Growing and Mentoring Your Research Group

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Abstract

As engineering faculty, one of our core responsibilities is research. To be successful, you will need to work with and mentor students, especially Ph.D. students. How should you find these students, and once connected with them, how should you direct them? Unlike teaching, where myriad books and conferences can help you become a better teacher, there are few sources that will show you how to become a successful research mentor in any academic field, and fewer still in the field of engineering. In this paper, three engineering professors with collectively more than 100 years of experience on university faculties share their techniques, together with the advice provided by more than a dozen highly successful faculty members and faculty developers.

1. Introduction

As an engineering faculty member, one of your core responsibilities is research. In today's complex world, research is almost always done by teams. Managing a research group is not just a technical exercise; it also requires social skills. This paper explores some of the challenges and offers tips on how to meet them. It is based on our own experience, and on advice from more than a dozen distinguished faculty researchers.

2. Related Work

There is a wide literature on effective mentoring techniques, which is almost entirely focused on student success. Prominent among these works are the series of "Entering Mentoring" publications [Handelsman et al. 2005, Handelsman et al. 2011, Pfund et al. 2015, Greenberg, 2018]. These report on seminars that have been conducted in diverse venues, starting at the University of Wisconsin. Their goal is to make undergraduate research more effective and rewarding. The National Institutes of Health have established the National Research Mentoring Network (NRMN) [Sorkness et al. 2017]. They aim to improve the success of early-career investigators in the biomedical and social sciences, especially those from underrepresented groups. The National Academies of Science, Engineering, and Medicine have comprehensively analyzed research on mentoring graduate and undergraduate students. Their research can be found in a book entitled, *The science of effective mentorship in STEMM* [National Academies 2020]. Their objective is to make mentoring an institutional priority, instead of an ad hoc relationship between two or more individuals. Mentoring is important, and while new engineering faculty could become more effective by practicing it, these sources do not address the broader issues of establishing and leading a research group. One of the few publications that does, *At the Helm: Leading Your Laboratory* [Barker 2010], is focused on the biological and health sciences rather than engineering.

3. Recruiting Students

First, you need to consider the kind of research you will be doing. The number and kind of people you recruit—their skills, background, and experience, will depend on your funded or potentially fundable ideas. You will likely spend significant time developing ideas and submitting research proposals to different funding agencies or entities. Once you have decided on the kind of research you will pursue, recruiting students is the next critical step.

Experienced researchers know that the students who perform best in class are not necessarily the same ones who will excel at research. Initiative counts for more in research, as does the ability to address problems that are not well formed. At the beginning of their career, graduate students are knowledge consumers, with a need to learn what is the state of the art in their discipline. Later they become knowledge generators, contributing results to their research group and the community at large. Successful graduate students walk a healthy balance between working with their professor and group and striking out with some of their own ideas and insights.

From your own classes. One obvious place to find students is in your own classes. In a school with a Ph.D. program, this will most likely be in a graduate class. It is possible to find good students in undergraduate classes, of course, but if they are advanced undergraduates, they will not be around long enough to accomplish much, unless they can be persuaded to go on to graduate school at the same institution.

How to attract students from your classes? Our expert faculty give advice that can be divided into three categories: the courses you teach; how you teach those courses, and the way that you bring your own research into the course. As to what kind of a course to teach, several kinds might help you: a required course for incoming doctoral students (because you would get to know a lot of potential advisees), an advanced course in your specialty (because all the students who registered for it would be interested in what you do), a "piggyback" course with both graduates and undergraduates (because interaction with grad students may encourage the undergraduates to pursue advanced degrees), and a large undergraduate course taken by majors in your department. A lower-level undergraduate course can be an excellent place to find students because you get to know them before other faculty can establish a research relationship with them. They may be flattered that you have approached them, and they will still be in the program long enough to get involved in your research deeply enough that they want to go on to grad school. That said, teaching a large undergraduate course is a lot of work, and you may not be able to afford the time when you are trying to start a research program. It may be better to start with small advanced courses in your specialization and work your way up to larger required courses.

As to how to interest those students in your work, the first step is to give them interesting experiences and show them you care about them and their learning. Explain things carefully, and more than once if necessary. Be approachable. Be available to interact with them and

answer their questions. Give them an opportunity to talk to you during office hours about their interests.

A key strategy is to make sure that students in your class know about your research. Show them that it is interesting and meaningful. Can you integrate some of your research findings into lectures? Can you assign projects related to your research? You might discuss some research your students have done recently, and how it fits into the material they are studying in the course. As one of our respondents puts it,

> Sharing how your research fits in the goals of the course is very important. It is our only way to excite students about coming up with the next generation of engineering solutions but be grounded in the course materials we are teaching. But what is also important is to be very excited so that excitement invites curiosity by the students in the class.–Joel DuCoste, Associate Dean for Faculty Advancement, College of Engineering (unless otherwise noted, our respondents were all from NC State)

From outside your classes. While we have met a large portion of our Ph.D. students in our own classes, there are many we have met in other ways. Often they have been recruited by our existing Ph.D. students. "Best resource is your own graduate students who can tell others of the exciting work being done in your group," said Jay Baliga, the Progress Energy Distinguished University Professor of Electrical & Computer Engineering. Almost half of our faculty respondents mentioned this pathway. Two of them added that they often hire their former TAs as RAs. This, of course, assumes that you already have graduate students. So what do you do when you are just starting out?

Xiangwu "Sean" Zhang, Samuel S. Walker Distinguished Professor of Textile Engineering and Associate Dean for Research says that when he was new, he would contact his own professors and friends and ask them to recommend their students. Joel DuCoste added that he makes presentations at meetings of student groups and "I attend conferences designed for student engagement at the undergraduate level like National Society of Black Engineers AAAS Emerging Research network conference." Another tactic is to circulate opportunities to academic advisors, or post them on a departmental web site or social media site dedicated to such opportunities.

Is it good to be engaged in graduate admissions? Another way to attract students might be to take a role in graduate admissions. But there is a downside to this: administrative responsibilities take time away from the teaching and research that you are being evaluated on. Nonetheless, more of our distinguished respondents say yes than no. Walter Robinson, Co-director Climate Change & Society Program in the Marine, Earth, and Atmospheric Sciences Department says, "Active! Every faculty member has an interest in bringing great students to their department/program, not just their own group." But Shawn Zhang counters, "It might be a good idea to be involved in the student recruitment process early, which helps you get the best

students for your own research group. But, please make sure not to invest too much of your time on this in the early stage of your career."

If you do look at graduate applications, what should you look for? Curiosity and motivation top the list. What projects have the students worked on so far? What did they find? How well do they understand the significance of their findings? How have they exhibited persistence? Some of these questions will be addressed in the student's letter of purpose, which can be an excellent source of information in general. Letters of recommendation are valuable if they speak of significant personal interaction or participation in research projects. If the student has any prior publications, that can tell you a lot.

Grades and test scores can be useful to establish that a student has minimum competence, but you don't need someone who is an "A" student across the board. Grades in related courses are useful to consider, but they don't need to be perfect. Walter Robinson counsels, "look in letters for specific instances that show evidence of a spark—effective leadership of a group project, an especially insightful question, expanding an assignment into a meaningful project, etc."

How do you convince students, once accepted, to come? If you recruit undergraduate students or students from other campuses, you still need to induce them to join your program. The following set of steps is recommended, in some fashion, by most of our respondents: First, schedule a video call with them. Discuss specific research problems that might interest them. Offer to put them in contact with your own students, who can describe what life is like in your group. Explain why the student's best option is your school. If possible, offer them financial support. You might even have the students on the call when you make contact, and if the recruit wants to talk with them, at that point you can leave the call and let the students continue to talk. This will give you an idea of how serious their interest is. It may not be worth spending a lot of time with students whose interest seems faint; they may be destined to go elsewhere. Rather, concentrate on continued contact with your best prospects. Your department may have funding to bring them for a campus visit. This is important, especially in recruiting domestic students.

4. Mentoring Students

Being a good mentor means working with your students to help them to progress, pushing them to do their best, but not frustrating them when they don't achieve what you hoped they would. Students are unique individuals, so what motivates and encourages each student may be different. Various tools such as personality assessments can help a mentor understand and customize their encouragement and appropriate responses for each student, as well as give students an awareness of their own perspectives and tendencies, ideally allowing the student to manage themselves better in the long run. How we mentor is important.

Guidance about topics. How much guidance should you give students about research topics and how to pursue them? You should give them a lot of help as they start out. Give them clear

instructions, but help them think critically about what they need to do. It needs to be the student who chooses the research topic; it needs to be something that interests them. Winser Alexander, Professor Emeritus of ECE, puts it like this:

> I think that it is important for students to select a research topic that is of very high interest to them. Thus, I try to provide options for them to consider and provide feedback during discussions as they consider those options. I feel that students will be more effective if they are working on a research topic that is very interesting to them.

Students should be given a lot of latitude to explore a research area. An important part of the Ph.D. process is choosing a dissertation topic. But the advisor can set guidelines that fall within the area expected by a funding source. Students should then be encouraged to read papers and discuss them with each other (this process is often called a "journal club" [Deenadayalan et al. 2008]).

This does not necessarily mean that the advisor will not be "hands on." A productive Professor of Computer Science advises,

> When working with a new student, it is very important to have them work on something that you yourself know how to do. If the student starts to have problems completing the work, then you can either (a) help them or (b) you know that the student is not what you expected. If you give a new student a project that you don't know how to complete, then you don't know if it is the student or the problem.

He also advises asking this question: "'and how will you evaluate that?' There are lots of great research ideas, but if we can't evaluate it, we can't get a paper published on it."

Be sure to talk with your student and set goals for each year they are in the graduate program. An Individual Development Plan (IDP) can be used [Marcus 2016]. This involves identifying career goals, assessing one's own knowledge, and discussing how to overcome weaknesses and build on strengths.

Another tactic that he counsels is to pair junior and senior students. This helps the junior student understand what the expectations are for experiments and publications, and it also helps the senior student be more productive. After a semester or two, the junior student should be ready to start a project that they "own."

Masters students can often help Ph.D. students with their experiments. If you have masters students in your courses, you can tell them about your research projects just about the time they register for courses, and invite them to do an independent-study project with you [Gehringer 2007]. Not only does this help the Ph.D. student to accomplish more, but the masters student gets to see what research is like and perhaps even be recognized as the co-author of a paper.

Literature review. In order to get started on their work, students need to understand the current state of the art. But how much reading should they do to figure it out? Two of our faculty respondents said that students should start reading and experimenting at the same time. Of course, as an advisor, you should steer your students away from areas you know are unlikely to be productive. A slightly different view is provided by Yale Patt, holder of the Ernest Cockrell, Jr. Centennial Chair in Engineering at the University of Texas.

> The student takes courses and reads papers until uncovering a problem area, then refines the problem which may include reading more papers. Once working full bore on a problem, he/she reads related work selectively to make sure his/her effort stands on its own.

As Joel DuCoste suggests, performing a literature review will be much different in the era of ChatGPT. A Computer Science professor recommends that students begin with a breadth "read" of papers and sort them into topic areas before doing a "deep dive" into them. By asking the proper questions of AI search tools, students may be able to come up to speed much more quickly than in the past.

Four respondents emphasized literature review more strongly, saying that students need to have done a thorough literature search before beginning their project. Eddie Grant, Director of the Center for Robotics and Intelligent Machines, says that literature search "is a key activity, and it should continue until the day of the student's final examination."

Whose responsibility is it to keep up with outside research that might affect your students' projects? In the beginning, it is your responsibility. As the student gains maturity, (s)he can take on this role. It is a good idea for each student to keep a journal. The journal should contain (or link to) details on each of the student's experiments. This is quite valuable in case the integrity of research results is challenged. It should also contain references to recent research papers by others that are relevant to the student's work.

Meetings with students. How often should you meet with your students? Most of our respondents said that you should meet weekly. This helps your students stay on track, and lets you know whether they are being productive. It also provides ample opportunity for them to seek your input. One of our respondents offered a formula for these meetings:

> My model for my Monday conversations are: (1) what went well last week? (2) what did not go well last week? (3) what are your priorities for this week? (4) in what ways can I make you successful?

A few professors said that sometimes less frequent meetings will work. Jeff Joines, Textile Engineering Department Head, said that he meets with his students biweekly during their first one or two years and weekly during the last year. More frequent meetings are indicated when a paper is in progress.

Should you meet with students individually or in groups? That depends on what the students are working on. If their projects are similar enough that they are in a position to offer each other ideas, then a group meeting makes sense. It is motivating to students to see the progress and success of others. If you have a lot of students, their projects may fall into multiple groups, and then it may be helpful to hold a meeting a week with each group. You might also invite masters students to those group meetings, because they get a bird's-eye view of what the Ph.D. students are working on and how they might assist them with their experiments. Nor do you have to limit the meeting to your own students. Winser Alexander, Professor Emeritus of Electrical & Computer Engineering, says his meetings often include other faculty members and their students.

A group meeting is also an excellent opportunity for students to learn presentation skills. They might be asked to make a presentation to the group each semester. This can serve as practice for oral exams or conference presentations. The students might even take turns presenting recent research results by others. Some workshops and conferences put presentation slides online, and even if not, the paper author will probably send you slides if you ask. This is one way of implementing a journal club.

It is not necessary to limit your interaction with students to formal meetings. You should be available for quick questions wherever it fits in your schedule. In these days of virtual meetings, a video call in the evening may help guide a student over a rough spot.

Publications. How can you guide students in choosing publication venues? Students should be familiar with the major venues from their background reading. In most cases, you should encourage them to publish in the best venues they possibly can. This means starting with the best journal or conference. If the paper gets rejected there, you will probably get good feedback about how to improve it. If you can accomplish what the reviewers ask for, then resubmit to a comparable venue. Only if it gets rejected again should you look for a less competitive place. An exception is that students early in their careers need to build confidence by having papers accepted. This might mean initially submitting to a lower-tier venue, but still, you should advise them to send the paper to the best place it is likely to get accepted.

The adviser will have more experience with different venues, and can help a student choose one that has published similar work. Such a venue is more likely to send the work to reviewers who will understand it, and it will receive more useful reviews. In the case of conferences and special issues, there is also the time factor. In general, work should be submitted as soon as it is ready. If the best conference has a deadline more than three months later, it might be a good idea to submit a preliminary version to another venue that can review it more quickly. But be aware that the final version must be sufficiently different from the first paper so that it does not violate publication guidelines. Usually that means at least 30% new material.

Who should be listed as authors of a paper? The general rule is, Anyone who has made a meaningful contribution. Though "meaningful" is subjective, most of our respondents said it is

better to be generous in granting authorship. Being named an author helps the author's résumé, without meaningfully diminishing recognition of other authors. Marcia Gumpertz, Professor of Statistics, says to include …

> People who have contributed to the writing, the design and analysis of experiments, development of products or algorithms or derivation of mathematical results. Possibly people who have conducted the experiments.

The general rule is that the student whose research it is ("intellectual leader") goes first, the advisor/lab director goes last, and other authors are listed either alphabetically or in order of contribution. This is not a hard-and-fast rule, and can be changed for good reason.

Presentations. Conferences and invited research presentations are an important way to promote your group's research. Students may not be accustomed to presenting in front of expert audiences, but you can help them. You can provide materials, such as articles and videos, on presentation skills. You can model those skills yourself, by presenting in front of your student, or providing recordings of presentations. Presentations from many conferences are available online. It's helpful to have your students critique these presentations, or presentations by seminar speakers, especially job candidates.

In developing their own presentations, Edgar Lobaton, Director of the Active Robotic Sensing Laboratory, counsels,

> I tell my students to consider the following: How long do you have? Who is your audience? What is one thing that you want your audience to take away? Based on this, they need to provide the appropriate background, tune their language and jargon, and make sure that their point comes across clearly.

A number of our faculty respondents said that they reviewed their students' slides and made any necessary changes. Students then present live in front of other students in their lab. The other students can provide feedback to improve the presentation. Some groups have students make presentations in front of the group on a regular basis, perhaps monthly.

Students can also record their talks. This allows the advisor to stop it and offer more detailed feedback. This can be done asynchronously, for example, by playing the student's video while recording a Zoom session, pausing the video to insert comments. One of our faculty elaborated:

> During the discussion of the presentation narrative, we discuss who the audience is, and what the goal of the presentation is. For example, the goal of a conference presentation is to get someone to read your paper, and you don't need to show all of the details. The goal of an oral examination by a faculty committee is to convey that you are an expert, so it is important to include some "fast ball" slides (and be prepared to get detailed if questions are asked).

Ethical conduct of research. Ethical considerations are always present in research. The first is plagiarism. It is good to broach the topic on Day 1. Students need to know that you take integrity seriously. Tell them always to give credit where credit is due, and not to claim anyone else's ideas as their own. Self-plagiarism is also an issue. Each research publication should stand on its own, and not include the same text or results that were previously published in another paper. Starting in August, all researchers funded by the National Science Foundation will be required to complete Responsible Conduct of Research training.

In these days of big data, *p*-hacking [Head et al. 2015] is a big problem. If one is striving for 95% confidence that a hypothesis is supported by the evidence, one need only try 20 hypotheses on average before one will be supported by chance. Before there were statistical software packages, trying hypothesis after hypothesis would have been a lot of work, but now it is easy to "correlate everything with everything else" and collect a set of random variations to report as results. These "results," of course, will not be replicable, but since replicating research is time consuming, the indiscreet researcher is not likely to be caught right away.

It is not only careless researchers who fall into the trap of reporting significance where none exists. The choice of which test to perform may depend on the data, and this in itself can lead to incorrect results [Gelman and Loken 2013]. This is a special case of algorithmic bias [Kordzadeh & Ghasemaghaei 2022], where algorithms "learn" the biases of the people who create them. Researchers should, at a minimum, write down their hypotheses in advance and support them with solid reasoning before experiments are performed.

When human subjects are involved, as they are in every user study, for example, issues of privacy and non-maleficence come to the fore. Students should be taught to work with their Institutional Review Board to mitigate these risks.

Just as in class assignments, the temptation to transgress increases as the deadline approaches. One should plan the timeline of experiments carefully to ensure that there will be time to perform replications and statistical analyses before a paper is submitted.

Teaching. While it is important to involve students in research as early as possible in the program, a teaching experience will prepare them for careers in academia and encourage them to consider such a career. Many students seek the PhD degree primarily because they are interested in teaching at a college or university. Even for students not seeking academic positions, teaching a course provides opportunity to practice organizational, leadership, and communication skills. NC State University offers several opportunities for mentored teaching: among them are specific mentored teaching courses and a Preparing for the Professoriate program that also deals with other aspects of an academic career. Teaching a course in the summer is another opportunity for a PhD student to gain teaching experience. As advisors/mentors we can encourage our students to take advantage of these opportunities. Mentored teaching is yet another way to strengthen the relationship between a student and their mentor.

5. Creating a Culture of Success

Building a successful research team often involves skills and activities not directly related to academic achievement. It is important to build a supportive lab culture, one that fosters collaboration rather than competition. It is good for students to feel invested in each other's work. Celebrating important events can help, like birthdays, paper acceptances, and the passing of milestone exams. Even lab cleanup or hosting events together (e.g., visiting dignitaries or future students) can help build a sense of camaraderie.

Some activities beyond academic ones are related to personal growth of the mentors, i.e., how do mentors find mentors for themselves. Others are related to student (and faculty) well-being: work-life balance, team building, celebrating important achievements and life events.

Support for mentoring. In many departments, assistant and associate professors have formal mentors, usually chosen by the mentee and working in a similar research area. Formal mentors primarily serve to guide the mentee through the tenure and promotion process and to advocate for them during departmental voting faculty meetings. The role of informal mentors is different. Conversations can be about best practices for teaching, advising students, developing a research program, and personal matters. An informal mentor acts as a non-judgmental listener.

Finding an informal mentor is an organic process. One approach is to invite a colleague for coffee. Some of the full professors indicated that they would benefit from having informal mentors, perhaps mentoring each other. Additional suggestions include: consider colleagues outside the department or even at other universities; show up at seminars and other departmental events and use the opportunity to engage in conversation. Jeff Joines, Textiles Engineering Department Head, offered an observation about the type of person to look for: "... someone who will be honest but also supportive. I suggest having multiple mentors (i.e., one potentially in your area and then one who is knowledgeable of the department politics, etc.)"

Work-life balance is a major issue for both students and faculty. In a recent survey of PhD students in the NCSU Computer Science Department, about one third of the students disagreed with the statement "I feel accommodated when my personal and professional life are in conflict." The observed work-life balance (or lack of it) of their advisors is reported by some to be a reason not to consider a career in academia. The question "How can you find a healthy balance between academic excellence and healthy life skills?" elicited responses from almost all of the survey participants, most acknowledging that it is difficult to achieve.

Strategies proposed by survey respondents depended on personality: they included setting aside time for fun/relaxing activities, setting boundaries, learning to say no, mitigating stress by planning ahead. No one approach works for everyone. Some departments provided a Getting Things Done (GTD) seminar; these were well-attended and popular. Tim Menzies, a professor of Computer Science, suggested that work/life balance might be a false dichotomy: "we are not

balancing, we are moving" with reference to an article that recommends, among other ideas, "spending a week in love with your job" [Buckingham and Goodall 2019].

Clearly, we as faculty need to model a healthy balance for our students, finding joy in both of our work activities and beyond. The next section addresses ways to engage students in that process.

Building community. The last three questions we asked had to do with getting students invested in each other's work and the celebration of important events. Most of our colleagues mentioned the importance of having students review each other's work, helping each other, working on joint projects, having group meetings, and celebrating academic successes. Opinions were mixed on whether and how to celebrate life events such as birthdays. They ranged from allowing students to celebrate on their own to having parties at the home of the faculty member. Based on personal experience and those of our colleagues we recommend parties in the lab, office or shared space at the university; or going out to lunch with small groups of students. One college is noted as having developed a modest fund to support meetings that encourage small-group interaction. Joint work on papers and proposals can also be an occasion for, as one colleague suggested, a pizza party.

If we are truly invested in the success of our students and colleagues, it is important to take an interest in their life beyond academia. Some of these opportunities may be more personal in nature. Examples include visits of groups of students at a professor's home or interacting in appropriate social venues. Other opportunities may be more specifically focused on professional development such as presenting at meetings or guest lecturing. The approaches vary a great deal and are dependent on our comfort level with different levels of engagement. Regardless, the principle is to enhance development of the student in scholarly and communication skills.

Service. Involving students in service activities is another way to build community and strengthen relationships between students and faculty. Student-led clubs with faculty sponsors engage in a variety of service activities: summer camps for K-12 students, robotics or autonomous-vehicle competitions, bridge-design contests, and hackathons. Some departments even encourage student participation on departmental committees, fostering not only preparation for academia but also leadership development.

Support systems. Students from underrepresented minority groups, international students in their first time away from home, and students whose families have little or no experience with academia face special challenges. It is essential that we provide support systems for these students. The most successful ones are student-organized and student-led, with faculty sponsors.

Some support organizations and scholarships are available at departmental, college or university levels, while others are national or international in nature. One recent example is a college or university sponsored dissertation-writing fellowship that can help guide students less familiar with writing and publication. Writing groups at departmental, college or university levels can set aside time and encourage one another to write, sometimes in a common space such as in quiet

Table 1. Summary of Best Practices

Recruiting students		
Step	Practice	Caveat
How to find	From courses, such as a required intro graduate course, advanced course in your specialty, intro undergraduate course.	It may be better to start with small courses in your specialty
	Have your current students recruit new students.	You need to have current students.
	Ask other faculty to recommend students to you	
	Discuss your research in your class.	Act excited about it.
	Get involved in graduate admissions	It may take too much time.
What to look for	Look for students with insight and initiative rather than grades	Grades in related courses are worth looking at, but are not the main factor.
	Have a video call with recruits, put them in contact with your own students.	Don't waste time on students whose interest is faint.
Mentoring students		
Choosing a topic	Provide several options for research topics.	Set guidelines appropriate to the expected funding source.
	Make sure that topics lead to research that can be evaluated.	
Organizing your group	Pair junior and senior students.	Senior students learn from mentoring too.
	Recruit masters students to help Ph.D. students with their research	The best time to promote independent-study projects is around the time that students register for classes.
Research practice	Encourage students to start experimenting as soon as they start reading.	Be sure not to ignore related work.
	Encourage students to keep a research journal.	It should be detailed enough to defend integrity of research results.
Holding meetings	Meet with students weekly	Meet more frequently when finishing a paper or dissertation.
	Group meetings save time and promote interaction.	Meetings can include other faculty members and their students.
Where to publish	Encourage students to publish in the best venues they can.	Early in their career, can build confidence by publishing in less competitive venues.
	If unsuccessful, use feedback to improve and resubmit.	Don't sit on results; turn papers around quickly.
Presentations	Model presentation skills for your students	Or provide recordings of excellent presentations.
Ethical conduct of research	Emphasize ethics from Day 1.	Starting in August, all NSF-funded researchers must complete RCR training.
	Treat data responsibly	Protect human subjects and personal data.
	Write down hypotheses in advance.	Avoid *p*-hacking.
	Plan ahead to finish w/o cutting corners.	Temptation rises as the deadline approaches.
Creating a culture of success		
For yourself	Find a senior faculty mentor for yourself.	
	Achieve work/life balance.	Set boundaries, learn to say no.
For your students	Foster cooperation, not competition.	
	Celebrate important events.	Invite students to your home.
	Punctuate work sessions with pizza parties	
	Provide support systems for students.	Student-led groups are most successful.

writing areas of the library with shared breaks to discuss and encourage the writing process. There can be virtual versions of these with specific times/dates to share writing progress. Scholarships come at many levels and can encourage research success. There are state-level scholarships in specific fields of study; national programs funded by various federal agencies (NSF, NOAA, USDA, etc.) and various nonprofit organizations that sponsor scholarships in specific areas. International support may come from binational sponsorship of certain research projects (as one example, these may be supported by NSF and equivalent agencies in other countries), or from organizations focused on international exchanges such as the various Fulbright programs.

These examples were provided by various students and colleagues who have used them and are not at all exhaustive. There are many ways to fund research but also to encourage good research, teaching and service; to exchange viewpoints, encourage collegiality, writing, speaking and other opportunities to enhance scholarship. We encourage students and mentors to work together to pursue relevant opportunities within their fields and areas.

6. Conclusion

As educators, we are not just teachers, but also mentors. Teaching gives us the opportunity to touch many lives, but to a limited depth for a limited period of time. As mentors, we become more deeply involved in the careers and lives of our students, cultivating professional relationships and, often, lifelong friendships. Just as we devote time to becoming a better teacher, we should also avail ourselves of the collective wisdom of outstanding mentors. This paper has distilled the advice of more than a dozen successful faculty members and faculty developers on a wide range of topics related to recruiting students and helping those students succeed in research.

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