

Guide to Advising Physics Graduate Students

The Physics Graduate Advising Award was started by the Physics Graduate Committee in order to recognize outstanding advising in the department. In 2015, we received several nominations from graduate students describing the outstanding mentorship of their advisors. Using these nominations, the Physics Graduate Committee has compiled a guide for graduate mentorship. In the following sections, Professor Adil Hassam, the winner of the 2015 award, shares his advising philosophy. We then present several principles for good advising, weaving in responses from student nominations. While it is ambitious for an advisor to excel in all categories, we believe that these principles have contributed significantly to student success, and hope this resource will be useful to any advisor looking to improve graduate mentorship.

Advising Graduate Students

Adil Hassam

Foremost, an adviser must have a relationship of mutual equal intellectual respect with the student. The operating assumption must be that the student has had less time to be exposed to and get experience in the academic discipline, and that that is the primary reason for the disparity in specialty knowledge between the adviser and the student. The adviser is there to share his experience and create an environment to allow the student to “catch up”. In the course of the advising, the most effective way I have found to establish good communication between the two scientists is, almost exclusively, the language of science. This modus operandi transcends cultural and personal differences and makes for a level field between adviser and student. It can be argued that, oftentimes, such focus on science could overshadow social communication. In my experience, the latter follows inevitably and naturally from the basic science communication established. This approach, in fact, can minimize personality differences and any idiosyncratic aspects. Overall, aiming for integrity, fidelity, and excellence in research is the best practice. The student should be given leeway and be encouraged to interact with other students or faculty. Attendance at professional meetings is very important and should be facilitated at an early stage in the research. Social connections and belonging to the greater group are nurtured at these meetings, as well as introduction to the breadth of scientific research in one’s field. Finally, it is imperative to keep an eye on the future career directions for the student.

In my interactions with PhD research students:

1. I try to explain clearly what I am doing and what I would like the student to investigate. Then, explain why; and suggest how to attack the problem, at least in Plan A.
2. For a given complex problem, we strip away all the complexities first. We start with a sub-subset of the problem, even if elementary. Then, progressively add layers of complexity until one arrives at a level where no one knows the answer. I try to state clearly when I don’t know what’s going on.
3. I always have the student learn how to approximate. Apply approximations ruthlessly until no more small terms are left. All surviving terms must have some physics meaning, or explain a known limiting result. Usually, a complex set of equations, after approximations, can be brought down to 2 or 3 sets of terms, which

encapsulate the underlying physics. There are always large or small parameters that govern the problem; thus, a reduced set of equations is not difficult to construct. Oftentimes, one can pose a parallel, simpler model problem first.

4. Needless to say, computational methods should be used in concert with asymptotic analytical methods.

5. I recommend starting to use powerpoints early. These are indispensable as a storage space for progress made, and the powerpoint skeleton can relatively easily be segued into a paper for publication. Having things in powerpoint for discussion is tantamount to "putting things on the table", i.e., it forces the student to commit to and defend a position. It's also good practice for presentations.

Guiding Principles for Graduate Mentorship

Willing to take the time to mentor and teach effectively:

Students appreciate advisors who take their commitment to teaching their students seriously and make themselves available to answer research questions and concerns. Multiple responses emphasise that their advisor's accessibility, such as having an open door policy, allows them to make greater progress on their research and further their education. These lowered barriers made it easier for students to ask questions they may have otherwise gotten stuck on:

“available to answer my questions, explain the details of research projects, and help with problems that arose in the lab.”

“Expanding on how [the advisor] makes [them]self available, [they] always [have] an open door policy. Many afternoons, I have stopped by just to ask questions or touch base on what I am working on.”

“[the advisor] takes [their] teaching seriously, putting emphasis on enabling [their] students to understand the material.”

Models authentic scientific discourse and practices:

Good advisors go beyond just telling students how to solve problems; they model the practices of professional scientists. Students particularly learn from advisors who encourage them to ask questions, and give students the resources to explore their ideas:

“[The advisor] does not just provide solutions to puzzles I encounter reading or coding; [the advisor] also has fostered a sense of exploration in the field. Many question-and-answer sessions end with [the advisor] emailing papers which go into even more detail than we possibly could in an afternoon.”

“[They advisor] encourages me to not just ask questions about things I don't understand, but questions a paper doesn't answer. I feel like this type of dialogue has been essential in my development as a scientist.”

Encouraging graduate student agency within research:

Students appreciate advisors who foster independence and encourage students to define their own research projects. This sense of ownership in their work helps students feel more engaged in their research and improve in skills necessary toward becoming independent researchers:

“While many mentors have students do work on the mentor's projects, [the advisor] has always emphasized pursuing my own interests and developing my own curiosity.”

“[The advisor] doesn't simply tell me what to do, instead focuses on helping me navigate that process myself. For example, we've recently been having conversations about how to turn one of my conference papers into a journal manuscript. Though it would be easiest to just tell me how to refine my argument, [the advisor] started by having me identify my goals for the paper, the audience, and my main points. Based on what I said, [the advisor] then used [their] expertise to suggest an appropriate journal, and what I'd need to add to make it publishable in that journal.”

Creating opportunities for collaboration and travel:

Students appreciate advisors who encourage and facilitate travel to relevant conferences, and actively help them become a part of their professional community. Fostering and nurturing these connections helps students build a professional network and contributes to their success in research and job searches:

“[The advisor] makes sure other scientists know who [the advisor's] students are. It is not uncommon to be invited to join a group of [subfield] for wine or drinks at a conference or workshop because they've heard about us from [the advisor] and want to know what we're working on, and [the advisor's] students have built collaborations and gotten jobs from these conversations.”

“[The advisor] is very aware of the utility of networks and connections throughout the field. [The advisor] goes out of [the advisor's] way to introduce students to visiting faculty and postdocs to foster these connections. These introductions often go beyond a simple handshake including opportunities to ‘talk physics’ with the visitor.”

Demonstrates concern for advisees' wellbeing and happiness:

Good advisors support students personally, as well as professionally. When problems arise, students appreciate advisors who care about them as a person. This support allows students to recover more quickly from personal and professional setbacks and helps foster a productive research environment throughout the graduate experience:

“[The advisor] often inquires about [their] student's lives outside of graduate school with genuine interest. [Their] advice and recommendations about such matters demonstrates that [their] interest is deeper than mere small talk. [The advisor's] language also demonstrates [their] confidence that the student can succeed, provided they are willing to do the work required.”

“Has always been emotionally supportive, well aware of the emotional struggles of graduate school. In times where [the advisor] has had to give critical feedback to pieces of my work, [the advisor] has also asked me to assess [their] process of giving feedback, making sure that our

meetings are productive and comfortable for me.”

“[The advisor] was very supportive during a personal crisis I was faced last year. Without [their] patience and personal/moral support, I would not have been able to get over my problems so soon and start being productive again. [The advisor] completely understood my situation and was very patient and at times kind to me during the entire time.”

“Although we are not exactly from the same cultural background, [the advisor] has always shown a keen interest in understanding my background to help me out with decisions that can affect my academic career.”

Develops an advising relationship that bridges personal and professional life:

In addition to supporting students as people, good advisors connect with their students on a personal level, and help them feel comfortable expressing their ideas. Students appreciate humour, humbleness and understanding:

“My advisor has a good sense of humor, and when we are not talking about physics [the advisor] is like more than a friend than a mentor. This is important in maintaining a balanced relationship between us, because I can express my ideas and opinions freely without feeling intimidated.”

“..[The advisor] cares a lot about [their] students and makes an effort to build a personal relationship with them, making us all comfortable enough to join [the advisor] for Thanksgiving dinner, trivia night, or any number of social outings. [The advisor] has a way of quickly making [their] students feel part of the community.”

Supports students along their career trajectory:

Advisors who support their students along their chosen career path, whether inside or outside academia, are also crucial to their students' well being. Good advisors know where their students want to end up and plan projects with students that help them develop the skills they will need. These advisors also leverage their own professional network to help the student take the next step in their career.:

“[The advisor] keeps up with past students who have left the field and provides support as they consider jobs outside of academia.”

“[The advisor] has also supported me in learning academic skills beyond research. Because of my interest in staying in academia, [the advisor] has helped me learn the grant-writing process. My first summer after starting graduate school, I had become fascinated with a summer camp that I was teaching as part of my TA-ship. [They] went out of [their] way to pitch some of my research ideas about the camp to an NSF program officer and we co-wrote a mini-grant proposal to formally study the project.”