biology? This can provide an indication of the type of research that is done in the lab.
3. Visit the professor's lab website. Hopefully they have one. It's 2024. How big is the lab group? Are you interested in a large or a small lab? Do they focus on one type of research, or does the lab have diverse interests?
4. Write down 3-5 questions about the lab based on your reading of the manuscripts and website.

Next up is actually contacting the advisor. I recommend calling their office phone number. I know, phone calls suck. I hate making them to strangers too. But they are much more immediate than emails. A not-so-secret: I receive somewhere between 50-100 relevant work emails each day, not counting the hundreds of Slack messages our group exchanges. If you send me a generic email asking about rotations, you won't necessarily get my attention. And unfortunately, because the timeline for establishing rotations is short, you should try to get my attention to schedule a meeting quickly. Another reason to move swiftly – and this is something I was not told when I was a student – is that many advisors are affiliated with several different PhD programs whose students are all looking for rotations at the same time. You might be the only student in the Cellular and Molecular Pathology program interested in my research, but you might not realize that students in the Cellular and Molecular Biology or Microbiology PhD programs are considering my lab for rotations too. Being first in line isn't a guarantee that you will get a rotation, but it certainly doesn't hurt.

The goal of the phone call is to schedule an in-person meeting with the lab head, or, if they are not available, one of her or his senior scientists. On the phone call, identify yourself, briefly describe why you are interested in their lab for a rotation, ask if they are considering hosting rotating students and, if so, when they would be willing to meet to discus further. As part of describing your interest in the lab, drop in one of the questions that you wrote down to show that you have done your homework. What happens if you can't reach the professor on the phone? Follow-up with an email. Make sure it is grammatically correct. Succinctly describe what you already know about their research and ask 1-2 of the questions about their research that you previously wrote down. If you send me a generic email that shows lack of effort, you can expect the same from me in return.

Face-to-face meetings

Now that you've contacted lab heads and arranged to meet, you need to prepare. Here are some things you should do before the interview:

1. Review the questions about the lab's research that you previously wrote down. Memorize them if you can.
2. Be ready to answer the questions, "what do you know about what my lab does?" and "why do you want to rotate in my lab?"
3. Print out a copy of your resume, emphasizing any special skills that you have that might benefit the laboratory (e.g, a foreign language if the lab works internationally, computer programming experience, experience with the same sort of assays the lab commonly performs).
4. Dress professionally, as though you are going to a job interview, which is sort of what you are doing. No shorts, no T-shirts. Some professors won't care how you dress, but some do. Don't risk it, its a dumb unforced error if the lab head cares.
5. Be ready to describe your previous research experience. If you did research in undergrad, rehearse a "3 minute thesis" version of your project. I don't want to hear a 20 minute spiel, but I want to know that you can communicate scientific ideas effectively.

During the face-to-face meeting, make sure that you:

1. Ask the 3-5 questions you've assembled about their research
2. Ask whether they have funding and space for a PhD student if the rotation is successful
3. Thank everyone you meet for taking the time out of their busy schedules to meet with you.
4. Ask if you can meet with a few lab members (bonus points for meeting more senior grad students) and get a tour of the lab space

5. Ask the lab head to describe their philosophy towards graduate student training. Are they hands-on? Do they expect students to work largely independently? What are their expectations for student prouctivity during the PhD? Are there set hours students are expected to be in lab? Or does the lab allow flexibility in work scheduling?
6. If there is mutual interest in a rotation, ask which rotation slot works best. Lab heads frequently travel during the semester. In some cases, this is representative of working in the lab. In other cases, it is exceptional. Try to select a rotation time that is representative of how the lab typically operates.

Phew. You've met with the lab head and the lab. There is one more step that is super-important. You might be stunned to learn how impactful a simple "thank-you" note can be. Yet only about 10% of students bother to write one. Within a day or two of meeting with the lab, you should write (bonus points for handwriting, but emails are adequate) a nice 1-2 paragraph note to the lab head thanking them for their time. **It doesn't matter if you liked the lab or not. It doesn't matter if you plan to rotate or not. Take the time to write the letter. A university is a small place and you might have that professor as a teacher or you might want them on your thesis committee.** It will also get you into the habit of thanking people for their time and help, which is an essential skill for a grad student, and really, any scientist. I still write letters to conference organizers and universities that invite me to present my work. It's a good habit.

Preparing for a month in a lab

All of the above has gone well and you have a one month audition (rotation) in a lab. In my opinion, rotations are like bi-directional interviews. As a student, you are looking for a lab that is doing science that interests you and could hold your attention for five years or more and an environment compatible with your learning style. There is no one lab environment that is perfect for everyone. As a lab head, I'm looking for students who are going to advance my research and make exciting new discoveries. Both sides are making a gamble. Students are gambling that the lab will be viable for the duration of their PhD and will provide good training. Lab heads are gambling that students will be productive and worth their investment of time, money, and energy.

It might not seem like it, but first year students are almost always more of a liability than a help. They consume time being trained that could otherwise be spent by others in the lab doing research. The lab is responsible for paying the student stipend, fringe benefits, and tuition – this is ~$50,000 a year at UW-Madison. And first-year students are effectively part-time employees, spending time in lab only when they are not in classes, seminars, or other program-mandated activities. A rotation where a student isn't productive is a red flag that this investment is particularly risky.

Professors have different definitions of productivity. It would be ridiculous to expect students to complete a full research project in a month. It is equally ridiculous to expect that students can just show up and hang out in the lab for a month to get its vibe. Different professors land in different places on the spectrum of what is considered productive. It is a good idea to clarify what a professor expects at the outset.

My expectation is that rotating students are going to demonstrate productivity in two areas:

1. Understanding the conceptual basis for their rotation project. Why are they doing the project? How does it fit into other work that is being done in my lab, and in the field in general? What would they do next if the project is successul? Reading is essential to developing this conceptual understanding quickly. I suggest finding a textbook that describes the type of research being done in the rotation to get a broad overview of the field. Then try to read at least 1-2 recent reviews on the project during each week of the rotation. Finally, try to read 1-2 primary literature papers describing specific aspects for the project each week during the rotation.
2. Working in the lab. It doesn't matter if a student is doing a wet lab project or an informatics project, I want to see that rotation students are eager to design and perform experiments. Then I want to see that they can interpret their results. I'm far less concerned about whether the experiments work than if students are able to define appropriate experimental controls and work hard on their experiments. This means that students need to be present in the lab as much as possible. Being present also allows students to interact with others in the group. Generally, the more rotating students interact with members of the lab, the more likely it is that the rotation will go well. Others in the lab can answer questions, provide guidance, and describe the lab climate.

This isn't easy, but neither is grad school. I encourage students to think about grad school like they job that it is. In my opinion, you should expect to spend about 30 hours a week in your rotation lab. This is based on my expectation that most PhD students in my lab typically work a total of about 50 hours a week on all of their responsibilities. This might be slightly higher than other labs, but I also strive to have my students graduate in 4 years (and have been successful in doing so).

Other keys to rotation success

Succeeding in a rotation, and in grad school more generally, is easier if you are well organized. Even if you are not naturally an organized person, you will save gobs of time by taking the time to organize certain aspects of your professional life. Before arriving on campus for graduate school, I reccommend:

1. Acquiring citation manager software. Minimally, a citation manager needs to store a list of things that you read and manages the automatic creation of bibliographies. Endnote is the most popular tool, though Mendeley and Paperpile are increasing in popularity. Personally I prefer Bookends for PDF management and Paperpile for in-text citations. They have largely overlapping features, so the one that you use is less important than simply choosing one and using it. You **will** need to prepare bibliographies for classes and labs in grad school and this is made dramatically easier with software that can prepare bibliographies automatically from in-text citations.
2. Familiarizing yourself with library resources that you will use to find background material. I'm partial to PubMed Central as the first place I go to explore papers on a new topic. You should also learn how to search PubMed and find full-text papers that are licensed through UW libraries. Google Scholar can also be very useful. Also learn how to restrict your searches to only review articles, since good reviews provide the best way to rapidly learn about the state of a field. Don't just mindlessly thumb through primary data articles.
3. There is a skills disconnect in many biology labs. Instruments are generating large datasets but most students aren't trained in analyzing them. Your value to many labs will be increased if you have experience and/or aptitude in working with large amounts of data computationally. If possible, take an undergrad class or two on computer programming. If that isn't possible, look to enroll in an introductory crash course in programming such as Data Carpentry or Software Carpentry as soon as you arrive in grad school. Those who learn well from books would benefit from reading and doing the exercises in Practical Computing for Biologists. The specific skills necessary will vary from lab-to-lab, but being able to work with files and tools using the command line, writing basic Python or R scripts, and making charts with lots of datapoints are skills that will be useful in many labs.
4. Learn to use AI tools effectively. The last few years have made it much easier than ever before to amass knowledge quickly, but with this great power comes some peril. Each lab is going to have its own AI policies (or at least they should) and boundaries about what is and it not acceptable. Personally, I think that as long as the information from AI is thoroughly vetted for accuracy and is not used as a replacement for original thought, it is an incredible accelerant that people in my lab should explore and use.

This ended up being pretty long, but I hope that if you are reading this you find it helpful. The first few months of graduate school can set the trajectory for the next several years of your life so it is important to get candid advice on how to maximize your chances of success. Please let me know if you have any questions or disagree with anything that I wrote.

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