



Advising Guidelines for members of the SIGMA research group

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Jenny Suckale

Feedback on these guidelines is always welcome. Please do not hesitate to get in touch with me for questions or comments.

Purpose

The purpose of these guidelines is to clarify expectations regarding advising for members of the SIGMA research group. To me, the three fundamental values in modern science are reproducibility, transparency, and equity. It is my responsibility as the principal investigator to ensure that our research abides by these principles as much as possible, but I need all of your help to do that. So, please read and let's achieve this together.

These guidelines are intended for all members of the research group including undergraduate and graduate students as well as postdocs. I have structured these guidelines into three parts. The first part are basic thoughts about advising philosophy, the second part explains differences in advising for different degree levels, and the third part contains suggestions about what you can do to improve your advisee experience.

Part 1: Advising philosophy

The difference between supervising and advising:

Different members in the SIGMA research group may pursue different degrees. These specific degree requirements are laid out in detail in the documentation provided by your academic program. Ensuring that you meet these requirements in a timely manner is the role of a **supervisor**. At the undergraduate level, a person other than me serves as your academic supervisor. At the graduate level, I expect that students are independent enough to be able to put together a study plan that fulfills the degree requirements. I am always happy to discuss course choices and other questions that may arise in the context of putting together your individual course plan, but I see it as the responsibility of the graduate student to ensure that course choices fulfill the degree requirements. Keep in mind that the student service manager in your program is available to answer questions about the degree requirements, but my fundamental assumption is that as a graduate student (or postdoc for that matter) you no longer need a direct supervisor.

As the PI of the SIGMA research group, I am the main **advisor** of all group members. **My main goal as an advisor is to support you in developing your own, unique potential as a scientist.** What "potential as a scientist" means is different for every member of the SIGMA research group and sounds vague at first. I use this term intentionally to emphasize that, in my opinion, the goal of advising is to enable your

personal growth as a scientist rather than produce a given set of tangible research products (e.g., a certain number of peer-reviewed publications). That being said, the only person who can actually make personal growth happen is you.

I believe that personal growth happens best in a safe environment in which you can challenge yourself without being worried about the possibility (or even likelihood) of failure. To create a safe environment, I, as your advisor, commit to unconditionally supporting all members of the SIGMA research group, who are in good academic standing.

What does it mean to be in good academic standing?

Good academic standing requires you to:

- Be responsive to requests by me or other collaborators via Slack or email. To be able to support you, I have to be able to reach you and communicate with you. Good communication is very important to me.
- Attend regular meetings with me and/or any collaborators that you may have, so that I and other collaborators are where you at in your thinking and can support you in moving forward.
- Abide by basic standards of ethical scientific conduct by not falsifying research results, misrepresenting your scientific contributions or engaging in plagiarism.
- Interact with other members in the research group in a respectful way. If you are worried about having insulted someone, or if you have feel like you have been treated badly, please bring up the issue as early as possible so that we can find a way to move forward as a group.
- Enroll and take the classes listed on the course plan as agreed upon by both student and advisor at the beginning of the year or quarter.
- Be committed to your research project and, through that, to developing your scientific potential.
- Be willing to share your research products upon request from the advisor and/or collaborators to ensure transparency and reproducibility. It is very helpful to first have other members within the research group reproduce some of your result before making your codes available to the broader scientific community.

What is meant by unconditional support and why is it important?

I believe that all members of my research group have the potential to become outstanding scientists. My goal is to help you develop that potential. In other words, I am here to support you, not to judge you. The way towards developing your potential as a scientist has inevitable ups and downs and it is important to me that everyone feels supported independent of recent successes or failures. For example, failing a class or an exam (or not doing as well as you had hoped) does not mean that I will support you any less than before. In fact, I personally believe that failures are important growth opportunities or, vice versa, that avoiding failures because of concerns about the

ramifications they might entail impedes progress. My commitment to unconditional support acknowledges that developing your potential as a scientist often requires trying and failing.

Everybody can be an advisor:

While I am your main advisor, I think it is valuable to not think of me as your only advisor. There are several additional support structures aimed directly or indirectly at improving your advising experience. These include other members of the SIGMA research group, other students in your degree cohort, other faculty members or researchers and even random audience members listening to your research at scientific conferences. I believe that your effort to develop your potential as a scientist benefits from varied input from a diverse group of experienced and budding scientists.

Tangible skills and group coherence:

The SIGMA research group works broadly within Earth Science, which partly reflects my own scientific identity. While I am committed to giving all SIGMA members space to develop their own research ideas and directions, there are several unifying themes that are important to me to maintain group coherence.

- SIGMA is a mathematical modeling group. We do not do laboratory-based research or lead large field campaigns. We collaborate with experimental or observational groups, but we do not lead these efforts.
- SIGMA develops rather than uses models. I expect all SIGMA members with the exception of summer interns to contribute to model development. This contribution can be large or small, ranging from a completely new model to an addition to an existing model, and can be analytical or numerical. Your ability to develop mathematical models for complex Earth systems is one of the key skills that you will build by being a member of SIGMA. When and how you build this skill depends on your prior training and research project. We will jointly decide what the right time for modeling development is.
- I have developed a new course named “Modeling Earth” to train this key skill. I strongly recommend that all full-time members of the SIGMA group take this course and I always welcome feedback about how to improve it.

Communication and culture:

We use Slack as our primary communication platform. I expect that I can reach you in a timely manner through Slack. I am committed to being available on Slack, but do not guarantee a quick turn-around time through email. If you have been waiting for my response on Slack for more than a day, please do not hesitate to ping me again. There is always the possibility that a post fell through the cracks.

In general, I strongly believe in open communication in the SIGMA group. It helps identify, address and resolve issues quickly. Please do not hesitate to let me know if you have concerns or feedback.

Part 2: Degree-specific guidelines

Undergraduate students:

The SIGMA research group offers summer research opportunities for undergraduate students through both formal programs like SESUR and SURGE and through individually tailored projects based on student interest. The goal of an undergraduate research project is to enrich a degree that is based primarily on coursework and provides an opportunity for students to engage in a research experience.

Advising: While I am the formal advisor of all undergraduate research projects, most efforts will be co-advised by an advanced graduate student or a postdoc. The motivation behind the co-advising structure is two-fold. On the one hand side, it provides opportunities for the undergraduate student to interact with and learn in a hands-on way from a more experienced researcher. On the other hand, it offers experienced students and postdocs the opportunity to build mentoring skills.

Research scope: Given that many undergraduate research experiences are only a few weeks long, the scope of an undergraduate research project is set by the advising team based on overlap with existing research efforts and student interests. While creative input from the undergraduate student is always encouraged and appreciated, the primary role of the undergraduate researcher is to follow the recommended path identified by the advising team.

Funding: Funding for undergraduate research opportunities is limited and not guaranteed. I encourage all undergraduates interested in summer research opportunities to apply to SESUR and SURGE. Additional funding might be available through specific, federally funded research projects on a case-by-case basis.

Publications: The primary goal of an undergraduate research opportunity is to gain research experience. Due to the limited time available for research and writing, it is rare that undergraduate research projects lead to a peer-reviewed publication with the student as a first author. Typically, the undergraduate student will be one of the contributing authors on a publication. If a first-authored publication is an important goal for some undergraduate students, I recommend to first build out the research project into a thesis. All thesis are single-authored by the undergraduate student, while acknowledging the support received by other members of the research group. I emphasize that converting a thesis into a peer-reviewed publication entails significant additional effort.

Conferences: I recommend that undergraduate students who have become excited by research present their work at an academic conference like AGU and will provide funding for that if the research progress merits it.

Graduate students:

A PhD is the highest academic degree offered. The goal of a PhD is to train the future generation of scientific leaders who will continue to push the frontiers of knowledge. As such, a PhD requires the development of a wide spectrum of different skills that include but go beyond technical rigor built through course work. Contrary to an undergraduate degree, the quality of a PhD degree is hence not typically assessed based on your grades but based on the scientific contribution you have made. Instead, it is important to realize that you have the power and responsibility to shape your PhD experience in a proactive way to support your growth goals. In that sense, **a PhD is what you make it.**

Advising: I am typically the main advisor for all graduate students in SIGMA, but I am also open to be co-advisor with another faculty member being the main advisor. If requested by the student, me and the other faculty advisor will decide on a case-by-case basis whether joint advising is sensible. In addition to your main advisor or advisors, your thesis committee consisting of other faculty members fulfills an important advisory role. I recommend that you identify and suggest faculty members that you would like to invite to your committee based on who could provide a constructive perspective on your research, ideally a perspective different than mine. We will then discuss these suggestions and agree on a thesis committee. Generally, it is important to keep in mind that the committee can change and typically does change over the course of a PhD. These changes often reflect a shifting research scope and are valuable to ensure faculty feedback.

Research scope: The key skill that you will develop during a PhD is how to identify good scientific problems. I emphasize that this is a skill that you build during your PhD and it sounds much easier than it actually is. It is extremely rare that graduate students have developed this skill already when starting their PhD. So, if you feel like you are not good at that skill yet, there is absolutely no reason to worry. Identifying good scientific questions is a skill that you will be building for years even concluding your PhD research, including your postdoctoral training. For this reason, I will suggest a couple of specific research projects at the beginning of your PhD to get the ball rolling. I expect that you will increasingly take ownership of your research scope as you progress in your degree. That can happen at a time or to a degree of your own choosing, but I think it is valuable to have this goal in mind.

I emphasize that I always strongly encourage your suggestions about research scope, new ideas or the voicing of frustrations about a current research direction. These are important steps in developing your scientific potential and identity. When you do present your ideas to me, please expect that I will often push back to some degree in the spirit of constructive criticism. Maybe your idea is great but not fully developed or maybe I fail to see the potential in a great idea. In turn, I expect that you push back and defend your ideas to generate a productive discourse. Refining and defending your scientific ideas is a key skill and constructive discourse is, in my opinion, a good method of making progress.

Funding: I guarantee funding for all PhD students that I admit to my group. I do, however, encourage all PhD students to be proactive about fellowship applications and apply to at least one fellowship or grant during their graduate career. Fellowships provide

important visibility for young scientists and I think that it is a valuable experience to contribute to grant writing. I do not guarantee funding for Master students, but there might be specific cases in which funding is available. Our Slack group has a dedicated channel for advertising fellowship opportunities.

Publications: There is no specific number of peer-reviewed papers required by Geophysics or most other Departments, but one first-authored paper submitted is commonly regarded as a minimum. In my opinion, it is not meaningful to specify the number of papers that characterize a good or excellent PhD thesis. The goal of a PhD is to make a scientific contribution and not produce a specified numbers of published or publishable products. I cover the publication costs for all peer-reviewed papers.

Conferences: The main objective of attending scientific conferences is to get feedback from the community about the research you are pursuing. As you progress in your PhD, additional objectives like exploring new research directions, networking or meeting with potential postdoc advisors become increasingly important. Keeping these various objectives in mind, you are often the best judge which conference is most helpful for you and I encourage you to be proactive in identifying conferences that you would like to attend. It is my goal to support conference travel for at least one conference per year, but I am open to discussing more trips.

Duration of the PhD: The duration of the PhD depends on your career goals after graduation. If you plan to go into industry or start a teaching career, investing additional time to refine your research is less valuable than if you are committed to an academic career. The ideal time to start thinking about your defense and future plans is at least a year prior to the actual targeted graduation date. If you are considering a career in industry, it is valuable to consider an internship prior to graduation. We will discuss and agree on a suitable time line and agree on a graduation plan with key deliverables for the defense. After graduating, it is possible to stay on as a postdoc if funding is available. I am happy to discuss this option on a case-by-case basis.

Postdoctoral scholars:

I see a postdoctoral experience as a traineeship for becoming junior faculty. While the primary focus is on advancing your own research agenda, I offer all of my postdoctoral scholars the opportunity to also invest in other important skills such as mentoring students or proposal writing. However, most postdoc appointments are short compared to a PhD, highlighting the importance of being strategic in the skills you want to build. Stanford offers a variety of workshops specifically for postdocs, which include negotiation, time management and many other useful skills. I encourage you to take advantage of these.

Advising: As a postdoctoral scholar, you are well on your way to becoming an independent scientist and have developed a scientific identity already. In my opinion, the key to a productive advising relationship at this stage is to clearly identify the specific skills or additional research directions you would like to acquire as a postdoc at SIGMA.

The better I understand your goals for individual growth, the better I can support you in achieving them.

Research scope: I respect the fact that many postdocs already have clearly defined research directions. At the postdoctoral level, I expect that we jointly identify a research scope that builds on your existing skills but also builds new expertise through engagement in SIGMA. Your postdoctoral research should ideally not be a mere continuation of your PhD work. While there is almost always some overlap, there should be new components that demonstrate your growth as a scientist. The main challenge is achieving that goal in a relatively short amount of time.

Funding: At the postdoctoral level, funding is decided on a case-by-case basis.

Publications: The number of publications is less important than the scientific contribution you make. That being said, hiring committees expect that your postdoc adds a new component to your research portfolio, highlighting that you should have at least one original publication that is not related to your PhD. I cover all publication expenses for papers presenting your postdoctoral research. I do not cover publication costs for papers coming out of your PhD or for papers you write after leaving SIGMA.

Conferences: Attending conferences is in many ways particularly important when you are a postdoctoral scholar, because it builds your visibility in the scientific community which is helpful when you are on the job market. I guarantee at least one conference trip per year and will try to accommodate more.

Part 3: Making the most out of advising

A constructive advising relationship is crucial for getting the most out of your time at SIGMA. Making it happen takes two, the advisor and the advisee. Here are some suggestions from my side that will help both of us achieve this goal:

- **Voice grievances early.** Please do not wait until an actual problem has emerged. Instead, let me know if you are unhappy or do not feel well supported by SIGMA. I am not able to fix anything that I do not know about. While I will try to pick up on discontent, you make my job as an advisor much easier if you let me know what is concerning you yourself.
- **Invest in your mental and physical health.** When you do research, you push the frontiers of knowledge. That is daunting and there will be many disappointments along the way. There also are few things as exhilarating as creating a new piece of knowledge or dissolving a long-standing puzzle. Try to prepare for these inevitable ups and downs by finding ways to relax and integrating these into your daily life. Research is intellectual athleticism. Good athletes take good care of themselves and know when they need a break to avoid injury. You should do the same. If you feel that your productivity is declining, give your mind a break. It probably needs it.

- **Let go of self-doubt to the degree that you can.** Please keep in mind that my role as your adviser is to support, not to judge you. We do not do research to demonstrate to ourselves or others how intelligent we are. We do research to advance knowledge. The key factor determining your success in science is not your intelligence. There is no doubt in my mind that all of you are more than intelligent enough to make exceptional scientific contributions. In my opinion, the key to success in science is your perseverance - your ability to see your research project through to the end, instead of giving up somewhere half way because you are scared, distracted, bored or frustrated.
- **Build a support network (and take advantage of it).** As your advisor, I will support you as best as I can, but my skills, perspectives and time are inherently limited. Prepare for the disappointment that I might not be able to help you and keep in mind that you are part of a larger community including the SIGMA research group, your degree cohort, your thesis committee, your friends, Stanford University as a whole and many others. In your journey to become a scientist, everybody can be an advisor.
- **Contribute to community.** Realize that you play a crucial role in creating a supportive community. I greatly value your feedback about my advising, ideas about group meeting session or group events, and your suggestions for improving the experience of being part of SIGMA.