Advice from a graduating science PhD

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Caveats:

- This list of advice is in no way comprehensive, but it contains many of the lessons learned that I think were critical to my success and wellbeing as a graduate student. In many cases these were the issues or challenges that held me back until I figured them out. I'm still working on implementing several of them.

- This document was compiled in January 2022. My opinions may have changed since then, but this advice is what I considered helpful after defending my PhD in December 2021.

- I am a white, cisgender, lesbian, woman who was born in the USA and speaks English as my first language. I completed my PhD in a joint program between two elite institutions. These factors of identity and privilege influenced my experience, and the advice below, in myriad ways.

- These sections are not organized in order of importance. I have grouped similar ideas together.

A. Research and Setting Goals

1. Be disciplined about maintaining goals and identifying the habits and systems that you can put in place to make these more attainable.
    a) Setting goals alone doesn't help you achieve them. You aren't going to achieve all your goals, but the process of thinking about what you want to achieve and being honest about your progress can help you identify the habits and patterns that lead to success.
        - Why are you not meeting your goals? Are you getting distracted by smaller details? Are there consistent technical challenges that slow you down? Is there equipment or extra support you need to be more effective? Are you spread too thin with meetings/classes/other commitments? Are you getting enough sleep? Are there financial/relationship/family/friend issues that are interfering with your work?
        - Why are you meeting others faster than you expected? What facilitates your progress towards goals? Can you get writing done faster in the morning vs. the evening? Does listening to music while you work help or hurt your productivity?
        - Writing goals down can help you find these patterns, and it can keep you motivated. Goals also force you to be honest with yourself about your progress.
    b) Set goals across different time horizons: long-term (10-year), mid-term (5-year/graduate school-length), and short(er)-term (i.e., annual, semester, monthly, and weekly). Revisit these goals regularly to make sure you are on track and/or to adjust as needed.
    c) Start thinking long-term as soon as possible. What projects can turn into papers? What skills do you want to learn, and how can you get started learning them? What jobs do you want to look for post graduate school and what steps will get you there?
    d) To quote George Harrison, who paraphrased Lewis Carroll's Cheshire Cat, "If you don't know where you're going, any road will take you there". Nobody tells you how to spend your time in graduate school, so goals can provide you with structure.
2. Time is your most important asset (in graduate school and in life).
    a) Be aware of opportunity costs. Saying no to some things = saying yes to others.
    b) Don't sweat the small stuff. Especially the small time-consuming stuff.
        - Many administrative tasks, studying extra to push a B+ to an A- in a course, etc., *can* be important, but they can also be time consuming beyond what they are worth. Don't let small things distract from the bigger goal of learning how to undertake high-quality research.
    c) Having clear goals can help you prioritize how you spend your time!
3. Have contingency plans.

a) *If you can balance it*, it can be good to have several projects in progress at once. If one project doesn't work out, you have another one to fall back on. Think through backup plans (in case, say, a global pandemic interrupts your research).

4. Have a comprehensive documentation system.
    a) It takes time to find a documentation system that works for you, but it is time well spent.
    b) Document **everything**! You will rarely remember why you ran a certain experiment as you did, even if it seems obvious at the time. Have a searchable paper trail for every decision.
    c) Archive your data and code clearly and consistently.
    d) Rule of Thumb: You cannot take too many notes or document things too well.
5. Take good notes during meetings.
    a) Taking thorough notes on what people say in real time gives you the opportunity to read through them later and think more deeply about what transpired.
        - (I'm grateful that I learned to touch type in real time – this is a useful skill.)
6. Be persistent…
    a) Talent and intellect can get you admitted, but consistency and persistence ensure you will finish.
7. …but don't fall prey to the sunk cost fallacy.
    a) You will inevitably put lots of time and resources into projects that won't pan out. Know when to cut your losses. It is not bad to leave some projects behind, especially if that means you have time to push other projects forward.
    b) If you stop working on a project, or even just 'put it on the back burner' for a while, save yourself time in the future and write a detailed description of *why* you left it, and what it would take to get back into it. Document the bottlenecks and/or difficulties of the project.
8. Learn how to write clearly (both code and text).
    a) Clear and concise writing is important, and writing will take up increasing amounts of your time as you move through graduate school.
        - Explore whether your university has writing courses you can take or a writing center you can visit to get feedback.
    b) Comment your code as you develop it. Make variable names that are easy to interpret. Get a code style guide and learn how to follow it.
9. When choosing projects, think about research questions *and* research methods.
    a) The routines of doing research (i.e., raising cell lines, programming, caring for animals, looking through archives) can be tedious. On a day-to-day level, an inspiring research question (usually) cannot keep you fully motivated, so it is also important to think carefully about the methods you like. How do you want to spend your days? In addition to choosing the questions that interest you, actively choose what types of methodological challenges you will face. Are you going to spend hours debugging code? Keeping cells or animals alive? Working with human participants? The amount of time you spend thinking about the big picture question is far eclipsed by the time you spend on the minutia – make sure you enjoy the minutia!
    b) Graduate students often receive the message that they should have a burning passion for their research question and topic of interest – but it is okay to prioritize methods! When I started graduate school, I didn't have fully formed ideas of what research questions were most interesting to me. But I did know the kinds of research methods I wanted to learn. This methods-driven approach ended up leading me to fascinating research questions.
        - Note: This message can lead to exploitation. Just because you love something doesn't mean you need to accept poor working conditions to study it.
    c) Sometimes developing new methods is just as important as answering specific questions.
10. Don't take it personally.
    a) *Everybody* has stories of mistakes, bad paper reviews, grant rejections, experiments gone horribly wrong, terrible bugs in code, etc. Don't take these things personally; they don't mean you are failing. Everyone makes mistakes. There is a lot of randomness in grant, paper, and award decisions. When something bad happens, take a moment to be upset, and then figure out what you can learn from it and **move on**.
11. Be a sponge.
    a) There are so many occasions for learning in graduate school, including seminars, talks, and classes. I wish I had taken more advantage of some of these opportunities.

b) When reading papers, it is easy (and lots more fun) to poke holes and figure out what the authors did wrong. It is harder, but more important, to think critically about what they did right and why.

12. Finish things.
    a) The distance between having a publishable result and having a paper published is ***vast***. As a junior researcher, it is your role to learn how to close that distance.
    b) Ask more senior researchers about how long some of their projects have taken to finish – the answers will almost certainly be longer than you expect. Publishing takes time!
13. Take moments to celebrate.
    a) Celebrate the efforts, not the outcomes. Effort is all you have control over.
        - (Credit to one of my best friends, Dr. Courtney Vaughan, for giving me this advice repeatedly throughout my PhD.)

B. Advisors and Advising

1. Choosing your advisor is the single most important decision you make in graduate school, other than which school to attend.
    a) The critical questions then become: "What makes a good advisor?" and "How do you identify a good advisor?"
        - What makes a good advisor (for you): Not everyone's criteria for a good advisor are the same. Do you want somebody who is very involved in your projects, or do you want more independence? How often do you want to meet with your advisor? Do you want to be in a lab that is more hierarchical (your advisor behaves like your boss) or flat (your advisor behaves like your colleague – remember, they are still your boss regardless of how informal they might be)? These are questions only you can answer.
        - How to identify a good advisor (for you): Once you have your own personal criteria for what you want in a mentor, ask graduate students in the lab for their honest opinions about their PI's mentorship style. Trust me, they will be more than happy to share their thoughts with you. Lab alumni might be even more willing to give you candid feedback than current graduate students. You can also ask graduate students outside their lab about the lab's reputation in its department. Does the PI shut their students off from collaboration? Do students in that lab seem happy? Do students often transfer out of that lab?
2. You are an active participant in your own advising.
    a) Reflect on your advising needs, and then tell your advisor what is most helpful to you.
        - Example: 'I just need top-level comments on this draft, I want to work through some of the details on my own first'
    b) Finding an advisor who is receptive to feedback can be an indicator of somebody you want to work with.
3. If you want to do something, ask! The worst thing your advisor can say is "no," but that, too, can be a good learning opportunity.
    a) Learning how to make decisions about taking on new projects and responsibilities is an important part of graduate school. If somebody says no or tells you something isn't a good idea, ask them to explain their response. You can often learn a great deal from a "no."
    b) A "no" can also teach you how to make your case more succinctly and convincingly moving forward, so that you don't get a "no" the next time you ask.
4. Let your advisor know about your opportunity cost calculations.
    a) Example: "You've asked me to do this analysis. But if I spend the two days needed to complete this analysis, I won't be able to return that draft you requested until next week – is that tradeoff okay or should I do the draft first and hold off on the analysis?"
    b) Learning how to prioritize is an important skill, so having frank conversations about priorities and goals is its own learning experience (and can save you time and anxiety!).
    c) I first internalized this advice through the lens of economist Harvey Liebenstein's "carte-blanche" principle, described in his 1976 book "Beyond Economic Man." To summarize, there is an inherent asymmetry of

motivations in the advisor/student relationship. Imagine that your advisor asks you to run an extra analysis for a project. This analysis will take you all weekend, imposing a significant cost on your time and mental resources. But this same analysis won't take your advisor any time at all (they aren't running your code, they just need to *ask* you to run the code!). The key to the 'carte-blanche' principle is that it is (almost) always in your advisors' best interest to ask you for more work, since is often no or low cost to them to do so. But it is not always in your best interest to *do* extra work. If you can make the cost of work apparent to your advisor (i.e. other projects won't be finished, deadlines that will be missed), you put yourself at a stronger position to ensure your time is efficiently focused on jointly understood priorities. This ultimately benefits both parties!

5. Manage up.
    a) There are many aspects of managing up (including most of the other points in this section), but it boils down to understanding your advisor's goals, preferences, and communication style, and given those, developing your relationship with your advisor so that you can work together effectively.
        - Your success can be critical to your advisor's success (and vice versa). How can you each support each other's goals?
        - Remember that your advisor is a person dealing with their own stressors (lab finances, hiring, advising other students, life outside the lab), and they have their own weaknesses and strengths.
    b) Some practical steps: Provide direct feedback, take good notes/keep clear records, communicate potential problems in advance so they don't become emergencies, discuss your goals and priorities and how they align with your advisors', anticipate when they or you might need extra support so you both can plan accordingly.
    c) There are resources that can help you learn how to manage up, including this, this, and this.

C. The PhD as a Job & Collegiality

1. As early as possible, start thinking of your PhD as your job (in contrast to an extension of undergraduate/Masters work)
    a) You have little to lose from erring on the side of formality.
    b) Your PhD is your job, not your life. You can and should have a life outside of the lab. Try to take weekends off and vacations. *True* vacations, where you block off your calendar and do not check your email.
    c) Treat others with kindness and consideration and remember that your colleagues are not necessarily your friends right away, and may not become your closest friends in graduate school. You can become friends with your colleagues, but in the office your interactions should be professional.
    d) Being vulnerable, bringing your whole and authentic self to work, being sick (physically and mentally) and asking for accommodations etc., are not signs of being weak or unprofessional – those are signs you are a human with a unique identity and with boundaries.
    e) However, be aware that universities generally do not treat students as employees, and often do not grant you the same protections and benefits you would have if you to be a full-time employee. This can lead to exploitation. Holding the university to the standards of a typical employer can make you realize when you are being exploited (i.e. working too many hours, not being adequately compensated, not receiving benefits you should, etc.), and therefore you can know when to take a stand for better working conditions.
2. If you don't know something, ask. Be considerate of others who ask for your advice!
    a) Learn from your colleagues.
    b) Answer questions for your colleagues. **You can and should be protective of your time,** but when possible be generous with your expertise.
3. Don't pull up the ladder behind you; lift as you climb.
    a) When you can, streamline things for other students so they don't need to struggle. The mentality of "things were so much harder when I did this; it's okay if it's hard for them" just makes you bitter.
4. Mentor and train other students.
    a) Being a mentor pushes you to be better at explaining things. Undergraduates and new graduate students have fresh perspectives that you can learn from! Mentoring others also helps you to think about mentorship more broadly. How can you help support the growth of other students? How can this help you learn about yourself and what type of mentorship is most effective for you?

   b) Hopefully you are in academia because you care about the field you are in. Mentoring others is one way to invest in the future of your field.
5. You are never the smartest person in the room, so approach others with humility and respect.

D. University Opportunities, Power Dynamics, and Advocacy

1. Try to get experience teaching.
   a) In addition to being an added or often necessary source of income, teaching experience helps you work on presenting clearly and thinking on the fly, among other skills.
   b) Ask for teaching opportunities! Actively search for them.
2. Apply for opportunities. Nominate yourself for awards.
   a) Put your hat in the ring for grants, fellowships, funding opportunities, honors, conference awards, etc. You generally don't get extra funding or prizes unless you apply for them. Don't be afraid to ask people to nominate you!
   b) Getting awards increases your chance of future awards, so keep applying.
3. Network!
   a) This is hard, especially during a pandemic, but don't be afraid to reach out to people to ask about their work. Don't be afraid to ask people questions at conferences.
   b) 'I enjoyed reading your paper' is about the nicest sentence anybody in academia can hear.
4. Do not be naive about the power dynamics at play in academia.
   a) On a personal level, be aware of the effect that people in power can have on you, and then realize that you can have that effect on others. You hold power over more junior graduate students, prospective students, undergraduates, etc. Understand these dynamics, and act accordingly by managing up as effectively as possible and setting an example for others.
   b) On a broader level, remember that universities often prioritize reputation and endowment above individual students.
      - Public pressure is a way to get noticed because it impacts the university's reputation. Social media, university newspapers, etc., can get attention and results.
5. You must be your own advocate, and sometimes you need to be the advocate for others.
   a) Very few other people will be your advocate unless prompted by you to behave as such.
   b) Be aware that complaining about a problem can make you the problem. Sometimes it is worth it to become the problem. (See Sara Ahmed's powerful book, 'Complaint!') If you are in a position of relative power, it is your responsibility to stand up for others who do not have your privilege.
6. The most important rule in the University rulebook is the '…or by permission of the relevant dean or provost.' That is, understand the faculty and department power dynamics.
   a) Many university deadlines, requirements, etc., are flexible if the appropriate dean or department head agrees to interpret the rules in your favor.
      - Example: Your program might say that your qualifying exam needs to be done by a certain time, but your program director can change that deadline if you are being responsible and reasonable about your request (mine was pushed by over a year!)
   b) University administration has *many* levels and gatekeepers, but if you push complaints high enough you may be able to get things done.
7. Get to know administrators!
   a) See rule above.
   b) Administrators in the career office, the graduate student office, etc., want to be able to help you, so get to know them! Use those resources!
      - Student Center administrators: Is there an amazing play or concert you want to see but can't afford the tickets? The outings office/community affairs office or student center might have a way to subsidize tickets for graduate students, or to get you discounted tickets. Is there somewhere near your university that you have been yearning to go, but you can't arrange the transportation? See if your graduate student government organizes trips and suggest the destination. Is there an author or scholar you have been wanting to meet, but an encounter is hard to arrange? See if you can organize a seminar and get funding for an honorarium to invite them. Your happiness as a student is

important, and it is better for student center administrators to spend time arranging events that excite students versus guessing what students want.

- Office of Career Services: Need to have a CV reviewed? They have got you covered.
- Graduate Studies Office: Need help paying for a conference or other research expenses? There are often grants that administrators know about to help cover costs.

E. Health and Life Outside the Lab

1. Take care of your physical and mental health. These must always be your key priorities.
    a) Seek professional help when you need it, and preferably, before you need it. Depression and anxiety are acute problems among graduate students. Be proactive and preemptive about addressing these issues. If your school allows for regular therapy, it can be useful to develop a relationship with a therapist before a crisis.
    b) I have found that many more people are willing to talk about their own struggles with mental health than you would expect, and it is helpful to know you are not alone.
2. Find your in-academia support team.
    a) In your research group, or through other activities at your university, have people you can talk to about common parts of the graduate school experience. Impostor syndrome is a good example; it hits everybody! It's good to have people to talk to who are facing similar challenges to your own.
3. Find activities outside of academia, among people who are not academics.
    a) The world is bigger than the lab and university. Internships, volunteer work, hobbies, etc., with people who know nothing about your research or what it is to do a PhD offer important perspective. These activities can also help boost your confidence and teach you how your skills are perceived outside of academia.
4. Learn to manage money.
    a) Have a realistic budget and stick to it.
    b) Don't be afraid to ask people how to manage money. Some graduate schools offer courses about budgeting, taxes, and financial management. In graduate school you generally live on a shoestring, but you are in it with other people who have also figured it out or are figuring it out. Do the math on repeat expenses – daily coffee and lunches at the office can add up quickly.
    c) Ask if there is a department or lab credit card you can use to book conference housing, travel, etc., so you don't need to wait for reimbursement.
    d) Don't be hesitant in seeking financial assistance from your university or department.
5. Read and discuss broadly and be intellectually curious.
    a) Read fiction, read non-fiction. Have conversations with people from different disciplines. Constantly broaden your intellectual horizons.

F. Burn-Out

Have systems in place for avoiding burn-out. Burn-out is real, debilitating, and if untended, can derail your career temporarily or permanently. Prevention is critical. The quote below has always been a good reminder of this point for me. I've had it hanging by my desk for all 6.5 years of graduate school:

"One final paragraph of advice: do not burn yourselves out. Be as I am - a reluctant enthusiast.... a part-time crusader, a half-hearted fanatic. Save the other half of yourselves and your lives for pleasure and adventure. It is not enough to fight for the land; it is even more important to enjoy it. While you can. While it's still here. So get out there and hunt and fish and mess around with your friends, ramble out yonder and explore the forests, climb the mountains, bag the peaks, run the rivers, breathe deep of that yet sweet and lucid air, sit quietly for a while and contemplate the precious stillness, the lovely, mysterious, and awesome space. Enjoy yourselves, keep your brain in your head and your head firmly attached to the body, the body active and alive, and I promise you this much; I promise you this one sweet victory over our enemies, over those desk-bound men and women with their hearts in a safe deposit box, and their eyes hypnotized by desk calculators. I promise you this; You will outlive the bastards."

- Edward Abbey