CADRE
Early Career Guide:
Tips for Early Career
STEM Education Researchers

Acknowledgements

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Introduction

ABOUT THIS GUIDE

The CADRE Early Career Guide offers advice on becoming a successful researcher in the field of STEM education and a portrait of an early career researcher support program. The advice offered throughout the guide comes from experienced researchers who are part of the National Science Foundation's Discovery Research PreK–12 (NSF DRK–12) community. Over the past eight years, they have graciously shared their experiences with small groups of doctoral students and other early career researchers through the CADRE Fellows program. Those experiences and insights have been compiled to provide guidance on navigating the STEM education field as an early career professional.

The guide is divided into three parts. Parts I and II offer tips and resources to address the needs of STEM education researchers who are early in their careers, primarily doctoral students and research associates. These materials are organized around four focal themes: (1) pursuing academic and non-academic career pathways, (2) writing for publication, (3) building professional networks, and (4) developing NSF proposals. Early career researchers may choose to independently access the resources in Parts I and II on an as-needed basis or pick from the resources and other elements of the Fellows program (described in Part III) to share with, for example, a study group with other graduate students and professional peers.

Building on Parts I and II, Part III describes a model for supporting early career STEM education researchers based on the CADRE Fellows program, and provides strategies and resources to guide those who supervise, advise, or mentor groups of early career STEM education professionals. Part III offers a detailed description of the structure and objectives of the CADRE Fellows program and the design of the activities within the focal themes. It also provides insights into the impact of the program. The guide is organized in such a way that advisors, supervisors, mentors, and program leads who work with early career researchers can choose those elements from Parts I, II, and III that are most appropriate and use them to develop customized supports to use on an ad-hoc basis or in the formation of a more formal early career researcher program. Early career researchers might also choose to use several of the guiding questions associated with each strand in Part III when talking with more-experienced researchers, or work on one of the assignments independently or with another colleague.

ABOUT CADRE AND THE CADRE FELLOWS PROGRAM

The Community for Advancing Discovery Research in Education (CADRE) is a network for STEM education researchers who have been awarded grants by NSF's DRK–12 program. CADRE connects these researchers who are endeavoring to improve STEM education in and outside of schools. CADRE helps the grantees share their methods, findings, results, and products inside the research and development community and with the greater public. CADRE also helps to build the capacity of researchers, including through the CADRE Fellows program.

The CADRE Fellows program is a competitive fellowship designed to build the capacities of and provide opportunities for early career STEM education researchers. Fellows are members of DRK–12 projects who have been identified by their project's principal investigator (PI) or coPI as a future leader in STEM education. They are primarily doctoral students or research associates, and they represent a variety of institutions, disciplines, backgrounds, and geographic regions.

Each year, CADRE selects 10 nominees to become Fellows. During the half-year program, Fellows engage in capacity-building activities to learn about DRK–12 research beyond their own projects, receive career advice from diverse perspectives, gain insight into NSF, network with researchers from a variety of institutions, and learn more about what it takes to be successful and effective in the field of STEM education research. More information about the CADRE Fellows program is available in Part III of this guide.

Part I
Tips for Early Career Researchers

About

Part I is organized around four themes: pursuing academic and non-academic career pathways, writing for publication, building professional networks, and developing NSF proposals. For each theme, we synthesized the advice provided by the DRK–12 community to develop a set of tips for early career researchers.

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PURSUING ACADEMIC AND NON-ACADEMIC CAREER PATHWAYS
These tips offer guidance on searching for positions in academia, industry, or the nonprofit sector; developing an application; preparing for the interview; and getting started in a new job.

WRITING FOR PUBLICATION
These tips offer insight into developing ideas for a manuscript, the writing process, navigating authorship, choosing the right journal, and the journal review process.

BUILDING PROFESSIONAL NETWORKS
These tips provide guidance on networking strategies, how and where to make connections, and how to sustain professional relationships.

DEVELOPING NSF PROPOSALS
These tips guide the reader through the proposal development process, from the earliest stages of developing a proposal idea to the NSF review process and beyond.

Tips for Pursuing
Academic Careers

This tool is designed for early career STEM education researchers to offer tips for pursuing careers in academia. The advice largely comes from National Science Foundation-funded awardees who have graciously shared information about their own career pathways, work experiences, and perspectives.

Academic Career Pathways

Scholars traverse a variety of paths into academia. Some take a traditional route from being a student in higher education directly to holding a faculty position; others come into positions later in their careers after working as educators at the district or state level, or in the private sector or the nonprofit world of research and development. Still others enter the profession of STEM education after a career in one of the STEM disciplines. All agree that it's hard to know early in your career exactly what you want to do, and it is challenging to plan too specifically in advance. Often it's a matter of being in the right place at the right time and having different experiences to determine what fits with your knowledge base, skill set, and personality. Education is a large and diverse field with many possibilities. For most scholars, it's about defining your goals and, if appropriate, your research agenda, deciding how best to develop yourself professionally, and pursuing different opportunities that align with your goals.

Postdoctoral Fellowships

After you earn your doctorate, consider a postdoctoral fellowship. A postdoctoral fellowship is not essential, but it is valuable. You can use your time as a postdoc to begin publishing from your dissertation and gain additional research, proposal development, and project management experience, which can position you to be very strong on the job market. If your research agenda is not as well-defined as you would like, or if you want to explore other areas or broaden the scope

of your research, a postdoc position can be a good opportunity for further exploration and professional growth. Also, the first year at an institution is often challenging, and postdoctoral fellowships can help ease the transition. NSF awardees who completed postdocs reported being better prepared to hit the ground running in their first faculty position than had they gone directly into that position after graduation.

There are a variety of ways to find postdoc positions. Many are advertised through popular e-lists such as AERA, SIG, or ISLS, or e-lists that intersect with a particular area of research.

Other resources include:

- Postdocjobs
- Findapostdoc

There are important things to consider before accepting a postdoc position. Make sure the position will allow you to maintain a balance between teaching, publishing, and project work. It's important to remain productive on the scholarship side while further developing your own research agenda and setting yourself up for future work.

It's possible that some institutions will value postdoctoral fellowships more than others. For example, a fellowship can be especially valuable if you plan to pursue a career at an R1 research university. Be sure your experience as a postdoc is setting you up for the work you want to do at the type of institution you want to be a part of.

Finding a Faculty Position

STARTING THE JOB SEARCH

Use the job search as an opportunity to think about who you are as a scholar, your future plans, and what contributions you want to make in your field. You can begin the job search and application process before defending your dissertation. If you haven't already, engage in self-reflection to begin to identify a long-term research agenda. Ask advisors, mentors, fellow students, and colleagues for advice. Take time to connect the dots on your educational and/or professional path. Figure out how your varied experiences connect with one another. Figuring this out early will help with your professional decision making.

Check for faculty positions on the websites of the institutions and scholarly associations that interest you, or on other sites such as:

- Higher Ed Jobs
- Academic 360
- The PhD Project: Academic Jobs Sites
- Vitae
- Academic Keys

If you are truly interested in a position, submit an application even if you don't have all of the required qualifications. In your cover letter, highlight all of the preferred qualifications you have and indicate that you are willing to grow into the position. You may have experience in your background that makes you an even more desirable candidate than someone who meets all of the required criteria.

DEVELOPING YOUR APPLICATION

Know your audience. Do your homework. Look at course listings. Demonstrate knowledge about the institution, the department, and the program. Know what the institution values. To the extent possible, learn about the people on the search committee and what they care about. Be clear about how your identity and goals fit with the job you're applying for, what you will need to be successful, and where you can be most successful.

What search committees look for varies by institution. Some want to see publications in top-tier journals while others prefer publications in journals with high-volume readership. It's assumed that you are a good teacher, but some institutions focus more heavily on teaching experience than others. Experience with funded projects is also a plus. Have a clear understanding of these expectations before you apply. Networking can help you gain this information. You can

also look at the profiles and portfolios of recent hires. What does their work look like? This can provide insight into what is expected at a particular institution. *Note: Be cautious of institutions whose expectations are shifting rapidly. Expectations might be shifting faster than the infrastructure to support them.* Understand what supports are in place to help you meet those expectations, particularly in terms of grant writing and publishing.

Search committees examine your career trajectory to understand who you are, what you have accomplished to date, and what goals you have set. Use the application process as an opportunity to tell your story. Committees also want to see evidence that you are well-connected to and engaged with your field of study through publications, conferences, and membership in professional associations. As much as they are thinking about what you can offer the institution, they are also thinking about how well they can support you as a scholar. They are considering whether they have the resources necessary to help you succeed or whether another institution would be better able to support you. In addition, there are considerations related to balancing the experiences, backgrounds, and research interests of their department's faculty.

CURRICULUM VITAE (CV)

Include as much relevant detail as possible on your CV. A CV is not the same as a resume; there's no need to keep it brief. A five- to seven-page CV is reasonable for someone early in their career. Key information includes:

- ✔ **Education**
- ✔ **Publications**

    Include manuscript submissions, articles "in review," and accepted publications. Don't list all publications together in one section; separate them by peer-reviewed journals, top-tier journals, conference papers, practitioner journals, etc. Don't try to hide that you don't have a lot of publications; it's okay, you're early in your career.

- ✔ **Research experience and productivity**
- ✔ **Methodological skill sets**

- ✔ **Proposal writing and/or grant management experience**

    Search committees will want to see that you can bring money into the institution.

- ✔ **Teaching experience**

    Provide evidence of strong teaching, even if it's not asked for explicitly. Include courses taught or developed.

- ✔ **Conference presentations and papers**

- ✔ **Administrative experience**

    Administrative work is relevant for managing projects.

- ✔ **Technical skills**

    Having certain skill sets such as software experience can set you apart from other applicants.

- ✔ **Languages spoken**

- ✖ **Do not include personal information on your CV, such as marital status, children, or activities in nonprofessional organizations.**

    Make sure that everything you include is relevant to your professional life.

Research how best to structure your CV. Ask yourself, "What do I want the search committee to see first? How do I want to communicate my priorities to them? How do my priorities align with those of the institution?" Think about listing information on your CV so that it aligns with the priorities of the institution. For instance, if an institution prioritizes publications, consider listing your publications first; if it prioritizes teaching, consider listing that experience first.

Have multiple readers review your CV. Choose reviewers who are in different positions and at different levels in their career trajectories; their input will offer you diverse perspectives.

COVER LETTER

Use your cover letter to directly address the position for which you are applying. Don't just recycle the same cover letter for every application. Convey your interest in the institution. Let them know why you're interested in them, what you can contribute, and what

you can learn. Speak to all qualifications (minimum and preferred) listed in the job posting. Be specific and targeted; don't use generic language. It's obvious to search committees when applicants have recycled application materials and haven't taken the time to tailor the application to each position.

Use your cover letter to connect the dots. If you've worked in a variety of fields, your CV might not easily convey that you're a good fit. Use your cover letter to complete the story, fill in any gaps, and demonstrate how your past experiences build on one another. This will make it easier for committee members to advocate for you.

PREPARING FOR A CAMPUS VISIT AND IN-PERSON INTERVIEW

The interview process generally begins with a phone or virtual interview to narrow the applicant pool. If the search committee invites you for an in-person interview and campus visit, this generally means that you meet the basic qualifications for the position. Now, they are looking for the best fit.

If accepting a position will require relocation, now is the time to explore the possibility of your spouse or partner working at the same institution. A good time to introduce the idea of a dual hire to the search committee chair is between the phone interview and the in-person interview. Share your spouse or partner's CV information with the chair so the committee can begin a conversation with other departments to see what opportunities might exist for them. Don't wait until you are offered the job to mention this; it won't be impossible to accommodate your spouse or partner later in the process, but it will be more difficult.

When you arrive on campus, recognize that you are always being interviewed, not just during the formal interview but also during other meetings, group meals, and informal social time. In addition to assessing your scholarship, research agenda, and eligibility for promotion and tenure, the search committee is also determining how well you'd fit in with existing faculty and staff. They want to get a well-rounded picture of who you are.

Be prepared for long days. The campus visit and interview is a grueling process. In addition to the formal interview, you will be expected to give a job talk, meet with other faculty, tour the campus, and possibly teach all or part of a class. Ask the search committee about these expectations before your visit.

Come with questions. Not asking questions is a red flag. Questions will likely arise naturally during the visit, but prepare a few in advance as well. Consider asking several faculty members similar questions about the department or program so that you can gain multiple perspectives.

If your research involves work in schools, examine the relationships between local schools, nonprofits, community organizations, and the university. Check out their respective websites for lists of community partners. Ask to visit schools and organizations and talk with university partners as part of your campus visit. Communicate to the search committee the importance of these relationships to your work. This will help both you and the search committee better understand what you need in order to be successful and whether your scholarship is a good fit with the institution.

JOB TALK

The job talk is your main research presentation during the interview. For early career scholars, the substance of your job talk often comes from your dissertation work. The main goal of the job talk is to communicate your research agenda and describe how it builds on the work you've done previously, how it relates to your professional goals, and how it contributes to broader themes in your field.

Demonstrate how your research agenda connects to the position for which you are applying. The search committee is interested in learning more about you, your work, and the kinds of theoretical and conceptual frameworks that ground your research.

Think of the job talk as a conference presentation. Job talks vary by institution, so ask the search committee about the format for the job talk before your campus visit. Use your time wisely. Speak passionately about your research interests. Explain why you want to

study these particular research questions, what impact you think this work will have, and how it fits into broader themes you care about. Be succinct and focused, but not too narrow. Don't focus on just one aspect of your work, but rather, speak to the broader parameters of your work. Give general descriptions of your methodology, the types of studies you want to propose, and the kinds of participants with whom you want to work. Keep the language general and invite follow-up questions.

WAITING TO HEAR FROM THE COMMITTEE

Know that hiring is a slow and bureaucratic process. Stay in contact with the search committee, and try not to get discouraged. If after the campus visit and in-person interview the institution does not offer you a position, try not to take it personally. It's not a reflection of your qualifications; you just weren't the best fit for that position at that institution at that time. Someplace else is a better fit for you.

Considering a Job Offer

If the university offers you a position, negotiate for the things that matter to you. Be serious about your interests; you're the only one who's representing them.

Know ahead of time whether the salary they are offering is appropriate for your level of experience. Salary information for public universities is usually available online. It might not always be easy to find, but it is publicly available. Do research to see what others at your level are earning. Ask for what you need and what you think you deserve, but understand that when it comes to salary, not everything is within the search committee's control.

Negotiate for non-salary benefits. Salary is important, but it's not the only factor. Determine beforehand what you need to be successful. Will you need graduate students or other research assistance? start-up money or discretionary funds? equipment? professional organization dues? travel funds? Your arguments are stronger if you present these requests in the context of

the work you want to do in the first few years. Make a case for needing those things for you to be productive. Don't forget to compare other benefits such as healthcare or retirement/pension plans among different institutions. If you have to relocate, ask whether the institution is able to cover the associated costs.

Be strategic in your negotiations. Think about what you need in the short and long terms. When might you benefit most from having a graduate teaching or research assistant? Does it make sense to have one in the first year when you're just getting settled or will you have a more productive relationship in year two or three? When might you need a reduced course load to do your research? Make sure you're meeting your immediate needs and setting yourself up for future work.

Think about how important work-life balance is to you when choosing an institution. During your campus visit, ask about your colleagues' work–life balance. Pick up on subtle cues. Do faculty members openly discuss their families or personal lives? Do they have photos of their kids in their offices? What messages are they sending you? Know that balance is easier to achieve at some institutions than others.

Consider the broader community beyond the institution. Does the location offer what you need to be personally as well as professionally fulfilled?

After You're Hired

Work to build relationships with people outside of your department. Gaining perspectives from other disciplines can help strengthen your research. For instance, STEM education researchers can benefit from establishing partnerships with content area experts.

TENURE

Make a conscious decision to choose the tenure track. Understand what it entails and make sure it aligns with your goals. Know that with or without tenure, you'll land on your feet. There are always other options – in industry, at nonprofits, or at other institutions with different foci.

Ask about tenure expectations upfront. They hired you because they thought you could be successful, so make sure you understand the tenure promotion process. Talk about tenure requirements because they can change. Ask people, especially newer faculty, how the process worked for them. Some of them might even be willing to share their tenure materials with you to help demystify the process.

Continue ongoing conversations about tenure with those in your department and beyond. If you remain engaged with the process, you will know in advance how likely it is that you'll get tenure. If it looks unlikely or questionable, you'll have time to plan. But you have to know whether you're on track; feedback from formal and informal mentors can help with this. If you're not on track for tenure, it's likely you're not at the right place to be able to do your work successfully.

Consider creating a document or electronic file to record everything you do that can count towards tenure. This is especially useful for things that are difficult to document on your CV.

WORK-LIFE BALANCE

Achieving balance between your professional and personal lives involves continuous attention, negotiation, and creativity. It's more of an orientation, a way of thinking about what you value, how you like to work, how to keep things in balance, and how to bring them back together when they are out of balance. Figure out your processes. Find ways to remain organized; it will save you time in the long run. For example, update your CV on a regular basis or keep track of references using a system that works for you.

CHANGING JOBS

Knowing you're in the right position for you is about finding the work you want to do while achieving a work-life balance. You can learn something valuable at each institution you work for and make connections with colleagues that you'll continue to work with and learn from throughout your career. Moving around to different institutions can give you a sense of how different universities operate, expose you to new people and new ideas, and offer insights into how ideas play out in different contexts. But, there are plenty of opportunities for growth within the same institution as well. Every few years you can reinvent yourself by working with new colleagues, beginning new projects, taking classes, developing new research interests, and teaching new courses.

Know that institutions take notice if a potential hire has moved around a lot. Search committees are looking for long-term investments in faculty, so they may wonder how long you'll stay with them and whether you're too risky an investment. Make sure you can explain your decisions, and be upfront about the changes that led to those decisions.

Remember that you're part of a larger research community. When considering future opportunities, think about how you can contribute to those broader networks. Your scholarship is the same no matter where you are; figure out what you need in order to make the impact you want to have.

If you decide to leave academia for another opportunity but think you might want to return someday, make sure you continue publishing and presenting at conferences. It's important to keep your name and work present in the field.

Additional Resources

- Academic Job Search—The Hiring Process from the Other Side
- Finding a Job in Academia
- From PhD to Professor: Advice for Landing Your First Academic Position
- Life After Rejection
- Maximize Your Chances of Landing a Faculty Job

Tips for Pursuing Non-Academic Careers

This tool is designed for early career STEM education researchers to offer tips for pursuing careers outside of academia. The advice largely comes from National Science Foundation-funded awardees who have graciously shared information about their own career pathways, work experiences, and perspectives.

Non-Academic Career Pathways

The large and diverse field of education offers many career possibilities. While many early career education researchers choose to pursue careers in academia, others prefer to establish careers outside of a university setting. The possibilities include, but are not limited to, public sector departments (federal and state departments of education, county and local school districts, or policy-making organizations), research and development groups and think tanks (nonprofit organizations or for-profit companies), cultural organizations and out-of-school programs, and a variety of start-up companies. Some professionals cite collaborative work environments and flexibility as reasons for pursuing careers outside of academia. Ultimately, you have to decide which path is right for you. You want to be in a place where there are good ideas and you can make a difference in implementing those good ideas. Sometimes it's hard to know early in your career exactly what you want to do, and it can be challenging to plan in advance when there are so many options. Often it's a matter of being in the right place at the right time and having different experiences so you can assess your interests, performance, and career satisfaction. For most people, it's about defining your professional agenda (e.g., research, professional development, curriculum development, assessment, evaluation, instructional design, specific grades levels, or school-to-work), deciding how best to develop yourself professionally, and taking advantage of different opportunities to pursue that work. It's important to be driven by the excitement of the work, wherever that takes you.

Finding a Position

PREPARING FOR THE JOB SEARCH

Engage in reflection and self-assessment. Ask yourself:

- What kind of work do I want to do?
- Dig a little deeper: If it's research, what are the research ideas I want to promote? If it's professional development, what is the pedagogical content area with which I'm most comfortable? If it's assessment, am I interested in standardized testing or authentic measures? In terms of instruction, how well-versed am I in new digital literacies?
- Why do I want to do this work?
- What do I need to be able to do this work?
- Who is doing work I think is important?

IDENTIFY ORGANIZATIONS THAT ARE A GOOD FIT FOR YOU

Research the types of organizations and groups that do the kind of work that most interests you. Unfortunately, there is not one particular clearinghouse to help you zero in on specific organizations; searching may require a lot of time and effort. You can start with internet searches, exploring websites of organizations you have identified, searching sites such as LinkedIn, or going directly to HR departments of particular organizations. You might think about accessing social media sites to determine colleagues who could prove valuable contacts.

Think about your identity as a STEM education professional and whether this organization will allow you to work in an area that aligns with your knowledge, skills, interests, and goals. Compare your career goals and, if appropriate, research goals with the mission and strategic goals of the organization. Know what supports are in place to help you develop the skills necessary to do this work. Understand how the organization staffs projects. What is the process for continuing a strand of work? How likely is it you'll be asked to step into roles that might not align with your professional goals?

Network. Networking is one of the best ways to figure out if a career path, organization, or job is right for you. Identify individuals who are doing work that interests you and get in touch with them through email or at conferences. As you identify organizations and specific STEM education leaders, set up informational interviews to learn more about the work of the organization and gauge whether it might be a good fit for your professional pathway. However, only reach out to people if you are truly interested in their work and/or the work of the organization.

Keep informational interviews short. Aim for about 20 to 25 minutes. If you find you have much in common and a lot to discuss, it's okay to let the conversation run longer, but be respectful of the other person's time. Set a goal for the conversation, and develop a list of clear, targeted questions to help you get the information you need.

The best time to reach out and make connections is before you're on the job market. Getting your name out there early can be advantageous when your job search begins. People will be more likely to speak with you if they don't feel pressured to offer you a position.

Ask your contacts at organizations that interest you if you can submit your resume to them. If they think you're a good fit, those contacts will often pass around your resume to other colleagues even if they don't have an open position at that time. Keep in touch with your contacts to learn about upcoming job opportunities. In the meantime, and if you have some time to spare, ask your contacts about volunteer opportunities. Volunteering can help you get a sense of whether the organization is right for you.

JOB POSTINGS

Most organizations include job listings on their websites and other job boards. Professional associations sometime promote job postings through databases and e-lists. Public sector jobs in education are listed on state department of education websites. Some organizations will allow you to submit a resume or CV online and will contact you if positions become available that align with your skills.

The job outlook varies, particularly in the nonprofit sector. At organizations funded through "soft money" (i.e., grants, contracts, etc.), employment opportunities are dependent upon the needs of individual projects, and hiring often occurs on a rolling basis. For some organizations that operate on soft money, new projects are often announced in the fall. For school district positions, the goal is to hire before school begins; for policy positions, before the legislative session starts. Overall, the hiring process tends to be quicker for non-academic positions.

DEVELOPING YOUR APPLICATION

Hiring is usually done by project staff rather than the human resources department, so knowing someone at an organization is beneficial. Hiring is typically a group decision, and committees can include representatives from the different areas within the organization with whom you will interact on the job.

Hiring committees are interested in well-rounded applicants whose expertise can be broadly applied across a variety of projects and roles. Think about how to present yourself in the best light, which may mean deep knowledge in one area but also experience and understanding of other areas. Having a diverse background can make you a competitive candidate. Hiring committees want to understand an applicant's vision. They want to see a commitment to professional growth and have a clear sense of what you hope to accomplish in your profession. This will help them assess whether the position or organization is a good match.

Organizations are interested in hiring people at different stages of their career trajectory. If a position calls for a doctorate degree, employers will sometimes consider an applicant who will soon graduate. Depending on the position, there may be organizations that are specifically looking for recent graduates. It's also possible to begin the interview process while you're still a student with the expectation that you'll begin working after graduation. It's worth it to begin making connections early rather than waiting until you're on the job market.

RESUMES AND CVS

Depending on the job description and the type of organization you are applying to, some things to highlight on your resume/CV might include:

- Relevant degrees
- Professional training
- Research experience
- Content knowledge
- Relevant skill sets
- Evidence of experience applying knowledge and skills in a similar setting
- Publication record (experience with writing, publishing, and dissemination)
- Practical experience
- Methodological skills
- Evidence of leadership
- Technical skills
- Fundraising experience
- Evidence of a core discipline to which your work is contributing

This list is tailored primarily to early career individuals looking for research positions, so adjust accordingly. For instance, if you are applying for a position to lead professional development, include information on sessions you've led or guides you may have created. If you are looking for a position in policy making, emphasize your knowledge of state and federal STEM education legislation.

COVER LETTER

Compose a strong cover letter to make your application stand out. With the advent of electronic applications, it can be tempting to get lazy with your letter. Don't let this happen. Be creative. Your cover letter is often what sets you apart from other applicants and conveys your personality. The goal is to get an interview.

If you are truly interested in a position, submit an application even if you don't have all of the required qualifications. Sometimes organizations need to hire a specific person with a specific skill set; other times they are looking for a well-rounded candidate to join a research team. You won't necessarily know which type of candidate they are looking for from the job description. In your cover letter, highlight all of the preferred qualifications you have and indicate that you are working toward the required qualifications that are missing. Show that you are willing to grow into the position.

PREPARING FOR AN INTERVIEW AND/OR JOB TALK

Be willing to travel for an interview if you can. Most organizations will conduct a phone interview first and then follow up with an in-person interview if they are interested in you as a candidate. Virtual interviews are limiting, and your willingness to travel shows dedication and commitment. However, there are many examples of excellent candidates, with positive results, who interviewed via Skype. Therefore, if you don't have travel funds, don't let it stop you from pursuing an interview.

Ask the hiring committee about the format for the interview beforehand. The expectations for interviews and job talks vary by organization and position, so understanding those expectations will help you prepare.

For research positions, a job talk is often part of the interview process. This will be an opportunity to showcase your main research thus far. For early career professionals, the substance of your job talk often comes from your dissertation work. Be prepared to discuss what motivates your research, describe your methodology, and communicate your findings. Hiring committees are looking to assess the quality of the work you've done, understand whether your empirical skills align with the work of the organization, and find out how well you understand the policy or other contextual implications of your work.

Be prepared to speak to your interpersonal skills as well. In addition to assessing your qualifications for the position, hiring committees also want to assess whether you are a good fit for the culture of the organization. They may be looking for people who can work independently as well as in teams, who are good communicators, and who have experience in diverse workplaces. A history of building strong relationships with colleagues and external partners is a plus for many positions.

In both the interview and the job talk, describe what you can offer the organization as well as what you can learn from it. Convey why hiring you will be mutually beneficial.

Hiring committees will sometimes request a writing sample in addition to a job talk. This allows them to assess how well you present your work both orally and in writing.

Always follow up after the interview. Take the time to thank the members of the hiring committee for meeting with you. Remain in communication with your contact on the committee. Remember that while this job might be highest on your list of priorities, members of the hiring committee are juggling the hiring process with many other professional responsibilities. Don't be pushy, but remaining in contact will help the committee remember you and will show your continued interest in the position.

Considering a Job Offer

Explore whether there is likely to be a fundraising aspect to the position. If so, you will need to think strategically about how to obtain and sustain funding for your work, particularly if the organization operates primarily on external funding, or soft money. You have to enjoy that aspect of the work and be confident that you can do it well.

Learn if there are ups and downs in terms of funding cycles. Some positions require paying attention to funding trends and ensuring that your organization is positioned to be competitive. You must be prepared to deal with funding uncertainties; only you can decide if you're comfortable with this situation. Organizations

that depend on external funding are not able to make a long-term commitment to you. The same is often true of public-sector positions that may require the passage of legislative or school committee budgets.

Do research to learn the typical salary range of someone in your position. Talk to people in your network. Ask about starting base salary ranges as they relate to education, professional experience, and geographic location. Advocate for yourself. Don't be afraid to ask for what you think you're worth, but be informed about what is common. Make sure you understand the opportunities and expectations for advancement within the organization.

Make sure you understand the benefits package. Benefits, such as vacation or sick time, are typically non-negotiable. There's no harm in asking HR specific questions about benefit flexibility, but be careful not to seem too pushy with the hiring committee.

During the negotiation process, explain what is important to you and what you need to be successful. Be open about your needs, but approach the negotiation as a flexible discussion rather than a demand or deal breaker. Make sure you understand the organization's policies regarding flex time, working remotely, or part-time work and how those policies apply to you.

If you interview for a job at an organization you like but aren't hired the first time, don't give up. There are new projects beginning all the time, and it helps to have already made a connection with that organization. Your persistence demonstrates that you are genuinely interested in the work of that organization.

After You're Hired

Always think about what comes next and how to position yourself well to continue doing the work you care about. Once you're hired at an organization, there will likely be opportunities to move around within the organization. Organizations often post jobs internally first and try to match people based on their research interests. Still, do not give the impression that you are accepting a position that you are not really interested in just to get your foot in the door. When considering

future opportunities, make sure you're continuing to build your portfolio in a way that is consistent with your career goals.

Maintain and expand your networks. Creating and sustaining partnerships is an essential part of much of the work in STEM education; make sure to keep in touch with colleagues from different types of institutions (e.g., academic, nonprofit, private sector).

If you think you might be interested in eventually pursuing an academic career, stay informed about what is expected in that field and work to remain eligible. It is challenging, but not impossible, to transition from a non-academic to an academic position. Keeping up with publishing in the non-academic world is difficult, but it's easier at some organizations than others. Ask about institutional support for this. For example, is publishing a requirement for promotion? If you write grants, include funding for manuscript preparation, publishing, and dissemination in your proposals. Presenting at conferences and writing conference papers can help you keep your name and work in the field. Knowing what is expected in both non-academic and academic fields can help you make professional decisions that won't limit your options later on.

Understand that the workload ebbs and flows. Very few professional careers allow you to keep a 9-to-5 schedule. Try to figure out the work schedules of people with whom you will be collaborating most closely. Do they stay late at the office? Do they work at home in the evenings or weekends? Are there times that are more and less busy? Decide whether this aligns with what you need to maintain a work–life balance. Realize that you may need to say "no" to some opportunities in order to maintain that balance. Most likely, there will be other opportunities. With time and experience, you'll have a better sense of your capacity to take on additional tasks, but don't stretch yourself too thin early on.

Additional Resources

- Strive for Work–Life Effectiveness, Rather Than Balance
- Top 10 Nonprofit Job Hunting Tips

Tips for Writing for Publication

This tool is designed for early career STEM education researchers to offer tips for writing for publication. The advice largely comes from National Science Foundation-funded awardees who have graciously shared information about their own writing and publishing experiences.

Developing an Idea for Your Manuscript

When considering what to write and where to publish, think about your career trajectory, professional goals, and values. Deciding what to publish requires a lot of self-reflection; think about where you are now and consider possible professional trajectories. How does publishing fit into your current career path and your overall research agenda? If you are new to the publishing world, do research and connect with others to help examine the terrain. Understand the assets and limitations of various types of publishing venues (specifically practitioner journals and research journals), and decide the role each kind of publication will play in your professional path.

Think about what is missing from the current body of knowledge in your field and what could make a good contribution. It is critical to determine what you can add to the existing literature on the topic. When looking at your data, consider what new conclusions you can contribute and what new questions arise.

If you are curious about a phenomenon you observed in your research or practice, don't let it pass. Explore the literature to learn what about that phenomenon has already been studied and published. This may be a starting point for a research topic.

You can recycle old ideas, but they might need to be updated. Ask yourself, "Is my argument still relevant? Does it need to be reframed?" Find out what new literature exists and how you can contribute to the current conversation.

Get organized around your research question. Ask yourself:

- What do I need to do to start to make sense of this question?
- What audience would be interested in this question?
- Who on my research team might want to collaborate?

In addition, consider the following questions:

- Whose ideas and writing style do I like?
- What do I like to read? Why?
- What kind of writer do I want to be?

Make your idea public. Share your research question(s) with your advisor, mentor, or research team. In this way, you'll get useful feedback to help you move forward, but you are also taking ownership over the idea. Continue to consult with these individuals as you progress.

A conference presentation/paper can produce a pre-publication. Presenting an idea that you want to write about at a conference is an opportunity to get feedback from peers before beginning your manuscript. Attendees may even have suggestions for appropriate journals. And even if your conference proposal is rejected, you still receive useful feedback that can help shape your manuscript.

The Writing Process

Focus on the process of writing; don't fixate on the finished product. Liken the writing process to something else in your life—something challenging but manageable, for example, running a marathon. It can make the process less daunting if you connect it with something you already know how to navigate. Think about intentionality, time commitment, and potential obstacles in both undertakings.

Structure your writing time. Create a timeline with daily, weekly, and monthly goals for your writing projects with strict deadlines. Use tools like Excel or Google Docs to create a timeline document that can easily be shared. Remember that identifying a realistic timeline gets easier with practice.

Write every day. Publishing is particularly important for early career professionals. Don't stretch yourself so thin with other professional commitments that you can't make time for publishing. Schedule time to write every day, even if it's only for 30 minutes. Mark it on your calendar. Don't treat it as flexible time; it's easy to put off if you don't make it a habit. Schedule your writing during the time in the day in which you are most productive. Write. It doesn't have to be perfect; it's only a draft. Just get the ideas on paper, and you can polish them later.

Consider finding a writing partner or forming a writing group, and meet consistently. This could include members of your research team, mentors, or even peers outside of your department/field. We do our best work in collaboration with others. Together you can share ideas or review each other's drafts. Find people you trust who will be accountable to your writing commitments and who will provide valuable feedback to make your work stronger. Writing partnerships and groups may or may not result in co-authorship.

You may find it helpful to keep a writing manual on hand (e.g., APA 6th edition). If possible, develop your initial manuscript following the basic guidelines for writing. This will save time in the end and help you develop good writing habits.

It is common to face challenges when analyzing your data and it's normal to feel overwhelmed. Hold on and be patient! With persistence, you will eventually start to see the pattern.

The author(s) that you heavily cited in your study may be a source of help. Don't hesitate to contact them for advice with your coding challenges or other questions. Some researchers may even provide further suggestions for your study.

Be creative in framing your data to appeal to different audiences. It's possible to use the same data set for multiple publications aimed at different audiences. This is especially true if you have several research questions addressing different aspects of your project. Think about how to write papers with

different foci or perspectives. As an example, you can write one article about the results of your study and another on your professional development model. As you conceptualize your ideas, figure out how to connect your work with different topics both in and outside of your field. This will require drawing on different literature and assessing the gaps in a particular field and how that relates to your research.

For doctoral students, you don't have to wait until your dissertation is complete before you begin publishing. While you're collecting and analyzing your data, consider submitting a manuscript based on your literature review or conceptual framework. This is good preparation for your future work on projects, when you should also engage in dissemination before the research is complete.

When writing, pay attention to the following:

- Title: wording that clearly conveys what the article is about
- Keywords: words that accurately capture the main focus of the article and function as search terms
- Abstract: a brief summary of the article highlighting key findings
- Headings and subheadings: useful tools for organizing the paper that clearly outline the logic underlying the paper and provide a flow to the narrative
- Guidelines for analysis and interpretation: evidence to justify the study's results and conclusions; clear description of the evolution of the research, including the underlying logic (i.e., flow from initial idea, to collecting data, analyzing the evidence, and summarizing the key findings of the study)

Give consideration to ethical issues such as:

- Plagiarism: Be aware of the guidelines for including figures, tables, data, or wording from other published or unpublished papers without citation.
- Duplicate publication: Do not submit the same paper or parts of the paper to more than one place.
- Falsification or fabrication: Do not alter data or use false data to strengthen the study's findings.

- Human welfare issue: You must always treat human subjects in way that aligns with journal policy.
- Conflict of interest: Be aware of situations in which you are in a position to derive personal benefit from actions made in your professional position.
- Authorship: Be sensitive to issues related to the addition, deletion, or even changing the order of authors on a manuscript.

Navigating Authorship

If you choose to do a group paper, have an explicit conversation with co-authors about responsibilities before you begin, especially if it's the first time you're working together.

There are many ways to determine authorship, so it's important to establish early on what method you intend to use. Sometimes PIs are the first author. Other times the team member who initiated the idea is the first author. Sometimes authorship depends on the level of contribution of each author and is determined after the writing is complete. If all authors have the same level of contribution, names can be listed alphabetically with a footnote to indicate equal contributions.

Find out whether there are policies in place for determining authorship at your institution. In addition, know what your institution values in terms of authorship. What are the cultural norms—the unspoken rules? For example, does your department or institution favor solo or group authorship? How important is first authorship? If you are in a non-academic setting, what priority is there for publishing? How is time for writing compensated?

There are a variety of ways to structure collaborative writing. One person can take on the bulk of the writing with other authors responsible for feedback and revisions. You can delegate sections to different authors and then have one person prepare the final manuscript to ensure coherency and flow. You can all write together, physically in the same room or virtually in a collaborative online space. Writing tasks are often negotiated based on availability, so figure out what works best for you and your team.

Deciding Where to Submit

When deciding where to submit your work, ask yourself:

- Who is my audience? What are those people reading?
- Where are other articles like this published?
- What journals am I citing in my own work?

Research the journals in your field. Read the requirements for submission and the journal's mission statement. Learn about the journal's culture, research the thematic and methodological interests of the editorial boards, and review recent articles to see what they are publishing. Use resources like [Cabell's Directory of Publishing Opportunities](#) as a starting place. All of this will help you get a sense of whether your manuscript is a good fit.

Do some investigative work to determine which journals are credible. Review the articles and assess their quality. Check the citation rate; heavily cited articles are a good indicator that it's a legitimate journal. Your advisors, mentors, or colleagues can offer insight as well.

Research the editorial boards of journals that interest you. A quick search on Google Scholar can offer insight into an editor's work. This is important because editors are responsible for selecting reviewers. The more an editor knows about your area of work, the more likely it is that they will choose appropriate reviewers.

Make sure your work fits but also offers something new. Pay close attention to the publishing trends over the past couple of years. Read relevant articles in a journal you want to publish in, and cite those works in an authentic way. Connect your work with the work these journals are publishing so that you know you're reaching your intended audience. Add your voice to the conversation they are already having.

Keep an eye out for special journal issues that relate to your area of interest. Special issues typically have quicker review processes and less competition. Editors will likely be more willing to work with you to make your article fit.

Research the review processes for different journals. The average length of the review process varies depending on the journal. Figure out the journals' timelines. Do they review monthly? Every 6 months? How often do they publish issues? Decide how quickly you need to publish and how long you can wait for a response. Journals with the highest impact have a greater number of submissions; therefore, the review process is much longer. Junior scholars typically can't wait 2+ years for their first publication. Understanding the review processes for different journals will help you find one that fits your timeline.

Reach out to lead editors with pre-submission inquires. This is especially useful if you are unfamiliar with the journal. Keep in mind, however, that editors are committed to reviewing full manuscripts rather than preliminary ideas. Send a concise message and brief abstract to gauge whether your idea is a good fit for a particular publication. Rely on advisors or mentors for more substantive feedback on the quality of your idea. Understand that editorship changes, which can affect what a journal is looking for. Decide how committed you are to making your work fit that particular outlet.

If you're just starting out in a line of research or as first author, begin with modest aspirations. Pay attention to the credentials of the authors in various journals. Be realistic and consider options beyond just the top tier journals. Ask colleagues/peers to help you identify an appropriate starting point. This does not mean you shouldn't submit to top tier journals, but that you should explore other options as well. Even if your manuscript is rejected by a top tier journal, these publications usually have great reviewers who provide high-quality feedback that can help strengthen your manuscript or even influence the overall direction of your research.

Diversity in publication matters, especially in academia. You want to be publishing in a variety of journals. Figure out what is common practice based on your career goals. Publishing is always good—no matter what—but do your research and connect with people who are doing the type of work you want to be doing.

Where are they publishing? Find commonalities between their trajectories and your own. This is an area where networking/mentoring can really help. It is also becoming increasingly important to have international experience and collaborations; American and European journals have many similarities, and many scholarly topics are universal.

While collaboration and diversity in publication are important, it's also crucial that you continue to develop your own area of research. This is especially important for early career scholars who might not yet have a clearly established research direction when they begin publishing. Your list of publications should have a central focus, and your articles should build on previous studies and contribute to the development of your research trajectory.

In higher education, know what is expected for tenure at your institution. Once you have tenure, you will have more freedom in terms of publishing. Until then, it's important to think about what academic departments and institutions prefer or require, and how that aligns with your career goals. What types of publications count toward tenure? Are there specific journals you must publish in to be eligible for tenure? Is there a preference for research journals over practitioner journals? How important are journals' acceptance rates, citation rates, or impact factors? There can be different expectations for publications at every level of the tenure process, so having mentors both within and outside of your department can help you navigate this.

With every research article you write, consider writing a parallel practitioner piece. This is good practice for communicating with different audiences, as it requires you to frame your research using clearer, more concise language. This also makes your work more visible and accessible. In addition, periodically taking off your researcher hat can help keep you grounded in the broader communities within your discipline.

If your research interests are interdisciplinary, think about which fields could benefit most from your work and which journals will provide a better entry point. If your work involves science education and English Language Learners (ELL), for example, ask yourself what is needed in those fields. Do science journals need an ELL perspective, or do ELL journals need a science education perspective?

You can find a home for almost anything you write if you do your research on various outlets and present your work appropriately. When conducting a study, your main focus is often on publishing your findings in a peer-reviewed research journal, but there are many other avenues for getting your work out there, such as blogs, project websites, conference papers, or online publications. Websites like ResearchGate and Academia allow for self-distribution. The world of publishing is much bigger than peer-reviewed journals! This is even true for once-rejected manuscripts. Rework, reframe, and figure out some way to get your work out there.

Submission and Review

Follow all formatting requirements, and submit your manuscript along with a convincing cover letter.

The review process is complex. Papers are evaluated on at least four factors: competitiveness, topic centrality, methodological alignment, and harmony between manuscript and journal. Upon receipt, manuscripts are first assigned to reviewers. Reviewers read the paper and submit a written review to the editor. (Reviewers only make recommendations; the editor makes the final decision on the paper.) Once a decision is reached, the editor can accept the paper, accept the paper with minor revisions, ask the author to revise and resubmit (to be reviewed by the editor, the same reviewer, or different reviewers), or reject the paper. Remember that it's very rare for an article to be accepted without at least some revisions.

After dedicating so much time and energy to preparing your manuscript, receiving critical feedback from reviewers can be an emotional experience. Read the letter, take a break, and return to it later. Then reread your manuscript in light of the feedback you've received. Give yourself time to process

your emotions before jumping into the revisions. Keep in mind that feedback is meant to make your writing stronger and more meaningful, even if you don't yet see the potential. Reviewers can be very insightful and help you take your paper to the next level. Don't be disappointed by critical feedback; be delighted that you have an opportunity to write an even better paper!

You can disagree with feedback from reviewers and discuss your concerns with the editor who shared the comments with you. Likewise, if you receive contradictory feedback from reviewers, you can consult with the editor for advice about which revisions to focus on.

The time needed for revisions depends on the feedback given. Reframing or reorganizing takes less time than reanalyzing data, for instance. You'll receive a timeframe for resubmission in your letter and can negotiate, if necessary.

Address every comment in the revision, and submit a response letter. This may seem daunting, but bear in mind that it will ultimately make your manuscript stronger. Be very pointed in your responses. Explain how you addressed the feedback, where you addressed it, and why you think it strengthened the manuscript. Acknowledge the comments you disagree with, and provide a rationale if you did not address them in the revision. Compose a solid response letter, as it reframes the manuscript and will influence the review of the revised version.

Revisions are usually submitted to the same reviewers, but not always. It's different for every journal. You can request that the same reviewers read your revised version. If you don't, you could end up with completely different feedback.

It can be challenging to revisit your manuscript since you've likely shifted your attention to something new. Conserve the energy you need to get back into that mindset. Prioritize other tasks accordingly. Don't allow yourself to lose steam at the end.

Prepare for the long haul. Getting published will take a long time. While your writing timeline depends on your own schedule, it can take up to a year or more from the time you submit until your article is finally published.

Plan for at least 2 to 3 years before you see your initial idea in print.

Because the writing/review/publication process is so time consuming, plan ahead and try to always keep different manuscripts at various places in the writing and publication cycle.

Dealing with Rejection

If your article isn't accepted by one journal, look at an alternative journal. One of the most common reasons for rejection of a manuscript is that it's not a good fit for that particular journal. If your submission was rejected or you're unhappy with the feedback from a journal, rewrite and submit elsewhere. Take the reviewer's comments seriously, though, even if you plan on submitting to another journal. The feedback will make your next submission stronger.

People generally want you to be successful in your career; take advantage of that. Even when you receive bad news, contact the editor to discuss feedback. See it as a learning opportunity. This is particularly important for young scholars.

Additional Resources

- Eight (8) Reasons I Accepted Your Article
- Eight (8) Reasons I Rejected Your Article
- Composing a Compelling Cover Letter
- How to Get Published in an Academic Journal: Top Tips from Editors
- How to Publish in Scholarly Journals
- How to Write a Good Title for Journal Articles
- Publications for STEM Educators, Policymakers, and Researchers
- My Writing Productivity Pipeline
- Scimago Journal & Country Rank
- Web of Science
- Writing a Journal Cover Letter

Tips for Building
Professional Networks

This tool is designed for early career STEM education researchers to offer tips for building professional networks. The advice largely comes from National Science Foundation-funded awardees and early career researchers and developers who have graciously shared information about their own networking experiences.

Why Network?

Networking is about building and sustaining relationships with people—those who contribute to your professional growth and those with whom you can work to contribute to the profession. Networking often occurs naturally in the course of your professional life, even when you don't realize it is happening. Building professional networks is one of the best ways for early career professionals to set themselves up for success. Learning more about others in the field ultimately makes you a better researcher. The perspectives of others can strengthen your work, and your professional relationships have the potential to create partnerships for the future. At the same time, your work, background, and perspective have much to offer your colleagues and the field.

Some reasons to form networking relationships include:

- Learning about an institution or organization
- Learning more about a person's research/work
- Seeking specific feedback on your own work
- Exploring opportunities for collaboration

Develop a Networking Plan

Spend time developing a networking plan and strategy. There are numerous ways to connect with people in your field (e.g., via email, at conferences, or through mutual connections). Think about how you want to expand your network; consider starting small and building over time. It's important to identify your needs and set goals for what you hope to get out of a networking relationship. Even when networking opportunities arise spontaneously, having a plan in place will help you get the most out of those interactions.

Identify your networking needs and opportunities. Consider questions such as:

- What are my career goals?
- How can networking help me reach those goals? What opportunities exist for me to further develop my strengths and address areas of need?
- What skills do I need to acquire or strategies do I need to implement in order to reach my networking goals?
- What types of professionals could help me? Where, when, and how can I best network with them?
- What kinds of conversations would I have with networking contacts, and what questions would I ask them, if given the opportunity?
- What would I do with their insight/advice?

The "Who" of Networking

Map your network. Use paper and pencil, Excel, or more advanced digital tools (e.g., bubbl.us or Lucidchart) to record who you have in your professional network. List what you know about them and what you would like to learn. Use this map to identify gaps in your network so that you can begin thinking about strategies to fill those gaps. It can be difficult to identify the gaps if you don't yet know exactly what you need, so think of this as a working document. This map can help guide you as you continue to build and sustain your network.

Design your map to fit your networking needs. You can map out your entire professional network or focus in on a particular context, such as a conference like AERA, NCTM, or NARST. If you plan to attend a conference, review the program beforehand to learn who will be there. From this list, identify who you already know, who you would like to get to know better, who from your institution will be in attendance, and who you would like to meet. You might also consider reviewing your reference list and comparing it with the conference program. Conferences are a great opportunity to connect with the people who have influenced your work.

Identify people to connect with for specific reasons. Networking is not about collecting business cards; it's about making valuable connections.

Explore shared connections. If you're uncomfortable reaching out to someone directly, figure out if the two of you share a mutual connection who can introduce you in person or through email. (LinkedIn can be a good tool for this.)

Don't underestimate anyone. Anybody could be in a position to help you in some way. You don't necessarily know how important a connection is going to be in the moment, so taking the time to get to know people and familiarizing yourself with their work can pay off in the long run. Don't just focus on the "stars" in your field—project PIs or people with a lot of publications; rather, take an active interest in everybody, and work to build relationships over time. After all, fellow students, for example, eventually move on to positions on hiring committees, advisory boards, and review panels. Put effort into connecting with peers and near-peers in your field; they are in a position to offer you particularly relevant advice.

Connect with people who are good at networking. These individuals often have vast networks, which can be a good resource for you. They can make recommendations or connect you to others in the field. This is an especially useful strategy for those who are more introverted. If you're strategic about making connections, you don't have to be particularly "good" at networking to have a large network.

The "How" of Networking

Nowadays, many networking relationships begin through email. When emailing to initiate a first meeting (whether that meeting will be by phone, virtual, or in-person), briefly introduce yourself, describe your research interests and why you want to speak with them specifically, demonstrate that you are familiar with their work, and highlight ways in which the conversation could be mutually beneficial.

Keep initial conversations brief. While it's okay to see where the conversation takes you when you talk with a contact, also be respectful of their time. Have a goal for the meeting and some questions to help guide the conversation. This will help ensure you get the information you're looking for.

Develop tools or "props" to aid in your networking. Create a personal webpage or update your LinkedIn profile. Join online groups related to your research interests. Draft guiding questions or sentence starters in preparation for conversations. Develop and practice your elevator pitch (a concise speech that provides an overview of your work).

Networking must be a two-way street. That's not to say that every interaction must have equal give and take, but it's essential that both people benefit from the networking relationship. Give people a reason to want to begin and continue interacting with you. If their research is meaningful to you, identify precise reasons why, and share how it has influenced your own work. Offer suggestions for how your work could be valuable for them. Sometimes, as an early career professional, it can be challenging to identify exactly what you have to offer a more experienced scholar. But your background is unique to your own life experiences, and you bring a fresh perspective to the field. Simply exchanging ideas or discussing your shared interests can help you both identify similarities in your work that can generate new ideas. You always have something to bring to the table.

The "What" of Networking

ELEVATOR PITCHES

Decide how you want to present yourself and your research, and how you might change this message depending on who you are talking to. Identify the most important points you want to convey. It can be challenging to condense your research into sound bites, but decide what you most want to convey about yourself and your work, and let that be the substance of your pitch. Adapt this pitch for different audiences.

For example, if you're speaking with people who have expertise in your area of study, contextual information probably isn't necessary; you can dive into the specifics and begin discussing your work immediately. If you're conversing with someone less familiar with your field, you will need to set the stage: a brief description of your area of study, the need, and how your work addresses that need. To make your pitch more accessible, think of concrete examples that illustrate the need for this type of work. In addition, you'll need to adapt your pitch for different time frames—figure out what points you want to highlight in a 2-minute pitch, a 1-minute pitch, and a 30-second pitch. The order and structure will vary, but make sure you're communicating your key points consistently.

Authenticity is key. Structure your elevator pitch in a way that sounds most authentic to you. If you prefer, you can offer a brief introduction to your work, and then turn it over to the other person and ask questions to learn more about their work and interests. This is particularly relevant if you are someone who's more comfortable listening than talking. After your conversation, take time to think about what you have in common and how you could benefit from a continued relationship. Pose this in your follow-up with them. Make sure the person knows what you're interested in, how your interests intersect, and that you're eager to work together.

TOPICS OF CONVERSATION

✔ Pose questions that arise as you review the literature in your field.

✔ Ask about their writing process or a project management strategy; these are areas of interest most scholars have in common and can be an opportunity to exchange best practices.

✔ Take a genuine interest in their work. Ask about how they are addressing their research questions or what they are doing in the classroom.

✔ Connect over a shared cultural identity.

✔ Ask how they navigate bridging two fields (e.g., science education and ELL).

- Discuss different perspectives on your area of research, particularly from people with similar interests but from a different theoretical research tradition.

- Don't just talk about research; get to know each other as people. People are complex, with many intersecting identities and interests. Don't let the desire to form professional connections allow you to overlook personal connections.

The "Where" of Networking

NETWORKING AT CONFERENCES

If you're attending a conference, try to be proactive in setting up networking opportunities with people of interest. You can approach them once you arrive or contact them by email before the conference to inquire about setting up a one-on-one meeting. If you're unable to work out a time to meet, briefly introduce yourself when you see them, keep the conversation short, and ask if you can follow up with them via email or over the phone. At a minimum, use the conference interaction to plant a seed, and then plan to follow up at a later date.

Connect with people during your conference presentations. Those attending your session likely have interests that overlap with yours. You may come from different backgrounds but share a similar professional or research goal. Not only can attendees offer valuable feedback on your work, but you might identify places where your work intersects, which can lead to ideas for future collaboration on papers or projects.

Attend conference poster sessions. Poster sessions provide a great opportunity to engage in authentic dialogue. The environment tends to be more relaxed than formal presentations, and the poster itself offers substantive talking points to help begin a conversation.

Consider pre-conference workshops and special interest group events. These sessions can be good spaces to meet people with similar research interests. They often include a mix of professionals—from PIs and more-established scholars to up-and-coming researchers

and graduate students—which provides you with access to an array of perspectives and expertise. Becoming involved in leadership for these groups can offer even greater opportunities to connect with others in the field.

Take advantage of informal opportunities! A lot goes on at a conference outside of the official program of events, and networking opportunities are all around you. Engage in casual conversations at the café during breaks or over lunch/dinner. Attend social events arranged by the host organization and others. Get to know people on a more personal level in a relaxed atmosphere.

Don't forget about small conferences such as single-discipline STEM conferences or practitioner-focused regional and national meetings. Large events like AERA can be overwhelming, with so many activities and distractions. People can be more relaxed at smaller conferences, which can allow for less hurried, more-organic conversations.

Take the time to jot down a few notes about your interactions. In a notebook or on the back of your contact's business card, write down a few keywords and/or ideas to help jog your memory about this person later. Begin drafting a follow-up email with key points from your conversation or voice record a message on your phone as you're walking to your next location. Keep in mind that if you know their name, you can find information about them online, or you can revisit the conference program later to refresh your memory.

NETWORKING AT OTHER VENUES

Serve as a reviewer for an academic journal or for NSF, or join a committee related to your field of study. This could allow you to gain new experience, demonstrate your expertise, learn from others with different background and interests, and get to know editors, program directors, and committee members.

Pay attention to events happening at other universities and organizations in your area. Events at neighboring institutions can bring together people outside of your network and provide opportunities to connect with new peers. Pay attention to school or community events as well, particularly if your work involves building community partnerships.

Invite guest speakers into your classroom, whether virtually or in person. Not only will you be able to learn more about this scholar's work and start to build a professional relationship, but your students will also have an opportunity to make a connection and expand their networks as well.

Sustaining Networking Relationships

Keep track of your contacts. Don't let business cards pile up with no plan to utilize them. Consider keeping a spreadsheet with the names and contact information of those you meet. Include columns to describe the context of your meeting, what was discussed, who connected you (if applicable), the date of your last contact, and follow-up goals.

Always follow up after you've made a connection. It's important to thank the person for their time and to communicate why the interaction was beneficial. If you see an opportunity for future collaboration, let them know this is something that interests you (e.g., "Keep me in mind for work in this area," or "I'm happy to be an extra set of eyes"). If face-to-face interactions are nerve-wracking for you, take extra care to shine in your follow-up message.

When you do establish meaningful connections, work to keep those relationships going. Follow up if you have additional questions or want feedback based on your most recent conversation. Share with your new contacts interesting articles or new resources that become available. Think of creative ways to keep in touch. For example, if you see they have a recent publication, send them a congratulatory email!

Remember that networking doesn't just benefit you. After learning about someone's work, you can begin to think about who in your network has similar interests and possibly make connections that are beneficial for both parties.

If you're unsatisfied with the quality of your interaction, think to the future. Your first meeting won't likely be your only opportunity to connect with that person. The STEM education world is relatively small; you will likely see them again in the future.

Sometimes you receive great advice in short, spontaneous interactions; take it for what it is. It's not always necessary to continue a networking relationship.

Just Do It!

Understand that networking is something you learn and improve upon as you go. If networking feels awkward to you, know that it does get easier with practice. At a minimum, show enthusiasm and keep an open mind. Be able to summarize your research for maximum effect, and be willing to answer questions about your work. Listen intently as your contacts discuss their work with you, and try to identify places where your interests intersect.

Remember that, in many cases, your reputation as a researcher and the quality of your work precede you. As you continue to progress in your field, you will have more and more opportunities to connect with others. Keep doing thoughtful and creative work that you're passionate about and you will have plenty to offer your peers!

Additional Resources

- 6 Networking Tips That Work for Me
- 7 Tips to Supercharge Your Academic LinkedIn Profile
- 20 Ways to Network That Don't Feel Like Networking
- Academic Self-Branding
- Authentic Networking: 9 Questions to Ask to Discover Who's in Your Network
- How Leaders Create and Use Networks
- How to Make the Most of Academic Conferences— Five Tips
- Sample Networking Emails and Thank You Notes
- The Elevator Pitch: Presenting Your Research in Conversation

Tips for Developing NSF Proposals

This tool is designed for early career STEM education researchers to offer tips for writing grant proposals. The advice largely comes from National Science Foundation-funded awardees who have graciously shared information about their own proposal writing experiences. Their perspectives are a good complement to the official NSF guidelines.

Developing Your Proposal Idea

Develop a research agenda and trajectory based on your interests. See the proposal as a vehicle for accomplishing your professional goal(s). Ask yourself:

- How does this proposal complement or build on my existing work?
- Will the proposed project help move me closer to my professional goals?
- Will the proposed project make a contribution to the field? How?

Project ideas can arise at any time and in many different ways. In the best of all worlds, your proposal idea emanates from prior research or a very specific area of interest. However, sometimes chance plays a role: a peer poses an informal question during dinner at a conference, or a newspaper article sets in motion the exploration of a new idea. Not every idea will automatically translate into a proposal, but over time, small pieces come together in ways that can inform the direction of your work.

PRELIMINARY RESEARCH

Conceptualize your project and develop an abstract or a preliminary statement. You can revise this as your proposal idea evolves. Approach your project idea by thinking about how you will do the work and present your findings in a way that will most benefit the field.

Conduct research to determine whether similar work already exists. Use this as an opportunity to catch up on all of the literature on the topic. Determine the quality of identified research as well as gaps or limitations in content, methodology, etc.

Identify funding sources. Some people look at funding sources first; others wait until they have a strong proposal idea and then identify sources that align with their proposed topic. Either approach should begin early in your process due to the unique guidelines and timelines for individual funding programs, even within the same agency. For example, NSF has a number of different portfolios within the education directorate. There are also education initiatives supported in the science directorates.

Explore how aspects of your research fit under different funding solicitations. It is likely that no single funding source or program will fund your entire research program over time, but you can focus on obtaining funding to address different parts of your program while always keeping your long-term research goals in mind. Every project can provide an opportunity to investigate a different aspect of your research goals in a way that moves your research program forward.

Start establishing partnerships early—at a minimum, 6 months to a year before the solicitation is due. It takes that long to build your team and build relationships with schools, teachers, and other institutions. Planning your project in advance, with well-established partnerships, can lead to a stronger proposal as well as to a better conceptual and methodological starting point if your work is funded.

NETWORKING

Get feedback from your peers to assess the need for the proposed work. Consultation with others can help you decide whether your proposal idea may be worth pursuing and, if so, how to think about the depth and breadth of the proposed research. Peers may be STEM education researchers within your institution or those from the larger STEM education network. If you are considering a DR K–12 submission, you might want to explore projects and PIs on the CADRE website: cadrek12.org. It is important to think about identifying colleagues from disciplines different from your own.

Many NSF proposals include project leaders with diverse backgrounds (e.g., curriculum, assessment, or professional development).

Talk to other successful NSF grant recipients at your institution. Ask about their process for developing proposals. Determine if they would be willing to discuss their funded proposals. Find colleagues you respect and with whom you share interests. You could arrange monthly meetings with colleagues as a way to discuss ideas. In some cases, these relationships might flourish and evolve into future collaborations.

Share your ideas more broadly with people in and outside of your field. When you have a clear description of your proposal, ask others to comment. These interactions can help to clarify your logic model, research questions, and methodological approaches. If you find someone whose work interests you, ask to see their funded (or unfunded) proposal(s). Many researchers are willing to do this; consider asking to see only their project description, because sharing a proposal budget can cause problems in terms of releasing confidential information. Even if the researcher says no, you've made a connection.

Consult with NSF. Once you're in a place where you can clearly articulate your idea, share a one-page concept paper with an NSF program director via email. Check the NSF website to find the program directors responsible for the program to which you are planning to submit. Try to zero in on one program director by identifying the contact for the discipline or focal area that relates to your concept paper. Bouncing your ideas off of a program director can be extremely helpful. Most directors will generously give their time to discuss your proposal ideas and to help you determine whether your concept is appropriate for a specific NSF program and aligns with the priorities of the solicitation. If your project idea is not a good fit, the program director may recommend a different program. NSF program directors are typically interested in coaching early career professionals.

Early Stages of Proposal Development

When developing your research ideas and questions, consider the following:

- What issues am I observing in my own practice and/or research?
- What questions is the field addressing at the moment?
- In what ways does my project idea align with the big questions within the discipline?
- What are some of the unanswered questions from my previous work?
- Do my research questions jive with the request for proposals (RFP)?
- What contribution can I make to NSF?

Consider how you will move from research question to project design:

- What claims do I want to make?
- What evidence will I need in order to make those claims?
- What methods will allow me to gather that evidence?
- What kind of project design is possible? What is useful? What is manageable?
- Is there a beginning logic model?

When beginning to think about choosing partners, advisors, and evaluators, engage in self-evaluation and critical thinking:

- What do I bring to the project?
- What knowledge/perspectives/expertise am I lacking?
- Who can bring that experience to the project?

Use your networks to find individuals who share your interests. Explore the places where your work and others' intersects, and propose opportunities for collaboration. You can decide beforehand where you want this work to take you and invite others to join, or you can decide as a group where you want to go together.

Remember that we as individuals don't know everything. A strong proposal and project require more expertise than any one individual (or even one institution) has. Collaboration will make your proposal more competitive and allow you to better execute the project. Consider how a team of researchers, developers, partners, advisors, and evaluators will bring the expertise needed to properly address the research questions. Look for people with whom you have good relationships and you enjoying working; you will be working together for a while.

Don't be afraid to reach out to new people to serve on your advisory board. Invite people whose work interests you and who you think would add an interesting perspective, even if you don't know them personally. Use the task of assembling an advisory board as a reason to form new relationships. Be clear about expectations for the advisor role as well as the logistics: number of meetings (virtual or in-person), stipends, and required travel. You can certainly revise the role and specifics but have an initial plan when you approach potential advisors. Some prospective advisors may ask to see a proposal abstract; others may ask who else will be serving as advisors. It is important to share why you are asking them to serve.

Use your network to find the most suitable evaluator for your project—someone whose opinion you respect and who can be a critical friend. Experienced PIs might be able to make recommendations for evaluators. Design a role description for the evaluator to serve as a starting point from which you can develop a full plan. Ensure that the evaluator is independent, and involve them in the early stages of the proposal development. An evaluator can help you think through your logic model and may assist with research design. Many evaluators prefer coming on board before the proposal is finalized; having a clear understanding of their role makes their job easier later on.

Proposal Development

A solid proposal should reflect your passion about the work. It's a good sign if the writing process generates excitement.

Writing a proposal is very different from writing for publication. With proposal writing, you are trying to offer a specific rationale for your project and very detailed information about your goals, objectives, research design, and activities, as well as the implementation, dissemination, and evaluation process. Clarity and detail are crucial, and you must ensure coherence between the sections of the proposal. Ultimately, you are selling your work to the reviewers.

Demonstrate how your approach is novel, trusting, and transformative. You must convince the reviewers that there is a need, that the need relates to a problem of national importance, that you know how to solve this problem, and that your team is in the best position to carry out the work.

Use the first two pages to convince the reviewers to fund you; use the remaining pages for elaboration. Introduce everything in the first two to three pages: the problem, your proposed solution, your research questions, and how are you going to go about answering those questions. Use the remaining pages to elaborate on each point. Don't introduce anything new beyond the introduction. You might benefit from writing the introductory pages first in order to think through your project timeline. As you work on additional sections, you can keep returning to the first two pages to tighten your argument. This strategy requires a lot of time upfront but can be beneficial in the long run.

Write for your audience. Don't make assumptions about the reviewers' backgrounds. You are writing for a diverse panel of experts. It's rare for all reviewers on a panel to have expertise in your specific area or even in your field; therefore, you must make your writing as accessible and understandable as possible. Read the solicitation to become familiar with the specific language it includes, and match it to your work. Provide concrete examples for those who might be unfamiliar with the concepts. Consider opening with a scenario or vignette to help engage people outside of your field. Don't simplify your proposal; just make it clear and accessible. Ensure deep intellectual integrity, but write it in a way that everyone can understand. Leave reviewers with the impression that it is important work, even if they don't understand all of the intricacies.

When available, experts will review the sections of your proposal that deal with their particular field. For instance, a methodologist will read your methodology section; a teacher educator will review your plan for professional development. If an expert discovers a weakness in a section that addresses their area of expertise, they can convince the panel not to invest in you. When developing a particular section, write for the highest expert in that field in terms of substance and expertise, but use language and examples that can be understood by everyone.

Remember that you are telling a story. You must include all sections required by the RFP, but arrange them in a way that helps your narrative flow. Determine what story you want to tell, and then, as you're writing, check in periodically to make sure your storytelling is consistent. It is your story that will stand out for reviewers. Make it compelling!

Develop a logic model to describe what you're proposing and how the pieces of the project fit together. There are many ways to illustrate the model. PIs have recommended looking at the format of models that others have used. The logic model should help with the coherence of the proposal.

Be considerate with your reader. Reviewers are reading many proposals. When writing, imagine that yours is the last proposal they are going to read at the end of a long day, and think about ways you can make their job easier. Consider using visuals to break up the narrative and present the information in a new way. This will give the reviewer a bit of a break but also appeal to different types of learners. When used properly, figures and tables can help reinforce the big ideas. Formatting can also help draw attention to specific areas you want to highlight.

Pay attention to NSF's requirements regarding font, page length, necessary letters of collaboration, and supplemental documents.

MANAGE THE WRITING PROCESS

The writing process will vary depending on your style. Some write the summary first and then build out the rest of the proposal; others do the opposite. Everyone starts at a different place depending on how they organize their thoughts. Most people go through a long process of writing and rewriting.

Authorship of the proposal varies. In some cases, the PI writes the proposal, often on the basis of conversations with potential team members, advisors, and evaluators. The best proposals are conceptualized by a team, not only by the PI. The process can occur in-person or virtually. In some cases, a lead writer (usually the PI) drafts an outline and then assigns sections to different members based on their areas of expertise. This creates greater buy-in from the team and strengthens the overall proposal.

Once the sections are complete, one team member should act as the final authority to ensure unified style and voice. Make sure the narrative flows and that everyone understands what teammates are proposing even if they are unfamiliar with the areas of expertise. The proposed PI has final authority for the quality of the proposal.

Ask a friend (or two) to read your draft. Are there missing pieces? Is it coherent? Does it make sense to an outsider? It's better to receive critical feedback from friends when the stakes are low than from blind reviewers when the stakes are high. Consider soliciting targeted feedback at different stages of proposal development. It is best NOT to wait until your final draft. By then, it is usually too late to make substantive changes.

CONVEY YOUR PLAN FOR SUCCESS, BUT ADDRESS POSSIBLE OBSTACLES

Decide first what "success" means to you. Be specific in describing how you will move from the idea to the final stage of the project. Demonstrate that your project team is qualified to do this work.

Rationale and execution are important, but reviewers also understand that projects evolve. Things can change with timeline, budget, partners, etc. Decide how much of a risk you want to take. Be clear about how you plan to measure success and interpret and deal with setbacks. Write the proposal as if everything will go according to plan, but demonstrate that you have thought of possible eventualities and are aware of potential obstacles. Explain the guiding principles you will use to deal with unexpected deviations from the plan. For example, partners might drop out. How will you go about choosing new partners? How would you deal with attrition? Know that any weaknesses in your proposal will be identified. Consider all the possible objections to this work and prove that you're able to think these things through.

ADDRESS INTELLECTUAL MERIT AND BROADER IMPACTS

At a minimum, follow the specific NSF guidelines for intellectual merit and broader impacts. The intellectual merit criterion encompasses the potential to advance knowledge, and the broader impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

Consider what you want your project's legacy to be. What contributions do you hope to make both conceptually and empirically? Put yourself at the end of the project and ask:

- What was accomplished?
- How did it contribute to the field?
- Why should society care?

Position your work within the national conversation around broader impacts. Don't just describe what you're going to do; describe how it will make a difference. Consider the following questions:

- What national issue can this work contribute to?
- How is this work going to make a difference?
- Who is impacted by this work?
- How can I ensure the right voices are at the table to do this work?

Think about broader impacts as extending beyond numbers. It's not just about reaching X number of people or certain populations; it's also about the substance of the work and how it will transform some persistent inequality or problem in the field.

A project's intellectual merit and broader impacts can make or break competitiveness. Convince the review panel that your work is a worthwhile investment.

WORK WITH YOUR INSTITUTION

Understand the funding process for your institution. Most academic institutions require that proposals be reviewed by the grants office to ensure that you're not making promises that have implications for the institution without their permission. Non-academic institutions will likely also want to clarify the institutional obligations required for your project. The process for this varies greatly by institution, so make sure you understand the requirements before pursuing external funding. Sometimes there is a cap on how many proposals can be submitted by the same institution. Check with your institution about this to know whether your proposal will be eligible for submission. Talk to them early and often!

SECURE LETTERS OF COLLABORATION

Prior to submitting your proposal, check to see if you should obtain letters of collaboration. If you are working with specific school districts or states, you should have a letter detailing their role on the project. In addition, it is advisable to obtain letters from your advisory board. Having letters from the people and institutions with whom you will collaborate demonstrates their commitment to the work. Please make sure you do NOT submit testimonials about your organization or letters from legislators or policymakers.

DEVELOP A BUDGET

The budget provides a lot of information about your project design. Your narrative explains the problem and how you plan to solve it, whereas your budget provides additional detail and demonstrates the costs for each component of the project. Make sure your budget reflects all the activities described in your proposal. If your proposed budget is too low, for example, the reviewers will know that certain activities can't be done or done well. Likewise, red flags will be raised if you're requesting too much money for a limited number of activities.

One of the biggest problems, especially with early career professionals, is promising too much with too few resources. Knowing exactly how much it costs to do certain activities becomes easier with experience, but be sure your budget aligns with what you want to do. For example, don't propose collecting more data than you can afford to analyze.

Make sure you understand the budget requirements for NSF and for your institution. See the budget guidelines in the Proposal & Award Policies & Procedures Guide (PAPPG). Some questions to consider include:

- Am I providing adequate stipends for participants? for advisors? Check the allowable and standard rates.
- Have I budgeted enough for travel to do the work, attend PI meetings, present my findings, etc.? Check the GSA per diem rates.
- Have I budgeted for the type of evaluation I want?
- If this is a multiple-year project, have I accounted for raises?
- Have I budgeted appropriately for the preliminary work required to get the project off the ground?
- Do I have enough money allocated for data analysis, writing, and dissemination at the end of the project?
- Is there a budget for advisors?
- Will there be subcontractors and/or consultants for this project?

Work with others to develop the budget. Some proposal leads will identify the parameters but allow those with more experience to generate the numbers. There might be institutional support to help you with this. Still, make sure you are engaged in the process because budget management will be your responsibility.

Even if the overall budget is adequate, there is often a need to shift individual line items over the course of the project. Maybe you won't need as much money for travel. Maybe you'll need to bring in more graduate students. Any significant changes will need approval from NSF. Knowing what constitutes a significant change

will get easier with time, but when in doubt, consult the program guidelines and requirements outlined in the PAPPG or talk to your program director.

Between Submission and Notification

Do not contact NSF while the proposal is under review. It's advisable to consult with program directors when you are developing your idea or to ask for advice to strengthen your proposal, but be hands off once you've submitted.

If the program director gets back to you with questions/feedback from the review panel, answer every question as thoroughly as possible and within the requested timeline. Be clear and specific so it is easy for the program director to advocate on your behalf during the final review.

See the questions as an opportunity. You've had a break and have been able to reflect on the proposal you submitted. There might be new things you want to highlight in your responses to the reviewers' questions. Their questions can help improve your work by reorienting you after the break. If funded, this will make it easier to hit the ground running.

The Successful Proposal: Getting Started

Getting a project off the ground is hard work, but hopefully your excitement about the idea outweighs the burden and responsibility.

Use the proposed timeline to create and implement a work plan. Don't shortchange yourself on the time it will take to get the project started. During this phase, you may need to hire staff and students, develop partnerships with school districts, prepare subcontracts and consultant contracts, set up your budget, or address Institutional Review Board (IRB) issues.

Introduce yourself (virtually or in person) to the program director assigned to your award, and keep them informed as you begin to navigate this work and throughout the process, especially when you encounter issues that require difficult decisions. At the same time, be judicious when asking for their time; program directors are busy!

Note when NSF will require your annual report. It will be an opportunity to share what you have learned and accomplished over the year. Keep notes during the year that can provide input for that report.

Dealing with Rejection: Try Again!

You can't be afraid of failure; you will be rejected at some point in your career. Failure is part of the experience. In particular, don't feel bad if your very first proposal is rejected. Some PIs report having submitted a proposal several times before getting funded. The hurt from rejection gets easier to manage over time, and each rejection brings a new learning experience.

If your proposal is rejected, schedule an in-person or phone meeting with the program director for additional feedback on how it can be improved. Ask yourself what you can learn from this. Many people do not take advantage of this opportunity. NSF staff is accessible as a resource to make your next proposal stronger.

Remember that your proposal is being reviewed by only one panel. If it had been reviewed by a different group of people, feedback might have been completely different. This is why it's important to discuss feedback with the program director who was in the room. It will give you a sense of how to improve your proposal.

You can revise the proposal by incorporating feedback from reviewers and program directors, and then resubmit the proposal. Consider whether another program is a better fit. If you find another program, make sure to revise your proposal so that it matches that program's solicitation. You might also be able to reconceptualize a project, such as resubmitting a design and development proposal as an exploratory research proposal.

You can build on rejected proposals by finding ways to incorporate your ideas into future proposals. Your original ideas can inform later work in many ways, even if you can't recognize those opportunities immediately. One PI was told she'd submitted a great proposal but the field was moving in a different direction. She held onto the rejected proposal for 10 years and was able to recycle some of those ideas once funding trends shifted.

Additional Advice for Early Career Researchers

It can be challenging for young professionals to break into the field. NSF wants to support the next generation, but they also want to see a record of success. It's hard to complete with 20+ year veterans, but there are options that can help you gain traction.

Research postdoctoral opportunities, such as the Spencer Postdoctoral Fellowship Program. This will give you experience writing a proposal and managing your own short-term research project. During this time, you will have an opportunity to further flesh out your research trajectory before you begin applying for faculty positions.

Consider submitting a proposal to NSF's Faculty Early Career Development (CAREER) Program. This program is designed specifically for junior faculty in a tenure track position, and is intended to provide a foundation for continued leadership in education research and development. The CAREER program allows you to integrate a research program with your own educational goals. While CAREER grants are extremely competitive, you're competing against other early career researchers like yourself and not veteran researchers with extensive backgrounds.

Although CAREER grants are great for some people, they are not ideal for all. CAREER grants are designed for solo researchers. If collaboration is an important part of your work at this stage of your career, another funding source would be a better fit. Your funding source should

never detract from your long-term research goals.

Explore opportunities for university, state, or foundation funding to gain experience managing grants and developing your portfolio before attempting to compete for NSF funding.

Your first proposal should be relatively modest—something small-scale but interesting to you and in-line with your research agenda and career trajectory. Spend some time flying under the radar. Focus on doing good work and getting good results.

A small grant will help you get your feet wet, establish a track record, and gain experience in different areas of project management on a small scale. Be realistic about project management. There's a steep learning curve around managing people, budgets, and reports. This is distinct from having a really good project idea, and both are critical for a successful proposal and project.

Collaborate with peers who are farther along in the field to develop a larger project, and serve as a co-PI to help build credibility. Collaboration will allow you and your team members to address a more complex problem from a variety of perspectives. However, in a collaborative environment, you will have to work much harder to carve out your identity and establish yourself as an individual. This is an especially important consideration for academics in tenure track positions.

Be a reviewer for NSF. Serving on a review panel is a great way to gain exposure to different styles of proposal writing and approaches to required content, as well as insight into how reviewers respond to those proposals.

Additional Resources

- Berkeley Research Development Office: NSF Faculty Early CAREER Development Program
- NSF Programs: Directorate for Education & Human Resources (EHR)
- Old Advice for New Researchers
- On the Art of Writing Proposals
- Where to Search for Funding
- Writing the Broader Impacts Section of Your Research Proposal

Part II
Additional Resources

About

The following resources were collected for or by Fellows to support learning around one of the focal themes. While not an exhaustive list, these resources provide a starting point for early career researchers as they explore how to build their careers.

Resources

PURSUING ACADEMIC AND NON-ACADEMIC CAREER PATHWAYS

CADRE Resources

- Non-Academic Organizations List (CADRE, 2017)
  List of postdoc opportunities and related resources in the field of STEM education research and development.
- Postdoctoral Fellowship Opportunities and Resources (CADRE, 2017)
  List of non-academic organizations in the field of STEM education research and development.

Curriculum Vitae and Resume Resources

- CVs (MIT Global Education & Career Development)
  Advice for developing and formatting your CV.
- How to Write a Winning Resume (Peter Fiske, 1996, *Science*, AAAS)
  Guide to developing your resume, including differences between a resume and a CV.
- Professional Profile Resources (Beyond Academia)
  Collection of resources for developing your professional profile for non-academic careers.

Job Talk Resources

- Academic Job Talks (University of Washington Career Center)
  Tips for how to structure your job talk and what to present.
- Dr. Karen's (Partial) Rules of the Job Talk (Karen Kelsky, 2012, The Professor Is In)
  A list of rules to help you avoid common job talk mistakes.
- The Art of the Job Talk (Marilynn S. Johnson, 2004, American Historical Association)
  Guide to planning your research talk and teaching demonstration for your on-campus interview.

WRITING FOR PUBLICATION

CADRE Resources

- [Publications for STEM Educators, Policymakers, and Researchers](#) (CADRE, 2016)
  List of publications related to STEM education, including target audiences and types of content.

Conference Proposal Resources

- [Conferences for STEM Educators, Policymakers, and Researchers](#) (CADRE, 2017)
  List of STEM education-related conferences.
- [Proposal Tips & Examples](#) (AERA)
  Tips and examples designed to help graduate students submit high-quality proposals and present at AERA.
- [Suggestions on How to Write a Successful Session Proposal](#) (Joyce M. Gleason, NSTA)
  Guide to understanding the review and selection process for the NSTA conference.
- [Writing a Successful Conference Paper Proposal](#) (Kecia Ali, 2009, Boston University)
  Advice for writing a conference paper proposal.

"Flipping Papers" Resources

- [The Ethics of Self-Plagiarism](#) (iThenticate)
  White paper that explains self-plagiarism and how to avoid it.

Researching Journals Resources

- [Choosing the Right Journal for Your Research](#) (Sarah Conte, American Journal Experts)
  List of criteria for choosing a journal that fits with your research.
- [Writing for Publication: Choosing an Audience](#) (Walden University)
  Guide for choosing an audience for your publication, including tips for selecting a journal, splitting your dissertation, and choosing between scholarly or popular publishing.

Drafting a Manuscript Resources

- [Storytelling 101: Writing Tips for Academics](#) (Nick Feamster, 2013, How to Do Great Research)
  Guide to writing an academic paper that tells a good story.

Peer Review Resources

- [10 Tips from an Editor on Undertaking Academic Peer Review for Journals](#) (Brian Lucey, 2014, Elsevier)
  List of useful elements of a quality peer review.
- [Helpful Hints for Effective Peer Reviewing](#) (Seri Lowell, Bates College)
  Guide for turning negative feedback into productive feedback.

BUILDING PROFESSIONAL NETWORKS

CADRE Resources

- CADRE Publications, Presentations and Websites (CADRE, 2017)
  Lists of new publications, upcoming conference presentations, and project websites for members of the DR K-12 community.

Other Resources

- 7 Networking Tips for Introverts, Extroverts, and the Socially Awkward (Christina DesMarais, Inc.com)
  Tactics for making important connections no matter your personality type.
- 17 Tips To Survive Your Next Networking Event (Darrah Brustein, 2014, *Forbes*)
  Tips for navigating and making the most of your networking event.
- Authentic Networking: How to Activate and Strengthen Your Network (Hannah Kane, 2013, Idealist Careers)
  Tips for engaging your network while job seeking and strengthening your network when you're not on the market.
- Branding Yourself as an Academic (Kelli Marshall, 2017, Chronicle Vitae)
  Guide to why developing a digital portfolio matters in academia.
- Can Social Media Get You a Job? (S. Donaldson, 2016, University College London)
  Tips for maximizing the career-potential of social media.
- Informational Interviews (Office of Career & Professional Development, 2014, UC Hastings College of the Law)
  Guide to conducting informational interviews.
- Networking Tips (Harvard Law School)
  Tips for networking when you're on the job market.
- Networking: Questions to Ask (Harvard Law School)
  Questions to ask when networking.
- The 31 Best LinkedIn Profile Tips for Job Seekers (The Daily Muse Editor, The Muse)
  Tips to help make your profile shine and attract recruiters.
- Three Personal Branding Secrets for Academics (Erik Deckers, 2013, Personal Branding Blog)
  Activities to enhance your online brand.

DEVELOPING NSF PROPOSALS

- Active DRK–12 Projects (National Science Foundation, 2017)
  List of active projects to help you assess the current DRK-12 portfolio.
- ARC-REESE Criteria & Guidelines for Rating the Methodological Rigor of Educational Research in STEM (Center for Advancing Research & Communication)
  Report on the methodologies employed by projects in the REESE program.
- Art of Grantsmanship (Human Frontier Science Program)
  Guidelines to help new and veteran researchers optimize their chances of developing a successful grant proposal.
- Proposal Writing Short Course (Grantspace, Foundation Center)
  Free, self-paced eLearning course on proposal writing for private grants.

CADRE Fellows: An Approach to Supporting Early Career STEM Education Researchers
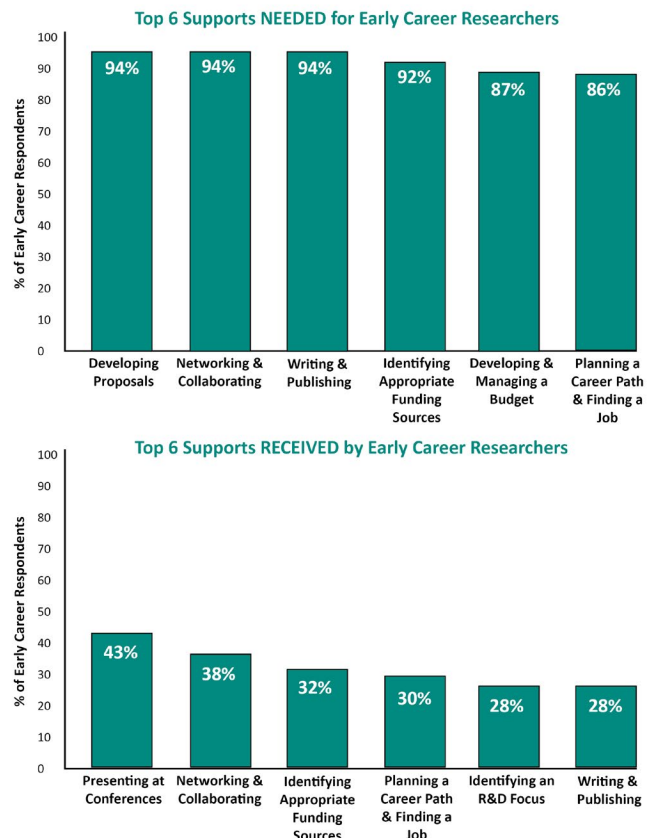
About

This section of the guide provides a detailed description of the structure and objectives of the CADRE Fellows program, the design of the learning activities, and benefits and challenges of the program on Fellows.

Anatomy of the CADRE Fellows Program

Established in 2009 as an extension of the supports offered by CADRE to DRK–12 grantees, the CADRE Fellows program is a competitive fellowship designed to build the capacities of early career STEM education researchers and to provide experiences that Fellows may not have in their current roles but that are helpful for their professional growth and development.

The activities of the CADRE Fellows program center on four strands of work: academic and non-academic career pathways, writing for publication, building professional networks, and developing NSF proposals. These topics were identified as needed areas for professional growth for early career researchers by CADRE staff, CADRE advisors, and the Fellows themselves (confirmed in the 2014 report *Early Career Researchers and Developers in the DRK–12 Program: Needs, Supports, and Recommendation* (Riley & Butler, 2014). See the Topics on Which Early Career Respondents Needed or Received Support graph). Fellows engage with these topics through a variety of activities, including in-person and virtual meetings, independent and collaborative assignments, discussion with panels of experienced researchers, networking opportunities, and communication with NSF program directors.

TOPICS ON WHICH EARLY CAREER RESPONDENTS NEEDED OR RECEIVED SUPPORT (N=50)

Top 6 Supports NEEDED for Early Career Researchers

	%
Developing Proposals	94%
Networking & Collaborating	94%
Writing & Publishing	94%
Identifying Appropriate Funding Sources	92%
Developing & Managing a Budget	87%
Planning a Career Path & Finding a Job	86%

Top 6 Supports RECEIVED by Early Career Researchers

	%
Presenting at Conferences	43%
Networking & Collaborating	38%
Identifying Appropriate Funding Sources	32%
Planning a Career Path & Finding a Job	30%
Identifying an R&D Focus	28%
Writing & Publishing	28%

HOW ARE THE FELLOWS SELECTED?

As of the spring of 2017, 78 early career researchers have participated in the evolving CADRE Fellows program. Each year (with the exception of Year 1), we have selected a cohort of 10 Fellows. With this number of Fellows, CADRE can ensure that each Fellow will have something in common—discipline focus, stage of career, etc.—with someone else in the cohort and that there are enough Fellows to bring a variety of perspectives and experiences to the meeting conversations. The number also allows a small enough group for effective community building.

Fellows are members of DRK–12 projects who have been identified through a nomination process by the head (PI or coPI) of their project as future leaders in STEM education. They are doctoral students or research associates who represent a variety of institutions, disciplines, backgrounds, and geographic regions. Nominees apply for the fellowship by submitting an application, CV, personal statement, and letter of recommendation from their nominating PI or coPI. Applicants are evaluated on a number of criteria by a team, including CADRE staff and Fellows alumni. The criteria include, but are not limited to, the following:

Individual criteria
- Limited access to the kind of support the CADRE Fellows program offers
- Experience working on a DRK–12 project (or with the PI) for at least one year
- Strong letter of recommendation
- Evidence of leadership and/or self-motivation
- Clear career goals with a path for future research and development endeavors
- Diverse background, experiences in education, and/or unique skills
- Expressed willingness to work with and learn from other Fellows

Group criteria
- Gender balance
- Science, technology, engineering, and/or math representation
- Research focusing on different grade levels (e.g. pre-K, elementary, middle, high)
- Racial/ethnic diversity
- Geographic diversity
- Institutional diversity (e.g., higher education, nonprofit, industry)
- Representing projects/PIs/institutions who haven't been represented by past Fellows

A presentation at the in-person orientation meeting.

From the rich pool of applicants, the team selects 10 Fellows to form the cohort for the upcoming fellowship year, typically aligning with the academic year.

PROGRAM COMPONENTS

Getting Started

Fellows are accepted and welcomed to the program through an email to the nominee and the DRK–12 awardee who nominated that Fellow. CADRE sends a press release template that Fellows can share with their institution's communications department. In addition, CADRE announces the new cohort of Fellows via social media, an email to the contacts in CADRE's network (including those at NSF), and a special section of cadrek12.org.

Fellows participate in an introductory virtual meeting hosted by CADRE. The meeting, which serves as a soft launch of the program, provides an opportunity for Fellows to introduce themselves to each other and CADRE staff. CADRE also provides a brief introduction to the program, including expectations and logistical information for the in-person orientation.

Fellows collaborating during the in-person orientation.

In-person Orientation

Fellows meet in person during a two-day orientation where they learn about each other's project work and research interests, discuss their professional trajectories, meet other STEM education researchers, and work with CADRE staff to develop an agenda for the upcoming fellowship year. Many of the activities are meant to increase the Fellows' familiarity with the wide range of resources, information, and contacts available to the greater DRK–12 community. CADRE also invites Fellows to offer input on discussion topics for the virtual meetings, collaborative assignments, and even new strands of focus during the fellowship. (The addition of the networking strand, for instance, was added in response to needs expressed by Fellows at an orientation meeting.) Most importantly, perhaps, the orientation— through conversations ranging from informal one-on-one to formal group discussions—enables the Fellows to develop relationships with each other and form a cohort of supportive peers.

NSF's Faculty Early Career Development (CAREER) Program offers awards in support of early career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization. CADRE provides early career supports designed specifically for DRK–12 CAREER awardees.

A sample agenda, available here, includes these elements:

- CADRE staff provide an overview of the CADRE resource network and Fellows program, and introduce Fellows to the resources and functionality of the CADRE website.
- Past Fellows share their experiences in and beyond the CADRE Fellows program.
- Leaders of DRL program resource centers provide an overview of their networks.
- Fellows illustrate their career trajectories and timelines, and then learn about each other's interests, professional backgrounds, and career trajectories when they share their illustrations.

- Fellows explore ways to build and leverage the DRK-12 community of peer, near-peer, and experienced awardees and colleagues.
- Current NSF awardees share their experiences and respond to questions.
- An NSF program director provides information about the DRK-12 program and NSF.
- Fellows provide a brief overview of their DRK–12 projects, followed by Q&A.
- Fellows reflect on project talks, identify commonalities (e.g., across project work, academic pursuits, and professional growth needs and opportunities) that have emerged, and consider implications for the fellowship year.
- Fellows discuss issues and questions related to the topics (e.g., career trajectories, writing for publication, grant writing) to be addressed during the year.
- Group assessment of orientation and discussion of next steps.

Monthly Virtual Meetings

Once a month, Fellows meet virtually for a discussion with guest panelists about one of the fellowship strands. During these 45- to 60-minute panels, DRK–12 grantees discuss their experiences with the given topic and engage Fellows in a Q&A session. In preparation for these meetings, Fellows are sent the Tips Sheets included in Part I of this guide as well as a draft of the questions that will be sent to the guest panelists. The Fellows are invited to add to or change the questions so that they best address their collective interests and need for information. (See sample questions in the strand sections below.) The questions seek to unearth the tacit knowledge and insights into the practice of being a researcher that are not often transparent or accessible to early career researchers. The conversation during the virtual meetings is then guided by the series of questions that were co-developed by Fellows and CADRE staff.

This structure provides a level of safety for Fellows who may not feel comfortable directly asking the more renowned panelists these questions. Afterward, Fellows and CADRE staff meet to debrief, discuss assignments (those completed since the last meeting) and next steps (including new assignments), and assess how well the program is meeting Fellows' needs.

CADRE identifies and invites panelists for the virtual meetings who
- are peers, near-peers (including past Fellows and CAREER awardees), or more-experienced STEM education researchers, and therefore offer the Fellows opportunities to hear the perspectives and learn from the experiences of researchers at different stages in their career.
- represent various STEM disciplines, genders, types of institutions, etc., over the course of the virtual meetings and, to the degree possible, for each virtual meeting.
- haven't previously served as a panelist in the Fellows program, thereby increasing the number of researchers familiar with the program, while also not overburdening them with repeat service.

A CADRE Fellow working on her visual map during orientation.

Monthly Assignments

Building on the knowledge gained during the virtual meetings, Fellows spend the next month collaborating in pairs or small groups on an activity of their choosing related to one of the four strands (e.g., researching journals for publication or non-academic institution career pathways). In some cases, there are individual assignments. CADRE provides a set of resources to each group related to these topics for additional support. During the next month's virtual meeting, Fellows report out on their process for working together and the results of their collaboration. Fellows who develop products (e.g., a postdoctoral fellowships guide or non-academic organizations list) as a result of their collaboration share those resources with the group during this virtual meeting and upload them to a shared folder online so that every Fellow can access, comment on, and, in some cases, update the work at any time.

> "The advice for early career individuals was very helpful and am currently putting that into action. The relationships made with others in similar positions to myself was also helpful in having someone outside the institution to discuss issues of practice."
>
> **-CADRE Fellow Alumnus**

The assignments allow Fellows to further develop their skills within a particular area while also giving them an opportunity to build a community with one another and engage in peer-to-peer learning. Fellows are generally given several options to choose from and rank in order of preference so the Fellows can focus their time on something that most interests them while allowing CADRE to more easily identify the "right" working partner for each Fellow. Details about the assignments are provided in the section, *Meetings and Assignments: Strand Content* below.

Additional Opportunities and Resources

CADRE hosts an e-list for current Fellows, one for Fellows alumni, and another for CAREER awardees. CADRE posts announcements (e.g., job openings, new publications by list members, NSF news) through the e-lists and promotes conversation between list members.

The e-list is an easy method for the early career researchers to broadcast that they are attending a conference or have recently been published.

Early career researchers also have access to resources on the CADRE website, including the following:

- *Early Career Spotlight*: A collection of information and resources, such as funding opportunities and information on NSF's CAREER program and awardees.
- *Mentoring Spotlight*: Tools and tips for mentoring graduate students, project members, and other early career researchers, including video conversations between a mentor and mentee and sample mentoring plans.

CADRE has also hosted networking sessions at national conferences, inviting current and past Fellows, CAREER awardees, and more-experienced PIs (particularly the PIs who nominated the Fellows). The sessions have been organized so that attendees can informally meet others at a similar stage in their careers, with a similar connection to the funding program, and with STEM education research interests. As a result, the group has had many overlapping interests and enough differences so that everyone could learn from someone else.

Read CADRE's other resources about working with early career researchers, including our tips for mentoring: *Mentoring Early Career STEM Education Researchers and Developers* (CADRE, 2015a).

Fellows also have access to the many resources and events that CADRE provides to all of the DRK-12 community (e.g., webinars, an NSF proposal toolkit, the CADRE newsletter).

Meetings and Assignments: Strand Content

CAREER PATHWAYS

The Fellows, the majority of whom are doctoral students, report not having tacit information about the inner workings of getting a job in academia or knowing very much prior to their participation in the Fellows program about career options outside of academia (CADRE, 2015b). One goal of the program, therefore, is to provide exposure to career options Fellows have not only in academia, but also at nonprofit organizations, state departments of education, and other institutions. No matter where Fellows may look for positions, they also need to know how to present themselves and make decisions about job offers. This strand addresses these areas.

Orientation

Fellows begin the career pathways strand by exploring and sharing their career trajectories during the in-person orientation. Fellows create a visual map of their career paths, share stories of how they developed their research interests, and describe the factors that influenced their educational and professional choices. Through this activity, Fellows begin to get to know each other on both a professional and personal level. During the orientation, Fellows also have the opportunity to engage with more-experienced researchers and Fellows alumni who work in various settings in conversations about career pathways.
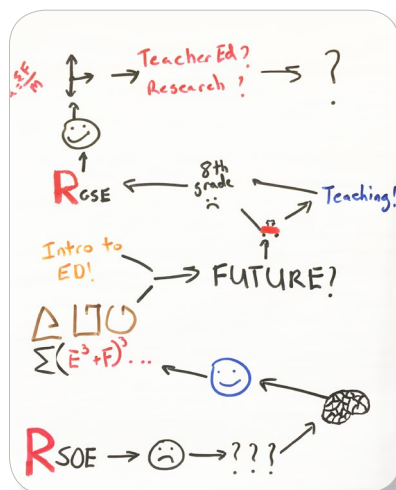
Examples of visual career path maps. Fellows share their career pathway stories in a presentation.

Virtual meeting

Fellows also engage in conversation with a panel of experienced DRK–12 researchers during virtual meetings on the topics of academic and non-academic career pathways. Because the majority of Fellows are from academic institutions, the focus on non-academic opportunities offers insight that is usually new to the group. CADRE invites the

panelists from academic and non-academic institutions to discuss their career trajectories and share advice related to choosing the right career track, the job search and application process, interviewing and negotiating for a position, and what to expect after securing a position. (See Tips for Pursuing Academic Career Pathways and Tips for Pursuing Non-Academic Career Pathways in Part I.)

> "CADRE was the only place that ever provided me with information about non-academic career pathways."
>
> -CADRE Fellow Alumnus

GUIDING QUESTIONS FOR THE VIRTUAL MEETING

Choosing the right career track:

- Why did you choose your career path (e.g., in academia, the nonprofit sector, or the for-profit sector)? What contributed to this decision? How did you get involved with the institution you work for?
- How easy or difficult do you think it is to switch career tracks (e.g. from nonprofit to academia and vice versa?) When do you need to make a decision about your career pathway?
- What should one consider when deciding on a career path? What are the advantages and disadvantages of working in academia, the nonprofit sector, and the for-profit sector?
- What do you wish you had known about careers when you were just starting your career?

Searching for a job:

- What are the available resources for identifying opportunities in academia? in the nonprofit sector? in the for-profit sector?
- What is the job outlook like for these sectors? What types of positions are more readily available?
- How does one build networks within the nonprofit and for-profit sectors? in academia?

Applying for a job:

- What are hiring committees looking for in applicants where you work? What factors are more or less important, and how are these qualities assessed?
- What tips do you have for preparing a strong application (e.g., What experiences should we have on our CVs? What should we address in our job talk?)
- In what ways should a CV look different for different sectors?

Interviewing and negotiating for a position:

- What was the interview process like when you applied for your position?
- What advice do you have for the negotiation of an offer?
- Do you have any specific advice for early career professionals?

After securing a position:

- What is the approximate breakdown of your time between different responsibilities (e.g., research, administration, teaching)?
- What are the major determinants in promotions or tenure where you work?
- What are some aspects of your career that you find the most fulfilling? What are some aspects that you find the least fulfilling?
- What are your tips for maintaining a work-life balance?

Assignment

Building on the information from the virtual meeting, Fellows work collaboratively with another Fellow to choose and complete one of the following activities, each completing the activity, sharing their product with the other Fellow, and providing feedback on the partnering Fellow's product:

> Assignment options have included:
>
> 1. CV preparation: Develop a CV for either a nonprofit or academic position. Your assignment partner will provide feedback. An additional review by a PI is optional.
>
> 2. Job talk preparation: Fellows who are planning to interview for faculty positions soon, or who would like more practice with a job talk, have the option of preparing an outline of a job talk and/or conducting a practice job talk with another Fellow. Review by an experienced researcher is optional.
>
> 3. Research and/or teaching statement development: Draft a research statement that describes the context of your research, your past research experience, your current research, and your short-term and long-term research goals. Your assignment partner will provide feedback.
>
> 4. Postdoctoral fellowships research: Research and identify resources (e.g., websites, e-lists, organizations) that advertise postdoctoral positions and provide ongoing support to postdocs.
>
> 5. Non-Academic organizations research: Conduct research on at least five organizations in a geographic area of interest (e.g., where you live or would be willing to move for a position) or by type of institution. Set up an informational interview with an appropriate person at one or more of the organizations.

WRITING FOR PUBLICATION

Doctoral students must publish to advance their careers. While they are likely to receive support from their advisors or project leaders, Fellows have fewer opportunities to speak with journal editors and researchers outside of the Fellows' institutions. This strand offers those opportunities.

Virtual Meeting

Fellows engage in conversation with a panel of both experienced PIs and near-peers during a virtual meeting on the topics of writing and publishing. CADRE invites panelists with experience writing for publication and/or reviewing manuscripts for academic journals to discuss their experiences and share advice related to choosing the right journal, understanding writing guidelines, developing your writing process, understanding the review process, and dealing with rejection. (See Tips for Writing for Publication in Part I.)

> "Along with colleagues, I led my first publication that will come out this fall. I think the advice that I received at the writing webinar was invaluable."
>
> -CADRE Fellow Alumnus

GUIDING QUESTIONS FOR THE VIRTUAL MEETING

Choosing a journal:

- What are some tips you can provide for choosing the "right journal"?
- What should authors know about a journal before submitting a manuscript?
- How is the quality of the journal determined? Do people pay attention to journal impact factor?
- Are pre-submission inquiries common practice?
- What are the differences between peer-review journals and practitioner-focused journals?
- Do you have an experience that illustrates how and why you made a particular choice of journal for your article? Was it the right choice?

Understanding writing guidelines:

- Are there any unspoken rules or etiquette involved in submission for publication (e.g., being sure to cite work from the editors/reviewers of a given journal)?
- What ethical issues do you need to be aware of when writing a paper for publication?
- What happens when you are co-writing an article? How is the order of authorship interpreted? How is the work organized?
- What is the best way to present your writing to different audiences? Can you use the same data for different journals?

Understanding the review process:

- What happens to the manuscript once it has been submitted to the journal?
- What factors affect the likelihood of acceptance?
- In what ways may the editor respond?
- How should you respond to the editor if revisions are required?
- If your article is ultimately accepted, how long is the process between acceptance and publication?
- Do you have an experience that illustrates how and why you, in an editorial role, made a particular choice of accepting/rejecting an article?

Dealing with rejection:

- Why are most papers rejected?
- What should an author do if a paper has been rejected?
- How do you know when to revise and resubmit vs. move on?

Long term thinking:

- Do you have any general advice or lessons learned to share with early career researchers who are hoping to embark on successful writing careers?

Assignment

Building on the information from the virtual meeting, Fellows choose one of the assignments and work collaboratively with another Fellow. The goals of the assignment are to (1) provide Fellows with time, structure, and support to work on at least one area of writing that is most aligned with their current needs and interests; (2) have them collaborate with and support another Fellow who is in a similar place in terms of writing experience or a current writing project; (3) help them develop a resource or draft that will be useful to their efforts to get published, perhaps in the near future; and (4) prioritize time to share their experiences, insights, and learnings with the Fellows group to clarify their thoughts and inform their publishing-related efforts.

> **"The CADRE fellowship year has really expanded my network with other early-career scholars and has provided me with opportunities to collaborate with others and share my work with the CADRE/DRK-12 community."**
>
> **-CADRE Fellow Alumnus**

Assignment options have included:

1. Draft a manuscript: Write a first draft of an article. At a minimum, this might include the introduction/problem, literature review, and theoretical framework. You will share ideas and initial drafts with your partner and receive formative feedback.

2. Peer review of a manuscript in progress: Review and provide meaningful feedback on another Fellow's manuscript.

3. Prepare a conference proposal: Very often conference proposals are the "first step" for writing an article. If you are at this stage and there is an appropriate conference deadline coming up, you can draft a session proposal to share with another Fellow to receive feedback. For a list of conference timelines, see Conferences for STEM Educators, Policymakers, and Researchers on cadrek12.org.

4. "Flipping" papers, or providing a new lens (e.g., methodology, theoretical framework, research question) on a study or pre-existing data set: Create an outline for a paper and/or an abstract based on one aspect of your project or dissertation. Your partner will serve as a resource to help you focus and review your outline or abstract. You might consider how you could repurpose an existing dissertation section, article, proposal, etc., for a new audience.

5. Research potential journals that align with your proposed paper: Identify journals that are appropriate outlets for your research. With your partner, identify four potential ideas or topics for a paper (two each). Then, independently, identify journals that would be appropriate outlets for all four of the ideas. After you each have identified journals, have a conversation with your partner about the journals you identified and justify why you chose those journals. (You may have selected different journals for the same idea, which could be an interesting conversation.) Prepare a one-paragraph summary about each journal to be shared with the Fellows.

6. Write a letter to the editor: Identify a journal, and prepare a summary of a potential paper topic to determine interest by submitting it to the editor of a journal. This can be a collaborative or individual activity. At the very least, discuss aspects you want to include in your paper, and provide feedback to each other.

BUILDING PROFESSIONAL NETWORKS

Compared with other topics, early career researchers report that support for networking and collaboration is both needed and received to a great extent (see the Topics on Which Early Career Respondents Needed or Received Support graph); however, opportunities to network depend significantly on institutional affiliation and facilitation by PIs or mentors. Even with all that help, networking support and opportunities have always been on the top of the list of what Fellows value about the CADRE Fellows program.

Virtual meeting

CADRE invites panelists who are relatively close to Fellows in their career trajectories, such as Fellows alumni and CAREER awardees, to share their experiences and offer advice on networking strategies and etiquette, how and where to make connections, and how to sustain professional relationships. (See Tips for Building Professional Networks in Part I.)

GUIDING QUESTIONS FOR VIRTUAL MEETING

Establishing needs, identifying opportunities:

- What have been some of your goals for networking?
- What do you think of as a networking opportunity? How has your thinking about networking opportunities changed over time?
- How have you identified authentic networking opportunities?

Making connections:

- What strategies have you used to network (e.g., social media, conference presentations, strategic mingling at conferences, one-on-one meetings)? What surprises or unexpected successes have you had with a particular strategy?
- What are some of the different types of networking relationships you've formed? What strategies did you use to make those connections?
- How have you leveraged formal networks (e.g., professional association membership)? Informal networks (e.g., friends)?
- How have you leveraged serendipitous or otherwise unplanned networking opportunities?
- How did you approach networking with more senior scholars?

Leveraging connections:

- Have any of your networking connections grown into a longer term collaboration? What did you do to make that transition happen?
- If networking has been a factor in your job searches, how has it helped or hindered your success?
- How do you leverage your friends' and/or colleagues' networks?

Lessons learned:
- What do you wish you would have known and/or done with regard to networking at the start of your career?
- How have your networking practices evolved over time (i.e., as you have gotten deeper into your career)?
- Do you have examples of networking gone wrong through which you have gained insights about what not to do? Please share lessons learned from these experiences.

Assignment

Building on the information from the virtual meeting, Fellows collaborate with one another or work on their own on an activity to identify networking needs and opportunities; map their current network; identify people to reach out to and plan a strategy for contacting them; and develop strategies or tools such as an elevator pitch, guiding questions, sentence starters, a personal webpage, and/or a LinkedIn profile. Here is the assignment:

> "I am still using the network that CADRE helped me build."
>
> **-CADRE Fellow Alumnus**

Please approach this assignment so that it works best for you. Your plan may result in strategizing to meet one person or many. You may choose to expand your contacts in your discipline or at a particular association. You may seek someone to engage with you in research-policy or research-practice conversations. You decide what will help you at this point in your career and who may help you. You may also decide to think about a 6-month, 1-year, and/or 5-year plan.

Step 1. Establish needs; identify opportunities
Assess your networking needs. Decide what it is you want to get out of a networking connection and what that implies for whom you want to have in your network.
Consider questions such as:
- What are your career goals?
- How can networking help you to reach those goals? What opportunities exist for you to further develop your areas of strengths and address areas of need?
- What skills do you need to acquire or strategies do you need to implement to reach your networking goals?
- What types of professionals could help you? Where, when, and how can you best network with them?
- What kinds of conversations would you have with networking contacts, and what questions would you ask them, if given the opportunity?
- What would you do with their insights/advice?

Step 2. Map your current network
After you've identified your networking needs, begin thinking about who can help you meet those needs.
- Tier 1: List those you already know (e.g., family, friends, former or current classmates, colleagues, professors). What can they offer you? (What can you offer them?)
- Tier 2: Think about those you know; who do THEY know? How can people in your existing network help you connect with others in the field to establish relationships to augment and/or fill in the gaps in your network?
- Complete the Mapping Your Network Worksheet (an electronic version can be downloaded here). You are welcome to include as few or as many people as you would like based on your needs, networking style, etc.

Step 3. Identify additional contacts; prioritize who you will contact first, second, etc.; and plan your strategy for contacting them
- Identify those who are not already in your network or directly connected to someone in your network, but who may fill one of the needs or opportunities you identified (e.g., someone who has led another NSF-funded project related to your current interests, or someone who works at an organization where you may want to work).
- As you plan how to build your network, consider starting small and building connections over time.
- Think strategically about whom to target first, and prioritize your contacts accordingly. Consider starting with the low hanging fruit!
- Think about how you will make a connection to them (e.g., through email, opportunities at upcoming conferences, through LinkedIn)?

Step 4. Track your networking plan and effort
As you identify potential contacts and make connections, keep track of those contacts. You may use a spreadsheet or your email program's contacts function (or a good old Rolodex or a notebook)! Try using "tags" (i.e., keywords to identify characteristics or categories of contacts) to organize your connections; use the "notes" section to record when you last contacted them. In your calendar, set up reminders of dates/deadlines in your networking plan.

Name	Title	Company	Address	Email	Phone	Date of last contact	Keywords/ Tags	Notes

Step 5. Work on your strategies, skills, and "props"
Consider creating a personal webpage, updating your LinkedIn profile, joining a LinkedIn group, etc. Develop and practice your elevator pitch. Draft guiding questions or sentence starters for a conversation. (See Networking Resources for examples and tips.)

Step 6. Report out at the next Fellows meeting
Be prepared to share your plan at the Fellows meeting. Consider presenting your elevator pitch to the other Fellows during the meeting.

DEVELOPING NSF PROPOSALS

Early career researchers have reported that developing proposals for funding is the topic in which they most need support, yet they receive it infrequently (Riley & Butler, 2014). In response to this need, the CADRE Fellows program includes an opportunity to read real NSF proposals, discuss those proposals with their authors, and engage in a mock panel review led by an NSF program director.

Virtual meeting
Fellows engage in conversation with a panel of experienced PIs (often including a person who held a position at NSF as a program director) during a virtual meeting on the topic of proposal writing. CADRE invites panelists who have been funded by NSF and/or served as reviewers for NSF to discuss their experiences and offer advice on developing a proposal idea, moving from idea to finished proposal, the proposal review process, and dealing with rejection. (See Tips for Developing NSF Proposals in Part I.) Panelists also share their funded proposals with Fellows beforehand to help inform the conversation and to provide Fellows with examples of successful proposals.

> "I learned a lot about the structure of NSF, how to get on NSF review panels, and more about the types of projects and ideas that NSF wants to support. All of this information has been invaluable in writing my own proposals and working on NSF projects."
>
> **-CADRE Fellow Alumnus**

GUIDING QUESTIONS FOR VIRTUAL MEETING

> "I'm not intimidated to apply for NSF funding. I know that I can reach out to program officers. I have more confidence in navigating education research."
>
> -CADRE Fellow Alumnus

Developing a proposal:

- How did you initially develop the idea for a proposal? How do the ideas develop as you work on a proposal?
- Generally, what timeline for development do you use?

Writing a proposal:

- What are the differences between writing for publication and writing grant proposals?
- What organizational principles do you consider when writing grants? Do you start grants from a framework or from the solicitation? If so, how might that change for different programs or funders?
- How have you managed the proposal writing process? Do you work with a team? What roles and responsibilities does each person take?
- How do you go about finding external reviewers?
- How many of the project details do you have in place when submitting a proposal? For example, do you have agreements to participate from teachers/school districts?
- What preliminary data do you incorporate in a grant application?
- What approach do you take to addressing NSF's broader impacts?
- What roles do tables and/or graphics play in your proposals?
- What do you take into consideration when developing the budget?
- What do you incorporate in your mentoring plan? data management plan?

Interacting with NSF before and after proposal submission:

- Do you ask preliminary questions, get feedback, or submit a concept paper prior to the final submission? If so, how helpful have you found this process?
- What happened during the negotiation process?

General Advice:

- Are there any special considerations to take into account when applying for NSF grants vs. other government organization or private foundation grants?
- Have you served as an NSF reviewer? If so, what did you learn from the experience that you've applied to writing your own grants?
- What have you learned from your unfunded proposals? What do you do with ideas that aren't funded?
- What are your first steps when a proposal is funded?

Assignment: Mock Proposal Review

In the proposal strand's culminating event, Fellows gather in person to engage in a mock proposal review at NSF headquarters. Building on the information from the virtual meeting on proposals, Fellows review two DRK-12 proposals and assess their intellectual merits and broader impacts and then prepare written review summaries. Fellows write comments that address the strengths and weaknesses of the proposals with references to the central merit criteria, using the review guidelines outlined by NSF. They prepare a written summary of their review comments and assign a rating to each proposal that is consistent with their written comments. This is an individual assignment.

> **"A better understanding of the NSF, of academic careers, and of the field in general will positively impact my ability to operate in the field. In addition, I will have long-term contacts at various institutions for collaboration and networking."**
>
> **-CADRE Fellow Alumnus**

The Fellows then participate in a panel discussion led by an NSF program director. During the mock review, one panelist summarizes a proposal for the benefit of the rest of the panel. The other panelists, in turn, comment on the proposal and state their ratings. All panelists may follow up with questions or comments, and may change their rating of any proposal. One panelist records the entire discussion and writes a summary of the panel discussion.

During the NSF visit, CADRE also arranges for Fellows to meet with program directors one on one or in small groups to learn more about the proposal review process, the structure of NSF, and NSF funding priorities, or to discuss Fellows' project ideas.

Benefits and Challenges of the CADRE Fellows Program

BENEFITS

Fellows have reported many benefits from participating in the fellowship, such as the following:

- A better understanding of NSF funding mechanisms
- Professional contact with more senior researchers and other professionals
- Awareness of different career opportunities in STEM education
- Increased confidence in participating in professional conversations
- Increased knowledge related to writing and publishing, and a better perspective of what it means to be a STEM education professional (Riley & Butler, 2016; UMASS Donahue Institute, 2013).

> **"Being a CADRE Fellow was an enriching experience for me since it allowed me to exchange ideas with peers, expand my professional network, and learn more about NSF's review process for proposals and funding."**
>
> **-CADRE Fellow Alumnus**

CADRE's previous research found that early career researchers (who were not in the CADRE Fellows program, or prior to their participation in the program) reported feeling that they were isolated, often not having meaningful engagement with colleagues outside of their institutions. Furthermore, early career researchers entering the fellowship have described a need for more authentic networking experiences with colleagues.

They said that "authentic" networking occurred when they were engaged in collaborative work, activities, or experiences. CADRE

added a networking strand and offered opportunities for more engagement between Fellows, as well as with Fellows alumni, CAREER awardees, and more experienced PIs. At the end of each fellowship year, the Fellows stated that one of the primary benefits of the program was the opportunity to engage with peers from other institutions by meeting in person, discussing the strand topics during virtual meetings, and working together on monthly assignments.

Fellows reported the intention to continue to stay in contact with each other, sending updates about work, publications, etc. Fellows alumni have reported formally contacting each other to provide writing support (peer critique) and share job information, and meeting at conferences where they share updates. They also report sharing tips and materials from the fellowship with their colleagues.

CHALLENGES

There are still some challenges with the program. For instance, while the Fellows report that the in-person meetings have been crucial to their abilities to network with each other, the travel for these meetings is expensive. To leverage travel that was already planned and paid for by other means (e.g., project funds), CADRE arranged meetings at national conferences and NSF PI meetings; however, not all Fellows typically attend the same meetings.

In addition, CADRE has selected Fellows who are at various stages of their doctoral programs or early career work, but the needs of a first-year PhD student and a final-year PhD student are different. Since CADRE serves the community of DRK-12 funded projects and, therefore, invites nominations from a limited pool of projects, and since CADRE seeks to compile a cohort of 10, we accept Fellows who are at any stage of their PhD programs, or at a similar stage in their career at other professional settings. Programs that serve postdocs only, for instance, may be better able to design activities to best meet the needs of those early career participants.

CADRE Fellows Program Evaluation (2015 & 2016 Cohorts)

Sample Findings:

- 100 percent of Fellows reported that the Fellows program was beneficial—either very beneficial (65 percent) or moderately beneficial (35 percent).
- Fellows most often reported that the Fellows program helped them to: Gain exposure to the NSF community and funding contexts (85 percent), Network with early career peers (80 percent), and Learn about different work contexts and career tracks (75 percent).
- 100 percent of Fellows reported that they anticipate collaborating or communicating with other Fellows after program completion, suggesting that the Fellows program is establishing a sustainable network of alumni in STEM education research and development.
- Of the three program strands, the Writing Successful Proposals strand was most appreciated, based on survey and focus group data. 75 percent of Fellows strongly agreed that this strand "provided information I will likely use in the future."
- The Career Pathways strand also received high reviews, with evidence that learning about non-academic careers filled a gap left from Fellows' other available resources.
- Fellows across cohorts appreciated opportunities to network and interact with their colleagues in the program and within the larger NSF network.

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